ASSESSMENT OF ORTHODONTIC TREATMENT BY PAR INDEX

[1]ASMA SHAFIQUE, [2]ABIDA IJAZ, [3]SADIA IQBAL

ABSTRACT

This cross sectional study was carried out to assess the results of orthodontic treatment provided at Lahore Medical and Dental College. Pre- and post treatment casts and orthodontic files of last 40 finished orthodontic cases were utilized to study the treatment results by using PAR index. Pre- and post-treatment PAR score was calculated for each patient. All patients who received complete orthodontic treatment were included in the study. One investigator assessed all the components of the PAR Index. ANOVA was used to compare point reduction in PAR score in various malocclusion groups. The degree of correlation between various variables was assessed through Pearson Correlation Coefficient. The results showed that there was100% improvement in upper and lower anterior segment. Class II div I malocclusion displayed maximum improvement in comparison to other malocclusions. There was a significant positive correlation between pretreatment PAR and point reduction in PAR score. Weighted pretreatment PAR was found to be a significant positive predictor of point reduction.

Key words: *PAR index, Outcome assessment, Orthodontics treatment*

INTRODUCTION

Quantitative evaluation of Orthodontic diagnosis is considered to be a difficult task due to its subjective nature.[1,2] On the contrary, several indices have been presented for quantitative assessment of severity of malocclusion and evaluation of treatment need.[3,4] These indices provide valid and reproducible system of measurement. The Peer Assessment Rating (PAR) index was introduced by Richmond in 1990 to assess the severity of malocclusion.[5] It provides a cumulative score for occlusal disharmonies and identifies a deviation between normal occlusion and malocclusion. It has been weighted according to the judgment of orthodontists and general dentists.[6] The malocclusion is quantified based on five criteria of variable weightings: upper and lower anterior segment alignment (x1), left and right buccal occlusion (x1), overjet (x6), overbite (x2), and centerline (x4). Pretreatment and post treatment study casts are used for and comparison. This comparison is used to judge treatment efficacy in correction of malocclusion.[1,7,8] Reduction in the total score and percentage reduction are used to measure changes in PAR index. According to Richmond et al.[6] 30 percent or more reduction in weighted PAR score is required for a case to be considered as improved. Similarly, if there is reduction of 22 points in total PAR score, it is considered to be greatly improved. Some other studies have reported that great improvement can be considered if a change in PAR score is equal or greater than 70 percent.[9] Nomogram is a graphic representation of these criteria.[6] Richmond et al considered that an acceptable occlusion is characterized by PAR score of 10 or less. An ideal occlusion, on the other hand is characterized by a PAR score of 5 or less.[6,7]

PAR index has various applications. It has been used to evaluate treatment standards among general dentists and orthodontic specialists, to assess severity of malocclusion[3,10] to compare treatment outcomes using different types of fixed appliances and to study post treatment relapse.[7,11,12,13] It is also used in studies assessing the effectiveness and outcomes of orthodontic treatment in private practices, graduate and undergraduate clinics.[1,2,9]

Despite of the fact that it is proved to be a reproducible, valid and objective index for scoring occlusal change for the entire mouth, it has several limitations.[14] This is principally because of the high weight assigned to overjet. Additionally, application of one weighting system to all types of malocclusions may give rise to difficulties because of the variation in occlusal features in different malocclusion.[15]

PAR index is now used to assess orthodontic treatment need as a valid and reliable index. However, numerous factors such as decalcification of enamel, facial profile, root resorption, and treatment stability are not assessed through PAR index.[16,17]

The present study was conducted to:

1 Assess the quality of orthodontic treatment provided at Lahore Medical and Dental College, by using PAR index.

2 Determine the significant factors contributing to

[1] **Corresponding Author:** Prof. Asma Shafique, Department of Orthodontics, Lahore Medical Dental College, Lahore. 54000, E-mail: asma.shafique@lmdc.edu.pk

[2] Professor/Clinical Dean, Orthodontic Department Akhter Saeed Medical and Dental College.

[3] Professor, Department of Oral Pathology, Lahore Medical & Dental College, Lahore.

point reduction in PAR index.

3   Determine the correlation between probable factors affecting point reduction in PAR.

MATERIALS AND METHODS

A cross sectional study was carried out at the Lahore medical and dental college, Lahore. Pre- and post-treatment records including orthodontic files and study casts of last 40 consecutively finished cases representing different malocclusion categories were evaluated. All patients receiving fixed appliance therapy at our Orthodontic clinic were included in the study. Single arch treatment cases and retreatment cases (treatment after relapse) were excluded from the study.

The total PAR score comprises of sum of scores of seven individual traits: alignment of upper and lower anterior segment, right and left buccal occlusion, overjet, overbite and centerline. A single investigator, who was calibrated in the use of PAR index, calculated both pre- and post-treatment weighted PAR scores according to British weightings system advocated by Richmond et al.[6] and labeled them as wPAR1 and wPAR2 respectively. A digital caliper (Mitutoyo, Kawasaki, Japan), with accuracy closed to 0.1 mm, was used to measure all parameters on the initial and final casts. Information regarding patients' age, gender, angle's malocclusion, duration of active treatment, extraction or non-extraction was collected from their files. The data were recorded on a data sheet especially designed for this study.

Descriptive statistics including means, minimum and maximum were calculated for all variables which included age, duration of treatment, pre-treatment PAR score, post treatment PAR score, angles class (malocclusions) and percentage reduction in PAR score. The percentage PAR reduction indicates the improvement and hence success of treatment. This is determined by the formula: T1- T2/T1 x 100% where T1 is the pretreatment score, T2 is the post treatment score. Cases were divided into three categories i.e. "Greatly improved", "improved" and "worse or no different" based on PAR score reduction, according to criteria mentioned by Richmond et al.[6,7] In addition means of all individual PAR attributes for WPAR 1 and WPAR 2 were also calculated. ANOVA was used to compare point reduction in PAR score in various malocclusion groups. Pearson Correlation Coefficient was used to assess the degree of correlation between all variables.

A linear regression model was formulated to see the significant effect of independent variables on dependent variable i.e. point reduction. The independent explanotories were: pre-treatment PAR score (wPAR1), age at treatment start (years), treatment duration (months), extraction and malocclusion based on Angle's classification. A stepwise regression model was calculated to evaluate most significant contributory individual factors to the changes in point reduction. SPSS 15 was used for all statistical analyses and p

<0.05 was considered as statistically significant.

RESULTS

A correlation matrix was used to investigate the dependence between multiple variables at the same time (Table 4). A significant positive correlation was found between the pretreatment PAR and point reduction in PAR score. Case category had significant negative correlation with point reduction and weighted pretreatment PAR. There is a weak but significant correlation between point reduction and age and pretreatment and post treatment PAR. No significant correlations were found among other variables i.e. age, gender, malocclusion groups, appliance type, duration of treatment and extraction/ non extraction groups. Multiple linear regression shows a significant regression equation i.e: F=5/34=43, P < 0.001 with R2 of.866=86%. Weighted pretreatment PAR is only significant positive predictor and predicts 91% of the variance in point reduction, p is < 0.001, as shown in Table 6 .

DISCUSSION

The results revealed that there was 100 % correction in upper and lower anterior segment followed by more than 85% correction in lower left, upper left, upper right, and right buccal segments respectively. Furthermore,

TABLE 1: MEAN WEIGHTED PRE TREATMENT AND POST TREATMENT INDIVIDUAL PAR SCORE.

	Pre treat Mean	Post treat Mean	Percentage improvement
upper right segment	.65	.08	87%
upper ant segment	2.75	0.00	100%
upper left segment	.55	.08	85.45
lower right segment	.50	.15	70%
lower ant segment	1.97	.00	100%
lower left segment	.43	.02	95%
right buccal segment	1.05	.18	87%
left buccal segment	1.13	.30	73%
overjet	9.45	2.10	77%
overbite	2.78	1.50	46%
centre line	1.50	.32	78%

TABLE 2: IMPROVEMENT CATEGORIES IN MALOCCLUSION GROUPS

Malocclusion	class I	class II div 1	class II div 2	class II sub div	class III	Total
Greatly improved	4	12	0	3	0	19
Improved	7	10	1	1	1	20
Not improved/worsened	0	1	0	0	0	1
Total	11	23	1	4	1	40

TABLE 3: DESCRIPTIVE STATISTICS OF PAR INDEX BEFORE (T1) AND AFTER TREATMENT (T2) IN MALOCCLUSION GROUPS.

	Class I		Class II div 1		Class II div 2		Class II Sub Div		Class III	
	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2
Mean	21.1	5	20.6	4.75	11	4	29	6.25	12	5
Max	37	14	36	12	11	4	45	12	12	5
min	7	O	8	5	0	0	11	0	0	0

TABLE 4: PERCENTAGE REDUCTION IN MALOCCLUSION GROUPS.

	Class I	Class II div 1	Class II div 2	Class II Sub Div	Class III	P value
% Red.	76.3%	77%	63.6%	78.4%	58.3%	0.85

*Test of significance: ANOVA
Level of significance: $p < 0.05$

TABLE 5: CORRELATION MATRIX

		Age	Type of malocclusion	Weighted pre-treat PAR	Weighted post treat PAR	Point reduction in weighted PAR	Total time duration	Arch extraction
type of malocclusion	R2	.111						
	p	.497						
weighted pre-treat PAR	R2	-.299	.067					
	p	.060	.682					
weighted post treat PAR	R2	.067	.063	.313				
	p	.683	.699	.049				
point reduction in weighted PAR	R2	-.324	.066	.920	-.079			
	P	.041	.685	.000	.630			
total time duration	R2	-.178	.070	.172	.310	.041		
	P	.272	.670	.317	.051	.802		
arch extraction	R2	.246	-.225	.064	.094	.015	.098	
	p	.126	.163	.694	.562	.925	.546	
case category	R2	.381	-.074	-.811	.050	-.882	.122	.007
	p	.015	.650	.000	.758	.000	.455	.964

TABLE 6: RESULTS OF MULTIPLE LINEAR REGRESSION ANALYSIS CONSIDERING POINT REDUCTION IN WEIGHTED PAR AS THE DEPENDENT VARIABLE.

S.No	Variable	P value
1	Age of patient	.226
2	Type of malocclusion	.865
3	Weighted pretreat PAR	.000
4	Total time duration	.075
5	Arch extraction	.457

Level of significance: p < 0.05

there was moderate correction in lower right, left buccal; over jet and midline i.e. 70-78 % . Overbite was the only variable that ended up with less than 50 % correction, (Table 1). In a study conducted by Kemal et al. [18] highest pretreatment and post treatment PAR scores were found to be in mandibular incisor extraction group and lowest PAR scores were found in non extraction groups. They considered that retraction in extraction space results in anterior deep bite leading to raised post treatment PAR scores. Extraction pattern might be a reason of overbite being the least successful variable in present study as thirteen out of forty cases were treated with single arch premolar extractions and three cases were treated with single lower incisor extraction only. In accordance to present study, Holman et al.[19] achieved more than 85 percent corrections in upper anterior segment, over jet and midline in extraction and non extraction groups. On the contrary, they were able to achieve better correction in overbite (71%) and less improvement in left buccal and right buccal occlusion (60%). This disparity might be due to difference in study design as they used American weighting system. Daniel et al.[20] had more consistent results with present study. However, they were least successful in correction of anteroposterior relationships in buccal segments, which they attributed to their assessment criteria instead of treatment mechanics.

We were able to highest percentage PAR reduction (78%) in Class II sub division malocclusion, followed closely by Class II division 1 and Class I malocclusion (77% and 76 % respectively). Lowest reduction was noted in Class III malocclusion (58%), (Table 4). These results are consistent with the results achieved by Gasgoos.[16] However, the statistical relation between percentage reduction and malocclusions in both studies was insignificant. Treatment of Class II Division 1 group was found to be most successful by Birkeland et al.[21] It was followed closely by Class II Division 2 malocclusion. In contrast to present study, their study design did not include class II sub division as a separate category. Fidler et al[22] also found a high percentage reduction and better long term results in Class II malocclusion group. Interestingly, in contrast to present tudy, treatment of Class II division 2 malocclusion was declared to be most successful with 80.8 % PAR score

reduction and was closely followed by Class II division 1 malocclusion. The disparity can be explained by the fact that our mean pretreatment PAR score of class II division 2 group was less in comparison to the rest of class II malocclusion categories. This eventually led to less mean PAR reduction in that group. Contrary to all these findings, Willems et al.[18-23] reported high success rate in Class III group when absolute values were considered but the difference among three groups was statistically insignificant. High percentage reduction in Class II group was attributed to its high pre-treatment PAR score by some authors[17,23,24] who advocated that this could be a result of over rated over jet and overbite frequently seen in this group. Interestingly however, class I malocclusion had maximum pre treatment mean PAR score in the present study. This was due to presence of impacted teeth, cross bite, overbite and center line shift in most patients of class I group.

Correlation matrix was used to evaluate the correlation of different variables (Table 5). There was a significant positive high correlation between the pretreatment PAR and point reduction in PAR score. This is in accordance to various other studies.[24-27] It implies that more pronounced treatment changes will be observed in more severe malocclusion. On the contrary, Woods et al.[28] found an insignificant correlation pretreatment PAR and post treatment corrections. This lack of correlation could be attributed to the fact that they employed variable treatment plans in order to treat different malocclusions. Point reduction was also found to be positively correlated to gender and experience of operators by Firestone et al[25] and Holman et al.[19] The relationship of these variables was not considered in present study. In accordance to Reidmann and Berg[26], a weak but significant correlation of treatment duration was found with pre and post treatment PAR. This suggests that greater reduction in PAR score is expected in patients having high pre-treatment PAR score and more complex cases take more time to finish.[14,29] In contrast to our findings some authors attributed their lack of correlation to the early termination of treatment due to which fine detailing was not possible in severe cases of Class II division 1 sample.[2,11,30] The present study however, found no correlation between age and duration of treatment (Table 6). This is in agreement to results by Gasgoos.[17] Similarly, extractions did not significantly influence any other variable in present as well as other studies.[19,25]

CONCLUSIONS

1. 100% correction was achieved in upper and lower anterior segment crowding, whereas, least improvement was observed in overbite.

2. Class II division I malocclusion exhibited maximum improvement and was found to be the most frequently encountered malocclusion.

3. A significant positive correlation exists between pretreatment PAR score and point reduction.

4. Weighted pretreatment PAR is only significant positive predictor of point reduction in PAR score.

REFERENCES

1 Bernas AJ, Banting DW, Short LL. Effectiveness of phase I orthodontic treatment in an undergraduate teaching clinic. Journal of dental education. 2007 Sep;71(9):1179-86.

2 Allen Dyken R, Sadowsky PL, Hurst D. Orthodontic outcomes assessment using the peer assessment rating index. The Angle Orthodontist. 2001 Jun;71(3):164-9.

3 Liu S, Oh H, Chambers DW, Baumrind S, Xu T. Validity of the American Board of Orthodontics Discrepancy Index and the Peer Assessment Rating Index for comprehensive evaluation of malocclusion severity. Orthodontics & craniofacial research. 2017 Aug;20(3):140-5.

4 Kaygisiz E, Uzuner FD, Taner L. A Comparison of Three Orthodontic Treatment Indices with Regard to Angle Classification. Journal of Clinical Pediatric Dentistry. 2016 Mar;40(2):169-74.

5 Richmond S. A critical evaluation of orthodontic treatment in the general dental services of England and Wales (Doctoral dissertation, University of Manchester).

6 Richmond S, Shaw WC, O'brien KD, Buchanan IB, Jones R, Stephens CD, Roberts CT, Andrews M. The development of the PAR Index (Peer Assessment Rating): reliability and validity. The European Journal of Orthodontics. 1992 Apr;14(2):125-39.

7 Firestone AR, Häsler RU, Ingervall B. Treatment results in dental school orthodontic patients in 1983 and 1993. The Angle Orthodontist. 1999 Feb;69(1):19-26.

8 Green JI. An Overview of the Peer Assessment Rating (par) Index for Primary Dental Care Practitioners. Primary dental journal. 2016 Nov;5(4):28-37.

9 Pangrazio-Kulbersh V, Kaczynski R, Shunock M. Early treatment outcome assessed by the Peer Assessment Rating index. American journal of orthodontics and dentofacial orthopedics. 1999 May;115(5):544-50.

10 Liu S, Oh H, Chambers DW, Xu T, Baumrind S. Interpreting weightings of the peer assessment rating index and the discrepancy index across contexts on Chinese patients. European journal of orthodontics. 2017 Jun;40(2):157-63.

11 O'Brien KD, Shaw WC, Roberts CT. The use of occlusal indices in assessing the provision of orthodontic treatment by the hospital orthodontic service of England and Wales. British Journal of Orthodontics. 1993 Feb;20(1):25-35.

12 Freitas KM, Guirro WJ, de Freitas DS, de Freitas MR, Janson G. Relapse of anterior crowding 3 and 33 years postretention. American Journal of Orthodontics and Dentofacial Orthopedics. 2017 Dec;152(6):798-810.

13 Freitas KM, Janson G, Tompson B, de Freitas MR, Simão TM, Valarelli FP, Cançado RH. Posttreatment and physiologic occlusal changes comparison. The Angle Orthodontist. 2012 Jul;83(2):239-45.

14 Kerr WJ, Buchanan IB, McColl JH. Use of the PAR index in assessing the effectiveness of removable orthodontic appliances. British Journal of orthodontics. 1993 Nov;20(4):351-7.

15 Onyeaso CO, BeGole EA. Orthodontic treatment—improvement and standards using the peer assessment rating index. The Angle Orthodontist. 2006 Mar;76(2):260-4.

16 Gasgoos SS. Evaluation of Orthodontic Treatment Time Using Peer Assessment Rating Index. Al-Rafidain Dental Journal. 2011(14):275-83.

17 Hamdan AM, Rock WP. An appraisal of the Peer Assessment Rating (PAR) Index and a suggested new weighting system. The European Journal of Orthodontics. 1999 Apr;21(2):181-92.

18 Kamal AT, Shaikh A, Fida M. Improvement in Peer Assessment Rating scores after nonextraction, premolar extraction, and mandibular incisor extraction treatments in patients with Class I malocclusion. American Journal of Orthodontics and Dentofacial Orthopedics. 2017 Apr;151(4):685-90.

19 Holman JK, Hans MG, Nelson S, Powers MP. An assessment of extraction versus nonextraction orthodontic treatment using the peer assessment rating (PAR) index. The Angle Orthodontist. 1998 Dec;68(6):527-34.

20 Eng F. The development of the index of complexity, outcome and need (ICON). Journal of orthodontics. 2000;27:149-62.

21 Birkeland K, Furevik J, Bøe OE, Wisth PJ. Evaluation of treatment and post-treatment changes by the PAR Index. European Journal of Orthodontics. 1997 Jun;19(3):279-88.

22 Fidler BC, Årtun J, Joondeph DR, Little RM. Long-term stability of Angle Class II, division 1 malocclusions with successful occlusal results at end of active treatment. American Journal of Orthodontics and Dentofacial Orthopedics. 1995 Mar;107(3):276-85.

23 Willems G, Heidbüchel R, Verdonck A, Carels C. Treatment and standard evaluation using the peer assessment rating index. Clinical oral investigations. 2001 Mar;5(1):57-62.

24 Ahmad A, Fida M. Orthodontic treatment outcome assessment using peer assessment Rating (PAR) Index. Pakistan Oral & Dental Journal. 2010 Dec;30(2).

25 Firestone AR, Häsler RU, Ingervall B. Treatment results in dental school orthodontic patients in 1983 and 1993. The Angle Orthodontist. 1999 Feb;69(1):19-26.

26 Riedman T, Berg R. Retrospective evaluation of the outcome of orthodontic treatment in adults. Journal of Orofacial Orthopedics/Fortschritte der Kieferorthopädie. 1999 Mar;60(2):108-23.

27 Freitas KM, Freitas DS, Valarelli FP, Freitas MR, Janson G. PAR evaluation of treated Class I extraction patients. The Angle Orthodontist. 2008 Mar;78(2):270-74.

28 Woods M, Lee D, Crawford E. Finishing occlusion, degree of stability and the PAR index. Australian orthodontic journal. 2000 Mar;16(1):9-15

29 Vig KW, Weyant R, Vayda D, O'Brien K, Bennett E. Orthodontic process and outcome: efficacy studies-Strategies for developing process and outcome measures: a new era in orthodontics. Clinical orthodontics and research. 1998 Nov;1(2):147-55.

30 O'Brien KD, Robbins R, Vig KW, Vig PS, Shnorhokian H, Weyant R. The effectiveness of Class II, division 1 treatment. American Journal of Orthodontics and Dentofacial Orthopedics. 1995 Mar 1;107(3):329-34.

	CONTRIBUTIONS BY AUTHORS	
1	**Asma Shafique:**	Introduction, discussion, data collection, data analyses, results, tables & figures.
2	**Abida Ijaz:**	Results, discussion & final editing.
3	**Sadia Iqbal:**	Results &final editing.