ORTHODONTIC TREATMENT OUTCOME ASSESSMENT USING PEER ASSESSMENT RATING (PAR) INDEX

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2MUBASSAR FIDA

ABSTRACT

The crosssectional study was carried out to determine the degree of improvement in malocclusion after orthodontic treatment provided at the Aga Khan University Hospital (AKUH), Karachi, and to find out which malocclusion showed a marked reduction in PAR score after orthodontic treatment. It was conducted from March 2007 to April, 2007.

This study evaluated the last 50 consecutively finished orthodontic cases using PAR index. The material consisted of pre- and post treatment casts and orthodontic files. Pre- and post-treatment PAR score was calculated for each patient. All patients who received complete orthodontic treatment at this hospital and whose good quality records were available were included in the study. Re-treatment cases and patients transferred out of hospital were excluded.

Records of 50 patients (38 females and 12 males) were evaluated for PAR score. The mean reduction in the PAR score was 24 points (91.95 %). The number of patients in 'greatly improved' category was 30 (60 %), in 'improved' category 19 (38 %) and in 'worse / no different' category 1 (2 %). Statistically significant correlation was found between percentage PAR score reduction and pretreatment PAR score. A significantly higher orthodontic treatment standard was achieved. The mean reduction in PAR score was almost 92 %. The percentage of patients in 'Greatly improved' category was 60 %. A significant correlation (p<0.001) was found between pre-treatment PAR score and percentage reduction in PAR score.

Key words: PAR index, Outcome assessment, Orthodontics treatment

INTRODUCTION

An assessment of orthodontic treatment outcomes helps to set goals, establish standards and achieve a measurable finish for completed patients. In addition, it is useful for educational purposes in postgraduate orthodontic programs. Traditionally, orthodontic treatment assessment has been accomplished using the subjective opinion and experience of the clinician. Unfortunately the variation in the criteria used by different orthodontists makes it difficult to compare results of treatment. It is, therefore, important to objectively assess whether a worthwhile improvement has been achieved in terms of overall alignment and occlusion for an individual patient and a greater proportion of a practitioner's caseload.

Several occlusal indices have been devised in an attempt to provide a more objective assessment of malocclusion severity, treatment need and treatment results. One of these indices, the Peer Assessment Rating (PAR) index, has been widely used for evaluating the severity of malocclusions and the effects of treatment in resolving them.

The Peer Assessment Rating (PAR) Index was designed specifically for the assessment of treatment outcome. The PAR Index provides a single summary score for all the occlusal anomalies which may be found in a malocclusion. Furthermore, it quantitatively evaluates orthodontic outcome by comparing pre-treatment and post-treatment casts. The difference in scores between the pre- and post-treatment patients reflects

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the degree of improvement and, therefore, the success of the treatment. This index has been widely used for evaluating the severity of malocclusions and the effects of treatment in resolving them.

Weightings have been derived for individual components from validation studies in which panel assessment serve as the “gold standard”. Weighted score for each of the components are combined to form a single summary score. Presently there are separate British and American weightings. The American weighting emphasizes mainly on overbite, the buccal segments and the midline. Lower labial segment alignment is excluded because it is not thought to influence the perception of treatment outcome. In contrast the British version includes the lower labial segment and places greater emphasis on overjet.

Richmond et al described three categories of orthodontic treatment outcome based on subjective assessment of 74 examiners. These categories were “Greatly improved”, “Improved” and “Worse or No-different”. They judged that a change of 22 points or greater, in weighted PAR score is required for a case to be considered as “Greatly improved” and greater than 30% reduction in PAR scores is necessary for a case to be labeled as “Improved”. Reduction of 30% or less in PAR score was considered in “Worse or no different” category. A high standard of treatment is achieved when the proportion of cases falling into the ‘Worse or No-different’ category is negligible and the mean percentage reduction in PAR score is high (e.g. greater than 70%). A PAR score of 10 or less was considered acceptable alignment and occlusion by Richmond et al and a PAR score of 5 or less suggests an almost-ideal occlusion.

METHODOLOGY

This was a cross sectional study carried out at the Aga Khan University Hospital, Karachi. The pre- and post-treatment records including orthodontic files and study casts of last 50 consecutively finished cases representing different malocclusion categories were evaluated.

The inclusion criteria adopted were:

Patients who received complete orthodontic treatment at our hospital.

Availability of pre- and post treatment records which include orthodontic casts, files and photographs.

Exclusion criteria were:

Retreatment cases (Treatment after relapse)

Both pre- and post-treatment weighted PAR scores were calculated according to British weightings system, by a single investigator who was calibrated in the use of PAR index. In addition the following information was collected form patient’s records. 1) Age 2) genders 3) Angle’s malocclusion 4) type of appliance used 5) duration of active treatment 6) extraction or non-extraction. The data were recorded on a data sheet especially designed for this study.

Descriptive statistics including means, standard deviations and ranges were calculated for all variables which included age, gender, malocclusion group, duration of treatment, 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 i.e. “Greatly improved”, “improved” and “worse or no different” based on PAR score reduction, according to criteria mentioned by Richmond et al. Chi-square analysis was used to compare three improvement categories among three malocclusion groups, between the two genders and between extraction and non-extraction groups. ANOVA was used when point reduction and percentage reduction in PAR score was compared among the three malocclusion groups. Pearson’s correlation coefficient was used to find correlations among various variables.

Intra-examiner reliability

Intra-examiner reliability was determined by duplicate scoring of 40 casts at a two months interval. Intra-class agreement was checked using Pearson’s correlation coefficient. The correlation coefficient was 0.96, which showed excellent intra-operative reliability for the investigator scoring the casts.
RESULTS

Records of 50 Orthodontic patients (38 females and 12 males) were evaluated for pre-and post-treatment PAR score. The mean age recorded at the start of treatment was 13 years 8 months (minimum 6 years 10 months and maximum of 23 years 6 months). The mean duration of active treatment was 2 years 7 months. Fifteen patients underwent extraction while the rest (35 patients) were treated on non-extraction basis. The pre-treatment PAR score was divided into four categories as shown in Figure 1.

The highest number of patients fell into fourth category with pre-treatment PAR score in the range of 31-40. The mean pre- and post-treatment PAR scores were 24.06 ± 9.80 SD and 1.50 ± 1.50 SD respectively. Majority of patients had post-treatment PAR score below 5 as shown in Figure 2, which showed a major improvement in malocclusion. The mean reduction in the PAR score was 24 points (91.95%).

The distribution of cases according to improvement categories (Table I) showed that majority of patients (60%) were greatly improved. No significant difference was found among the three malocclusion groups in term of improvement categories (Table 1).
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Percentage reduction in the PAR score for the whole sample and individual malocclusion groups (Table 2) showed the highest percentage reduction in Class II followed by Class I malocclusion group. However the difference among the three groups was not statistically significant (p>0.05).

A comparison between male and female subjects in terms of improvement was not statistically significant as shown in Table 3.

No significant difference was found between extraction and non-extraction groups when reduction in PAR score was compared (Table 4). A significant positive correlation was found between the pretreatment PAR and percentage reduction in PAR score as shown in Table 5. However no significant correlations were found among other variables i.e. age, gender, malocclusion groups, appliance type, duration of treatment and extraction/ non extraction groups.

TABLE 1: IMPROVEMENT CATEGORY IN DIFFERENT MALOCCLUSION GROUPS

<table>
<thead>
<tr>
<th>Improvement category</th>
<th>Angle’s malocclusion</th>
<th>Total (%) (n=50)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greatly improved</td>
<td>Class I 5 Class II 24 Class III 1</td>
<td>30 (60%)</td>
<td>0.300</td>
</tr>
<tr>
<td>Improved</td>
<td>Class I 6 Class II 12 Class III 1</td>
<td>19 (38%)</td>
<td>0.331</td>
</tr>
<tr>
<td>Worse/No different</td>
<td>Class I 1 Class II 0 Class III 0</td>
<td>1 (2%)</td>
<td>0.133</td>
</tr>
</tbody>
</table>

*Test of significance: Chi-Square
Level of significance: p ≤ 0.05

TABLE 2: PERCENTAGE REDUCTION IN MALOCCLUSION GROUP

<table>
<thead>
<tr>
<th>Angle’s Malocclusion group</th>
<th>Class I</th>
<th>Class II</th>
<th>Class III</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage Reduction</td>
<td>89.65%</td>
<td>92.97%</td>
<td>87.50%</td>
<td>0.692</td>
</tr>
</tbody>
</table>

*Test of significance: ANOVA
Level of significance: p ≤ 0.05

TABLE 3: IMPROVEMENT CATEGORIES IN MALES AND FEMALES

<table>
<thead>
<tr>
<th>Improvement category</th>
<th>Gender</th>
<th>Total</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greatly improved</td>
<td>Male 5</td>
<td>Female 25</td>
<td>30</td>
</tr>
<tr>
<td>Improved</td>
<td>Male 7</td>
<td>Female 12</td>
<td>19</td>
</tr>
<tr>
<td>Worse/No different</td>
<td>Male 0</td>
<td>Female 1</td>
<td>1</td>
</tr>
</tbody>
</table>

*Test of significance: Chi-Square
Level of significance: p ≤ 0.05

TABLE 4: IMPROVEMENT CATEGORIES IN EXTRACTION AND NON-EXTRACTION GROUPS

<table>
<thead>
<tr>
<th>Improvement category</th>
<th>Extraction</th>
<th>Non-Extraction</th>
<th>Total</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greatly improved</td>
<td>11</td>
<td>19</td>
<td>30</td>
<td>0.091</td>
</tr>
<tr>
<td>Improved</td>
<td>3</td>
<td>16</td>
<td>19</td>
<td>0.079</td>
</tr>
<tr>
<td>No different</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0.456</td>
</tr>
</tbody>
</table>

*Test of significance: Chi-Square
Level of significance: p ≤ 0.05
DISCUSSION

A high standard of treatment may be judged according to the mean percentage reduction in weighted PAR score for an individual practitioner’s caseload, e.g. greater than 70%\(^1\). The present study has revealed a mean percentage reduction in weighted PAR score of almost 92%. Turbill et al\(^9\) reported this to be about 47% in the General Dental Service Orthodontics in England and Wales. In a related study in the United States by Holmann et al\(^10\) the mean percentage reduction was 79.41% for the extraction group and 77.63% for the nonextraction group. Similarly other studies reported PAR reduction of 76.9% by Birkland et al\(^11\), 70% by Piskorski\(^12\), 83% by McKnight\(^8\), 86% by Onyeaso and BeGole\(^14\), 66% by Fox\(^15\) and 56% by Reidmann and Berg.\(^16\) Firestone et al\(^17\) evaluated improvement in malocclusion after orthodontic treatment and reported 73% reduction in PAR score in cases treated by post graduate students. Dyken et al\(^18\) reported 87.9% reduction in PAR score for Board accepted cases and 81.7% for graduate student treated cases. The difference among these studies can be attributed to the use of different treatment modalities. The high percentage reduction in PAR score in present study can be due to use of fixed appliances as greater control of tooth movement can be achieved with these appliances. Several studies\(^7,15,19\) have shown a higher percentage reduction in PAR score with fixed appliances as compared to removable appliances.

For a practitioner to produce high standards not only must the mean percentage reduction for the caseload be high, but the percentage of patients having been greatly improved should also be high (e.g. greater than 40%)\(^1\). In the present study, the greatly improved category constituted 60%. The percentage of patients in improved category was 38% while 2% fell into worse or no different category. Firestone et al\(^17\) reported, for the greatly improved category, an average of 27% for patients treated by postgraduate and undergraduate students. In the same report, the “greatly improved” category was 28% for undergraduate and 40% for postgraduate students. This report also indicated 12% of patients in worse or no different group, as against 2% in the present study. Kerr et al\(^20\) reported 89.3% of patients as either improved or greatly improved with 10.7% classified as worse or no different, in assessing the effectiveness of removable orthodontic appliances. Birkland et al\(^11\) reported 52.2% cases in “greatly improved” category, 44.7% cases in “improved” category and 3.1% in “worse or no different” category at the end

<table>
<thead>
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<th>TABLE 5: CORRELATION MATRIX</th>
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<tbody>
<tr>
<td><strong>Age of patients</strong></td>
</tr>
<tr>
<td>Age of patients</td>
</tr>
<tr>
<td>Appliance type</td>
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<tr>
<td>Malocclusion group</td>
</tr>
<tr>
<td>Ext./Non Ext.</td>
</tr>
<tr>
<td>Duration</td>
</tr>
<tr>
<td>Gender</td>
</tr>
<tr>
<td>Pre-TxPAR</td>
</tr>
<tr>
<td>Percentage reduction</td>
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<td></td>
</tr>
</tbody>
</table>

*Test: Pearson product-moment correlation coefficient at 0.05 level (2-tailed)
of active orthodontic treatment. In Piskorski\textsuperscript{12} study, 18% of patients were categorized as greatly improved, 73% as improved and 9% as worse or no different. Willems et al\textsuperscript{13} found that 44.2% of their patients showed great improvement as a result of orthodontic treatment, 50.6% showed improvement while 5.2% cases fell into worse or no different category. In a study by Fox\textsuperscript{15} 41% patients were categorized as greatly improved, 47% as improved and 12% as worse or no different. This difference in the result in term of improvement categories can be due to one of the shortcomings of PAR index. For a case to be labeled as greatly improved, it must have pre treatment PAR score above 22 point. This has a significant contribution to the treatment outcome since the higher the pretreatment score, the easier it would be to achieve the 22 point reduction needed for a case to be categorized as “Greatly improved”. If a case with a class I malocclusion having pre-treatment PAR score of less than 22 points, is treated to almost normal occlusion, it still cannot be included in “Greatly improved” category. However a case with class II or class III malocclusion can have increased pre-treatment PAR score due to contribution of high weightings given to overjet, overbite and crossbite. At the end of treatment these cases even if treated to a less ideal than class I, would be included in greatly improved category. In our sample the increased number of patients in greatly improved category can be due to this reason, as almost two-third (72%) of the patients had class II malocclusion. This high percentage of patients with initial PAR score of greater than 22 points contributed to a high percentage of patients belonging to greatly improved category in this study. Another possible reason could be the use of predominantly dual arch fixed appliance system as being practiced at our centre. Several studies\textsuperscript{7,12,15,19} have reported that a far better result can be achieved with fixed appliances as compared to removable appliances. In our study 94% of the patients were treated with fixed appliances which can be a reason for a high percentage of patients in greatly improved category.

In this study the mean pre- and post-treatment PAR scores were 24.06 and 1.50 respectively. Onyeaso and BeGole\textsuperscript{19} reported the mean pre-treatment weighted PAR score of 23.83 and the post-treatment weighted PAR score of 1.72. Firestone et al\textsuperscript{17} reported pre-treatment PAR scores of 25 for undergraduate and 24.8 for postgraduate student treated cases. Their corresponding post-treatment PAR scores were 8.3 and 5.3 respectively. Turbill et al\textsuperscript{18} reported pre-treatment PAR scores of 26.74, 24.74 and 29.69 for patients treated with removable, single arch fixed and dual arch fixed appliances respectively. Their corresponding post-treatment scores were 15.19, 11.40 and 9.36 respectively. The study of Holman et al\textsuperscript{10} showed pre-treatment PAR score of 30.01 for extraction group as against 25.21 for the nonextraction group in a related study that used the American weighting system. McKnight et al\textsuperscript{9} reported the pre-treatment PAR score of 31.3 and post treatment of 5.2 for British weighting system. The mean pre-treatment PAR score was reported as 28.7 and post-treatment score of 6 by Birkeland et al\textsuperscript{11}. Dyken et al\textsuperscript{18} reported pre-treatment score of 27.9 for Board accepted cases and 25.6 for cases treated by graduate students. The post-treatment scores reported were 3.1 and 4 respectively. Willems et al\textsuperscript{13} reported pre-treatment score of 26.2 points and post-treatment score of 6 in their study. This can be seen from above studies that pre-treatment PAR score in our study was comparable with most of the studies which showed that cases treated at our centre had malocclusion severity comparable with other international studies. The post-treatment PAR score in our study was less than in majority of studies mentioned above. Only one study\textsuperscript{14} had a post treatment score close to our result. It could be seen that all cases treated with fixed appliances had significantly less post treatment PAR score than cases treated with removable appliances. This could be the reason for a minimum post-treatment PAR score in our study. As stated by Richmond et al\textsuperscript{1,7}, a PAR score of 1-5 indicate normal or almost normal occlusion, it can be said that almost all patients in our centre were treated to this range.

In present study class II malocclusion showed the highest percentage reduction in PAR score followed by class I group while the lowest reduction was noted for class III group. However the difference between the three groups was not statistically significant (p>0.05). Similar result were reported by Birkeland et al\textsuperscript{11}, who stated that greatest success was achieved in Class II Division 1 group followed closely by Class II Division 2 malocclusion. The minimal improvement was achieved in Class III group as compared to other groups. However no significant difference was found among the malocclusion groups in terms of post treatment PAR score. Fidler et al\textsuperscript{21} also found a high percentage
reduction and better long term results in Class II malocclusion group. Willems et al\textsuperscript{13} reported a high success rate in Class III group when absolute values were considered but the difference among the three groups was not statistically significant. This high percentage reduction in PAR score in Class II group can be explained by a high pre-treatment PAR score found in this group as compared to Class I malocclusion. This can be attributed to increased overjet and overbite which are common finding in this malocclusion group. As high weighting is given to these features, it will result in a high pre-treatment PAR score as reported by several studies\textsuperscript{11,13}, and ultimately greater improvement in PAR score at the end of treatment.

Extractions did not significantly influence treatment success in our study, which indicated that when fixed appliances were used, there was a prospect of achieving good results both with and without extractions, as reported earlier by Uhde et al\textsuperscript{22} and Fidler et al\textsuperscript{21}. Holman\textsuperscript{10} also reported that no significant difference was found in percentage reduction in PAR score in extraction and non-extraction groups. Lobb et al\textsuperscript{23} reported that extractions during treatment were associated with more frequent treatment failures, but in their sample the treatment was provided by removable appliances in most cases.

There was no gender difference in the treatment outcome in our study. This was in agreement with some other studies\textsuperscript{11,14} who reported that gender of the patient had no effect on change in PAR score. But this was in contrast to the finding of Kerr et al\textsuperscript{20} who studied removable appliances and found better results for girls. The reason may be that treatment with fixed and removable appliances requires different levels of cooperation.

The pre-treatment PAR score was found to have a significant positive correlation with percentage reduction in PAR score. Firestone et al\textsuperscript{17} found that pretreatment PAR score and gender were two factors having significant correlation with change in PAR score. Holman et al\textsuperscript{10} found that percentage reduction in PAR score was significantly correlated with pretreatment PAR score and operator’s experience. Fox\textsuperscript{15} concluded that percentage reduction in PAR score had a significant correlation with the type of appliance used, and fixed appliances in both upper and lower arches gave the highest value of percentage reduction in PAR score. Reidmann and Berg\textsuperscript{16} also found that duration of treatment and pretreatment PAR score correlated significantly with the PAR score reduction. This can be explained by the fact that all patients having a high pre-treatment PAR score will show a greater reduction in PAR score when treated to a normal occlusion.

CONCLUSIONS

- The mean weighted PAR score reduction was 22.56, whereas the mean percentage reduction was almost 92% indicating a significant improvement in malocclusion as a result of orthodontic treatment.
- The “Greatly improved” category constituted 60%, the “improved” category 38% and the “worse or no different” category 2% indicating that a high treatment standard was achieved.
- The Class II malocclusion showed the highest percentage reduction in the PAR score, followed by Class I group; however the difference among the three malocclusion groups was not statistically significant.
- No significant difference was found between males and females and between extraction and non-extraction groups in term of improvement in PAR score.
- A significant positive correlation was found between pre-treatment PAR score and percentage reduction in PAR score; however the correlations with age, gender, appliance type, duration of treatment and extraction non-extraction groups were not statistically significant.

REFERENCES

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