

# Evaluation of Orthodontic Treatment Time Using Peer Assessment Rating Index

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## الخلاصة

**أهداف البحث:** يهدف البحث إلى تقييم مدى تأثير العمر، الجنس، تصنيف النجل، قلع الأسنان ومدى صرامة الإطباق على الوقت العلاجي لتقويم الأسنان باستخدام دليل (PAR). **المواد وطرائق العمل:** نماذج علوية وسفلية لمائة مريض (٥٠ ذكر و ٥٠ أنثى) قبل وبعد العلاج، تتراوح أعمارهم بين ١٥-٢٥ سنة، تحتوي على أنواع مختلفة من المشاكل الإطباقية، تم انتقاء هذه العينات من أربع عيادات خاصة لتقويم الأسنان في مدينة الموصل وحسب معايير خاصة. أخذت جميع المعلومات من البطاقة الخاصة لكل مراجع تتضمن العمر، الجنس، دليل (PAR) قبل وبعد العلاج، وفترة العلاج بالأشهر، والحالات التي عولجت بقلع الأسنان، وتصنيف النجل. أما دليل (PAR) فقد تم قياسه حسب (Richmond *et al*) وتم استخدام الدليل الإحصائي (Pearson Correlation Coefficients) بين المتغيرات. **النتائج:** أظهرت النتائج ان النسبة المئوية في انخفاض دليل (PAR)، كان الأكبر في التصنيف الأول من الإطباق ٩٧,٢% يتبعه في ذلك الصنف الثاني من الإطباق ٩٢,٢% وبعده الصنف الثالث ٩٠%. لم يكن هناك أي علاقة معنوية بين النسبة المئوية لانخفاض دليل (PAR) والوقت اللازم للعلاج ولا علاقة بين العمر ووقت العلاج ضمن هذه الفئة العمرية (١٥-٢٥) سنة. بينما كان هناك علاقة معنوية بين دليل (PAR) قبل العلاج مع الوقت المستغرق في علاج الصنف الأول من الإطباق، التي تم علاجها بدون قلع الأسنان وكذلك مع الصنف الثاني والثالث التي تم علاجها بقلع الأسنان. المعدل الزمني لعلاج الصنف الأول من الإطباق كان ١٤,٤٤ شهرا و ١٦,٩٢ شهرا للصنف الثاني و ٢١,٢٥ شهرا للصنف الثالث من الإطباق. **الاستنتاجات:** الوقت المستغرق للعلاج والتكلفة المادية كلاهما تكون واضحة أمام المريض قبل البدء بالعلاج عند استخدام دليل (PAR) لتحديد مدى صرامة الحالة .

## ABSTRACT

**Aims of the study:** To assess the effect of age, sex, Angle classification, extraction of the teeth and severity of malocclusion on orthodontic treatment duration using Peer Assessment Rating (PAR) index. **Materials and Methods:** Upper and lower study models of 100 patients (50 males and 50 females) before and after orthodontic treatment with age ranged between 15-25 years old of different types of malocclusion were selected from four private orthodontic clinics in Mosul City according a certain criteria. The data were collected for each patient from their case sheet includes age, gender, PAR index before and after treatment, treatment time in months, extraction cases and the Angle classification of malocclusion. The PAR index was measured according to criteria of Richmond *et al*, and then Pearson Correlation Coefficient was used among these variables. **Results:** The percentage of reduction in PAR index was highest in Class I malocclusion (97.2%) followed by Class II (92.2%) and Class III (90%). No significant correlation was observed between the percentage of reduction of PAR index and time of treatment, also no significant correlation was found between patient age and treatment time at this age group (15-25 years), but there was a significant correlation between PAR index before treatment and the treatment time in Class I non extraction, Class II and Class III malocclusion extraction cases. The mean treatment time was 14.44 months for Class I, 16.92 months for Class II, 21.25 months for Class III malocclusion. **Conclusions:** both treatment duration and cost effectiveness could be clear for patient before starting the treatment when using the PAR index to evaluate the malocclusion severity. **Key words:** PAR index, treatment time, malocclusion severity.

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## INTRODUCTION

Treatment duration is very variable from country to country and to some extent depends on the type of the service where it is delivered and also the health care and remuneration system. It is possible to predict estimated treatment time for a patient by using a small number of personal characteristics and treatment decisions.<sup>(1)</sup>

Malocclusion is a continuum ranging from an ideal to considerable deviation from normal. Assessing cut-off points for those needing and not needing treatment is problematic. The severity of the malocclusion, appliance type to be employed, skill of the operator and cooperation of the patient have to be taken in to account.<sup>(2)</sup>

An index such as Peer Assessment Rating index facilitate the assessment of

cost effectiveness.<sup>(3)</sup> The PAR index is a quantitative, objective method for measuring malocclusion and the efficacy of orthodontic treatment. The PAR index provides a single score, based on a series of measurements, that represents the degree to which a case deviates from normal alignment and occlusion.<sup>(4)</sup>

There are basically two methods of assessing improvement using the PAR index either reduction in the weighted PAR score or percentage reduction in the weighted PAR score.<sup>(5)</sup> It has been suggested that a good standard of orthodontic treatment should result in a mean PAR reduction of 70% or more.<sup>(6)</sup>

Although proven to be an objective, valid and reproducible index for scoring occlusal change for the entire mouth, the PAR index has limitation for assessing treatment outcome.<sup>(7,8)</sup>

Factors such as facial profile, root resorption, decalcification of enamel, and the likely stability of the result are not addressed. Nevertheless, these indices have now become accepted within the orthodontic profession both in the UK and overseas as being an easy and relatively quick method of assessing orthodontic outcome.

So, the aims of the study were to assess the effect of age, gender, Angle classification, extraction of the teeth and severity of malocclusion on orthodontic treatment duration using PAR index.

### MATERIALS AND METHODS

This study was conducted in four private orthodontic practices in Mosul City to reduce the effect of a local standard of care or single educational approach. Patient age varies between 15-25 years at the

beginning of treatment with the availability of pre-treatment and post-treatment models and patient case sheet.

The number of selected cases were 100 patients (50 males and 50 females), all were treated by orthodontists with Master Degree using same type of pre-adjusted edgewise appliances 0.022 inch system.

The following cases were excluded: Patients without complete records, patients who had orthognathic surgery as part of treatment, patients with cleft lip and palate, patients who had one arch fixed appliance therapy only, patients with irregular appointments, cases of worse or unacceptable results were also excluded.

The following data were obtained: Age at start of treatment in years, gender, the PAR score of the initial (pre-treatment) study models, the length of the treatment time in months (from date of initial bonding to date of debonding). The PAR score of the final result (day of debonding) study model, Angle classification of the cases, and cases that treated with or without extraction were assigned in Class I only because all Class III malocclusion cases were treated with extraction and only two cases of Class II malocclusion were treated without extraction so that, non extraction cases of Class II and Class III samples were excluded from this study.

The PAR index was measured for each model and weighted according to criteria of Richmond *et al.*<sup>(9)</sup>

The five components of the PAR index:

1. Upper and lower anterior segments (spacing, crowding and impacted teeth).

Score	Displacement
(0)	0-1 millimeter
(1)	1.1-2 millimeter
(2)	2.1-4 millimeter
(3)	4.1-8 millimeter
(4)	Greater than 8 millimeter
(5)	Impacted teeth
Weighting X 1	

2. Left and right buccal occlusion (from canine to last molar).

<b>Antero-posterior</b>	<b>Vertical</b>	<b>Transverse</b>
Score	score	score
(0) good integration class I,II,III	(0) no open bite	(0) no cross bite
(1) less than half cusp from full integration	(1) lateral open bite on at least two teeth(not partial eruption	(1) cross bite tendency
(2) half a unit (cusp to cusp)		(2) single tooth crossbite
		(3) more than one tooth in crossbite
		(4) more than one tooth in scissor bite
Weighting X 1		

3. Overjet

<b>Overjet</b>	<b>Anterior crossbite</b>
Score	Score
(0) 0-3 millimeters	(0) no crossbite
(1) 3.1-5 millimeters	(1) one or more teeth edge to edge
(2) 5.1-7 millimeters	(2) one single tooth in crossbite
(3) 7.1-9 millimeters	(3) two teeth crossbite
(4) over 9 millimeters	(4) more than two teeth in crossbite
Weighting X 6	

4. Overbite and openbite

<b>Openbite</b>	<b>Overbite</b>
Score	score
(0) no openbite	(0) ≤ to one third coverage of the lower incisor
(1) openbite ≤ 1 millimeter	(1) > 1/3 but < 2/3 coverage of the lower incisor
(2) openbite 1.1-2 millimeters	(2) > 2/3 coverage of the lower incisor
(3) openbite 2.1-3 millimeters	(3) ≥ to full tooth coverage
(4) openbite ≥ 4 millimeters	
Weighting X 2	

5. Centerline

<b>Score</b>	<b>Centerline</b>
(0)	Coincident and up to 1/4 lower incisor width
(1)	1/4 - 1/2 lower incisor width
(2)	Greater than 1/2 lower incisor width
Weighting X 4	

The error of the method for the recording of the PAR index were evaluated from double recording of 10 randomly selected patients from the original sample. The pre-treatment and post-treatment study casts were evaluated a second time; 20 double records were performed. The random or accidental error for weighted and un-weighted PAR index scores was evaluated

with the formula: 
$$S_i = \sqrt{\frac{\sum d_i^2}{2n}}$$

Where  $d_i$  is the difference between the

double determinations and  $n$  is the number of the double determinations.<sup>(10)</sup>

No significant difference was observed between the two readings at  $p \leq 0.05$  level of significance.

The statistical analysis includes descriptive statistics of the variables, Pearson Correlation Coefficient between the time of orthodontic treatment and the percentage of reduction in PAR index, between time and the weighted PAR before treatment, between time and the Angle classifi-

cation and between the time and age of the patients.

### RESULTS

According to the case selection in this study, the percentage of reduction in PAR

index was very good; it is highest in class I then class II and class III respectively (Table 1).

Tables 2 and 3 showed the descriptive statistics of PAR index in three Angle classes before and after treatment.

Table (1): Descriptive statistics of percentage of reduction in PAR index in three Angle classes.

<b>Angle class.</b>	<b>Number</b>	<b>Minimum</b>	<b>Maximum</b>	<b>Mean</b>	<b>±SD</b>
<b>Class I (non exo.)</b>	51	86.67	100	97.18	4.02
<b>Class I (exo.)</b>	15	89.47	100	97.31	3.70
<b>Class II (non exo.)</b>	2	86.67	90.70	88.68	2.85
<b>Class II (exo.)</b>	24	83.33	100	92.53	4.56
<b>Class III (exo.)</b>	8	84.62	95.92	90	4.21
<b>Total sample</b>	100	83.33	100	95.3	4.86

Table (2): Descriptive statistics of PAR index before treatment in three Angle classes.

<b>Angle class.</b>	<b>Number</b>	<b>Minimum</b>	<b>Maximum</b>	<b>Mean</b>	<b>±SD</b>
<b>Class I (non exo.)</b>	51	17	52	27.63	7.58
<b>Class I (exo.)</b>	15	18	50	35.53	8.47
<b>Class II (non exo.)</b>	2	30	43	36.5	9.19
<b>Class II (exo.)</b>	24	22	56	38.58	8.67
<b>Class III (exo.)</b>	8	40	52	46.25	4.98
<b>Total sample</b>	100	17	56	33.11	9.84

Table (3): Descriptive statistics of PAR index after treatment in three Angle classes

<b>Angle class.</b>	<b>Number</b>	<b>Minimum</b>	<b>Maximum</b>	<b>Mean</b>	<b>±SD</b>
<b>Class I (non exo.)</b>	51	0	6	0.84	1.27
<b>Class I (exo.)</b>	15	0	4	0.93	1.28
<b>Class II (non exo.)</b>	2	4	4	4	0
<b>Class II (exo.)</b>	24	0	8	2.88	1.99
<b>Class III (exo.)</b>	8	2	8	4.63	2.06
<b>Total sample</b>	100	0	8	1.71	1.96

The mean of treatment time for total sample was 15.63 months, found to be 14.44 months in class I, 16.92 months in

class II and 21.25 months in class III (Table 4).

Table (4): Descriptive statistics of time of treatment in months in three Angle classes

<b>Angle class.</b>	<b>Number</b>	<b>Minimum</b>	<b>Maximum</b>	<b>Mean</b>	<b>±SD</b>
<b>Class I (non exo.)</b>	51	8	22	13.94	3.07
<b>Class I (exo.)</b>	15	11	20	16.13	2.72
<b>Class II (non exo.)</b>	2	15	18	16.5	2.12
<b>Class II (exo.)</b>	24	11	23	16.96	2.99
<b>Class III (exo.)</b>	8	18	26	21.25	2.71
<b>Total sample</b>	100	8	26	15.63	3.59

Pearson Correlation Coefficient was used to compare the variables, however, no significant correlation was observed

between percentage of reduction in PAR index and the time of treatment (Table 5).

Table (5): Pearson correlation coefficient between time of treatment and percentage in PAR reduction of extraction versus non extraction cases in both sexes.

<b>Time of treatment in months</b>				
<b>Angle class.</b>	<b>Extraction</b>	<b>Sex</b>	<b>Correlation</b>	<b>% PAR reduction</b>
<b>Class I</b>	NO	Female	Pearson correlation	-0.010
			p-value	0.963
		Number	24	
	Yes	Male	Pearson correlation	-0.119
			p-value	0.555
		Number	27	
<b>Class II</b>	Yes	Female	Pearson correlation	0.094
			p-value	0.824
		Number	8	
	No	Male	Pearson correlation	-0.642
			p-value	0.120
		Number	7	
<b>Class III</b>	Yes	female	Pearson correlation	0.568
			p-value	0.054
		Number	12	
	No	Male	Pearson correlation	-0.292
			p-value	0.357
		Number	12	
Yes	Female	Pearson correlation	-0.261	
		p-value	0.739	
	Number	4		
No	Male	Pearson correlation	0.394	
		p-value	0.606	
	Number	4		

Note: only two cases of Class II malocclusion were treated without extraction and excluded in this table and all Class III malocclusion cases were treated with extraction.

There was a significant correlation between PAR index before treatment and the duration of orthodontic treatment in class I non extraction, class II and Class III malocclusion cases as showed in Table 6. When Angle classification of the cases was compared with the time of treatment, we can see a significant shorter treatment time in class I than class II and class III

malocclusion respectively, so that class I cases can be finished with shorter time than class II and class III cases.(Table 7)

The age group of all patients was vary between 15-25 years and no significant correlation was observed between age and time of treatment within this age group as showed in Table 8.

Table (6): Pearson correlation coefficient between time of treatment and PAR before treatment of extraction versus non extraction cases in both sexes.

Angle class.	Time of treatment in months		Correlation	PAR before
	Extraction	Sex		
Class I	No	Female	Pearson correlation	0.516**
			p-value	0.010
			Number	24
	Yes	Male	Pearson correlation	0.776**
			p-value	0.000
			Number	27
Class II	Yes	Female	Pearson correlation	0.637
			p-value	0.090
			Number	8
	No	Male	Pearson correlation	0.591
			p-value	0.162
			Number	7
Class III	Yes	Female	Pearson correlation	0.746**
			p-value	0.005
			Number	12
	No	Male	Pearson correlation	0.386**
			p-value	0.215
			Number	12
No	Female	Pearson correlation	0.856**	
		p-value	0.144	
		Number	4	
Yes	Male	Pearson correlation	0.592**	
		p-value	0.408	
		Number	4	

\*\* Correlation is significant at 0.01 level ( $p < 0.01$ ).

Note: only two cases of Class II malocclusion were treated without extraction and excluded in this table and all Class III malocclusion cases were treated with extraction.

Table (7): Pearson correlation coefficient between treatment time and Angle classification.

Angle classification		
Time of treatment	Correlation coefficient	0.495(**)
	p-value	0.000
	number	100

\*\* correlation is significant at 0.01 level.

Table (8): Pearson correlation coefficient between treatment time and patient age.

Age		
Time	Correlation coefficient	0.050
	p-value	0.618
	number	100

## DISCUSSION

The percentage of reduction in PAR index for all cases was very good. This may be explained by the case selection, because we may select only the greatly improved cases, the percentage of reduction in PAR index of Class I was the best followed by Class II and Class III malocclusion respectively. These values were higher than that of Dycan *et al*<sup>(11)</sup> who found that mean percentage of reduction in PAR index 81.7% for graduate student and 87.9% for board accepted cases but his study included patients treated with orthognathic surgery.

When we compare the mean value of PAR index before treatment among the Angle classes, we can see that the mean PAR index in Class III is 46.25 which is larger than that in Class II (38.42) about 8 points, followed by PAR index in Class I (29.42) by 9 points than that of Class II. So that, there was more score reduction after treatment of Class III cases followed by Class II and then by Class I malocclusion. According to Richmond *et al*<sup>(6)</sup> the more severe malocclusion are, the most likely to be greatly improved and similar observations were seen in.<sup>(12,13)</sup> Regarding to this explanation, the time of treatment needed to correct Class III malocclusion was about 21.25 months which was significantly higher than that of Class II malocclusion (16.92). The mean treatment time for Class I malocclusion was about 14.44 months and this was significantly lower than that of Class II and Class III malocclusion. This was similar to the findings of other studies<sup>(14,15)</sup> that reported significant associations between duration of orthodontic treatment and severity levels of malocclusion using both dental aesthetic index (DAI) scores and index of complexity outcome and need (ICON) scores.

The mean treatment time of this study was 15.3 months, a higher treatment time was found in other studies, about 22 months in Richmond *et al*<sup>(6)</sup> and Algers<sup>(16)</sup> and about 23 months in Fink and Smith.<sup>(17)</sup> so that the initial severity of malocclusion as assessed by PAR Index was a good predictor of duration of treatment.<sup>(18)</sup>

In regards to this results shorter treatments are also desirable in view of the briefer exposure to possible harmful side-

effects.<sup>(19-21)</sup>

A study<sup>(22)</sup> found no relationship between treatment duration and three indexes of malocclusion severity. The sensitivity of PAR index is sufficient to detect differences in treatment outcome when using different treatment methods.<sup>(7-9,23)</sup> In Class I malocclusion, the PAR index before treatment affect significantly the treatment time in non extraction cases, and so a longer duration of treatment was needed to correct Class I malocclusion with higher PAR index before treatment in non extraction cases only, but this correlation was not found in cases of Class I extraction.<sup>(5)</sup> Fink and Smith<sup>(17)</sup> determined that treatment length increased by 0.9 month per extracted premolar, whereas Vig *et al*<sup>(24)</sup> found no significant correlation between extraction and non extraction cases. In Class II and Class III malocclusion the treatment time was significantly correlated with PAR score before treatment.

Pearson Correlation Coefficient showed no significant correlation between percentage of reduction in PAR index score and orthodontic treatment time. This may be due to that more time was spent (21.25 months) to get 90% reduction of PAR score in Class III malocclusion and less time (16.92 months) in Class II malocclusion treatment to get 92% reduction of PAR scores and less time (14.44 months) of treatment in Class I malocclusion to get 97% reduction. Although, PAR score not affected by pretreatment Angle classification (molar relationship) but in weighted PAR index the anterior crowding (weighted X 1) was found to be inferior to changes of the overjet (weighted X 6) so that better result were obtained after treatment of class I malocclusion than Class II and Class III malocclusion, a similar observations were found by another study.<sup>(8)</sup>

Increase overjet associated with Class II division 1 were found to have a longer treatment duration than Class I malocclusion, these results were supported by other researcher<sup>(24)</sup> who determined that Class II treatment on average takes 5 months longer than Class I treatment. Consequently these results support the notion that it takes longer to correct the buccal occlusion and overjet in orthodontic pa-

tients.<sup>(25,26)</sup>

The results of this study showed no correlation between treatment duration and patient age. This support the finding of Robb *et al*<sup>(25)</sup> who found the mean duration of treatment time was  $30.6 \pm 8.0$  months for the adult group and  $29.4 \pm 8.8$  months for the adolescent group. There was no significant difference ( $P > 0.05$ ) between the two groups and the percentage PAR reduction was similar. Another study<sup>(27)</sup> showed that the duration of treatment was shorter for the older ( $24.2 \pm 9.1$  months) compared with the younger ( $27.1 \pm 12.1$  months) group. However, the occlusal results, as measured by the PAR index, were inferior for the older group and this was significant ( $P < 0.001$ ).

A research<sup>(28)</sup> revealed statistically significant positive associations between pre-treatment age as well as duration of treatment with the PAR Index. The present result about PAR Index could be seen as consistent with the original development of the index.

### CONCLUSIONS

Treatment time can be calculated for our patients according to the malocclusion severity and Angle classification before starting the fixed orthodontic therapy using PAR index. This protocol could give a confidence to the orthodontic patients and a decision of controlling their appointments. In addition to that it is very important for orthodontist to use PAR index to facilitate the assessment of cost effectiveness of treatment for each patient before starting it.

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