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October 2016

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ORIGINAL ARTICLE

OCCLUSAL OUTCOME OF NON-EXTRACTION AND ALL FIRST PREMOLARS EXTRACTION TREATMENT IN PATIENTS WITH CLASS-I MALOCCLUSION

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Background: Class-1 malocclusion commonly presents with crowding and poses an aesthetic concern to patients. An orthodontist may encounter a variety of dental problems and must handle them strategically to establish adequate occlusal relationships. Hence, this study was conducted to evaluate the occlusal characteristics of patients who have undergone non-extraction or all first premolars extraction treatment for class I malocclusion using the peer assessment rating (PAR) index. **Methods:** The pre-treatment and post treatment dental casts of 94 subjects with class-I malocclusion were retrospectively screened. The sample was distributed into two groups, i.e., non-extraction and all first premolars extraction groups. The Mann Whitney-U test was used to compare the mean percentage improvement in the PAR scores between the two groups. A *p*-value of ≤0.05 was considered statistically significant. **Results:** The mean percentage improvement in the non-extraction group was 74.28% in the non-extraction group and 74.5% in the all first premolars extraction group. A significant difference (*p*=0.04) was found between the pre-treatment PAR scores for the two treatment modalities. There was no significant difference between the post treatment PAR scores (*p*=0.45) and the mean percentage improvement in PAR scores (*p*=0.41) between the treatment groups. **Conclusions:** The improvement in occlusal characteristics in patients who underwent non-extraction treatment and all first premolar extraction treatment was comparable as assessed through mean percentage improvement in PAR scores.
Keywords: Angle class I; Index; Occlusion; Malocclusion

INTRODUCTION

Class I malocclusion may present with a number of occlusal discrepancies. These may include crowding, spacing, and rotations, cross bite, open bite or deep bite. Dental crowding, measured as the contact point displacement among teeth, is usually the principal concern of many patients who present for orthodontic treatment.[1–4] Dental arch expansion is usually the preferred treatment option for cases with mild dental crowding. Moderate to severe crowding requires the extraction of premolars to eliminate tooth size arch length discrepancy and to correct the alignment of teeth without adversely affecting aesthetics and stability.[5] The severity of crowding is one of the most important factors in deciding the treatment modality.[6–8]

The objective of orthodontic treatment is aimed towards achieving ideal occlusal relationships with appropriate overbite, overjet, and interdigitation of teeth. The improvement in occlusion can only be quantified after a thorough assessment using an index that can objectively measure the malocclusion before and after treatment. A number of indices were proposed in the past which include the occlusal index,[9] Eismann index[10] and the index of treatment need[11] (IOTN) but failed to gain popularity. Richmond *et*

al[12] developed the PAR index to overcome the shortcomings of all previous indices. It was widely accepted and embraced as a tool to determine treatment outcome as it provided a quick and reliable method to evaluate the pre-treatment and post treatment casts with a high inter-examiner reliability.[13] Current indices including the American Board of Orthodontics objective grading system[14] (ABO-OGS) and the index of complexity outcome and need[15] (ICON) comprehensively evaluate the occlusal characteristics. This makes them time consuming, complicated, and therefore they have a poor reproducibility. Hence, the PAR index is still used extensively.

The PAR index is composed of five major components. Each component is scored on the dental casts according to the deviation of the teeth from ideal occlusion. These scores can then be summed to obtain the overall pre-treatment scores. Similarly, the post treatment casts are scored and summed and the difference between the pre-treatment and post treatment scores reveal the improvement in occlusion and orthodontic treatment success.

A greater PAR value is seen in those patients who present with a greater severity of malocclusion and there is usually a greater improvement in their PAR score after treatment.[16–20]

In recent literature, it was speculated that the ideal occlusal characteristics would be difficult to achieve using the premolar extraction treatment approach in comparison to the non-extraction treatment.[21] Therefore, this study was designed to evaluate only the occlusal characteristics achieved at the end of non-extraction and all first premolars extraction treatment as assessed through percentage improvement in PAR scores.

MATERIAL AND METHODS

The pre-treatment and post treatment dental casts of 94 subjects with class I malocclusion who presented to the dental clinics were retrospectively screened. The study findings of Jansen *et al*[5] were used for sample calculation. The α was set as 0.05 and β was taken as 90% for sample size calculation which showed that we required a minimum of 47 subjects in each group.

The total sample constituted of two groups, i.e., non-extraction (mean age: 19.4±4.9 years) and all first premolar extractions (mean age: 19.5±4.1 years). Since there were two treatment groups, the overall sample comprised of 47×2=94 subjects.

All orthodontic patients aged between 18–35 years having class I malocclusion treated only with straight-wire appliance 0.022" slot with Roth prescription were included. These subjects had either undergone either non-extraction or all first premolars extraction treatment. Patients with missing teeth, craniofacial syndromes and traumatic injuries involving facial structures were excluded from this study. Patients treated with any appliance except the straight-wire appliance were also excluded from this study.

The PAR index was used to evaluate the pre-treatment and post treatment dental casts of each subject.[12] The components of the PAR index are listed in table-1.

Table-1: PAR Index

The PAR Index	
Components	Weightages
Upper and lower anterior segments	x1
Left and right buccal occlusion	x1
Overjet	x6
Overbite	x2
Centreline	x4

Dental crowding was recorded from the mesial contact point of the left canine to the mesial contact point of the right canine in the upper and lower segments. The buccal occlusal segment was evaluated for inter-digitation between maxillary and mandibular teeth, lateral open bites and cross bites.

The distance between the most protrusive maxillary incisor and mandibular incisors was measured using a ruler which was parallel to the occlusal plane to determine the overjet. The overbite was recorded at the point of maximum vertical overlap of the mandibular incisor by the maxillary central incisor.

The following formula was used to calculate the percentage improvement in PAR scores:[2]

$$\%PAR = \frac{PAR\ T1\text{-}T2}{PAR\ T1} \times 100$$

PAR T1 represents the pre-treatment PAR score and PAR T2 represents the post treatment PAR score.

The outcome of treatment was then be categorized into three categories:[21–25]

- Worse or no different: <30% improvement
- Improved: ≥30% improvement
- Greatly improved: ≥70% improvement

The analyses of data were performed using SPSS for Windows (version 20.0, SPSS Inc. Chicago). The normality of the data was tested using the Shapiro Wilk test which showed a non-normal distribution. The Mann-Whitney U test was used to compare the mean PAR scores among the two treatment modalities.

To test the intra-examiner reliability, 30 pre-treatment and post treatment casts were randomly selected and their PAR scores were re-evaluated. The intra-class correlation coefficient was calculated for the pre-treatment PAR score (ICC=0.990) and the post treatment PAR score (ICC=0.977) to assess the reliability of the readings.

RESULTS

The mean improvement in each PAR component is summarized in table-2.

The comparison between the mean pre-treatment and post treatment PAR scores revealed that 5.3% of the sample could be allocated in the worse or no different category; 24.5% of the sample in the improved category whereas, 70.2% in the greatly improved category.

The mean PAR scores recorded from pre-treatment and post treatment dental casts showed significant differences when compared between males and females. However, no significant differences were reported when compared to the mean percentage improvement in PAR scores. (Table-3)

The mean PAR scores amongst the two treatment modalities showed significant differences in pre-treatment scores; however, there was no significant difference in the post treatment scores. In addition, there was no significant difference in the percentage improvement in PAR scores between the two groups. (Table-4)

Table-2: Mean pre-treatment and post treatment scores for different PAR Components

Variables (mm)	Non-Extraction (means±SD)		Percentage Improvement (%)	Premolar Extraction (means±SD)		Percentage Improvement (%)
	Pre-treatment	Post Treatment		Pre-treatment	Post Treatment	
UAS	2.34±1.22	1.28±0.98	37	3.45±0.90	1.64±0.98	52
LAS	3.26±0.94	0.72±0.68	78	3.43±0.99	1.23±0.78	64
OJ	1.62±1.26	0.15±0.36	91	1.60±1.19	0.19±0.39	92
OB	1.00±1.02	0.32±0.62	68	1.06±1.00	0.19±0.39	82
MID	0.28±0.45	0.02±0.14	92	0.32±0.62	0.04±0.20	87
RBO	1.15±0.83	0.53±0.95	54	1.30±1.26	0.87±1.07	33
LBO	1.06±0.79	0.43±0.58	60	1.28±1.26	0.66±0.60	43

n=94, Descriptive Statistics, UAS: Upper and lower anterior segments, OJ: Overjet, OB: Overbite, MID: Midlines, RBO: Right buccal occlusion, LBO: Left buccal occlusion

Table-3: Comparison of mean PAR scores among gender

Parameter	Gender		p-value
	Males (means±SD)	Females (means±SD)	
Pre PAR Scores (T1)	25.41±5.31	21.67±10.77	0.02*
Post PAR Scores (T2)	6.35±4.08	4.92±4.01	0.05*
PAR Improvement	75.5±16.57	73.74±25.28	0.57

n=94, Standard Deviation, Mann Whitney-U test, SD: Standard Deviation, p≤0.05, NE: Non-extraction, PME: Premolar Extraction

Table-4: Comparison of mean pre-treatment and post treatment PAR scores between treatment modalities

	NE (n=47) (means±SD)	PME (n=47) (means±SD)	p-value
Pre PAR Scores (T1)	21.15±8.91	24.89±9.44	0.04*
Post PAR Scores (T2)	5.19±4.35	5.68±3.82	0.45
PAR Improvement	74.28±26.03	74.49±18.47	0.41

n=94, Standard Deviation, Mann Whitney-U test, SD: Standard Deviation, p ≤0.05, NE: Non-extraction, PME: Premolar Extraction

Table-5: Mean pre-treatment and post treatment PAR scores and percentage improvement

	Non-extraction			Premolar Extraction		
	PrePAR (T1)	Post PAR (T2)	Percentage Improvement (%)	PrePAR (T1)	Post PAR (T2)	Percentage Improvement (%)
Illeri et al[2]	17.1±5.7	1.4±1.14	91.2	27±6.2	3.5±3.19	87.7
Jansen et al[5]	24.32±7.67	5.67±5.62	72.69	--	--	--
Freitas et al[29]	--	--	--	29.46±8.79	6.32±3.48	74.2
Holman et al[27]	25.21±8.55	5.64±3.08	77.6	30.01±8.20	6.18±3.04	79.4
AKUH	21.15±8.91	5.19±4.35	74.28	24.89±9.44	5.68±3.82	74.5

DISCUSSION

The purpose of this study was to assess the improvement in occlusal characteristics by evaluating the percentage improvement in PAR scores of those patients who have undergone a non-extraction or all first premolars extraction treatment for the correction of class I malocclusion.

The treatment planning process is a complex procedure and a number of variables are taken into consideration. The decision to undertake non-extraction treatment or all first premolars extraction treatment approach is dependent on many factors which may include the amount of crowding in the upper and lower arch, overjet, lower incisor angulation, and lip procumbency.[6–8] The extraction of premolars is usually necessary when severe malocclusion exists.[1] In these cases, a non-extraction approach would be futile as it can lead to the positioning of teeth off the basal bone and therefore result in an unstable treatment outcome.[26]

The overall improvement in PAR scores indicates that both treatment modalities can help achieve a significant improvement in occlusal characteristics. However, the superiority of one modality over the other cannot be deduced as the pre-treatment PAR scores were not equivalent in these groups.

An individual comparison was reported to determine the PAR components which have contributed to the occlusal success rate in the two treatment groups. Among the components, the decision of premolars extraction was taken in cases with greater pre-treatment PAR scores of upper and lower anterior segments and a poor buccal segment occlusion. This indicates that cases presenting with a greater severity of malocclusion are more likely to undergo extraction treatment. At the same time, the percentage improvement of these components is greater for all first premolars extraction treatment, further validating the extraction decision.

The comparison of the mean post treatment PAR scores of each component in the non-extraction group reveals that better occlusal results were achieved in these patients. Specifically, the percentage improvement in the buccal segment occlusion was greater in the non-extraction group. This could be due to the high anchorage

considerations for premolar extraction cases and the consequent difficulty in obtaining ideal buccal segment occlusion. The overbite, overjet and midlines were corrected significantly in the both treatment protocols. Although the pre-treatment PAR scores of the individual components of the all first premolar extraction group were greater, the overall percentage improvement in PAR scores is similar to the non-extraction group. Freitas *et al*[21] and Holman *et al*[27] had greater mean pre-treatment PAR scores for cases which underwent all first premolars extracted in comparison to non-extraction treatment. The post treatment PAR scores achieved after the two treatment modalities by these studies are similar to the post treatment PAR scores achieved in this study. (Table-5)

The PAR index is universally accepted as an objective method for measuring malocclusion and provides a single score that represents the degree to which a case deviates from the normal occlusion. It has also been used for the assessment of pre-treatment and post treatment occlusion to identify treatment outcomes which indicates the improvement in dental occlusion.[28,29] In comparison to previous studies,[5,27,30] it can be seen that the mean percentage improvement in PAR scores for both treatment modalities was in the greatly improved category. (Table-5)

The severity of the orthodontic problem is well defined by the PAR index. It incorporates all of the dental attributes to an ideal finish of a case. The ability of the PAR index to identify minor changes in occlusion was explained by Birkeland *et al*.[31] It was stated that the PAR index is sensitive for small changes from the ideal intercuspation of all teeth from canine to third molars and consequently even small changes would affect the PAR index.[31] Richmond *et al*[12] has proposed that when the PAR value is smaller than or equal to five, the occlusion is almost perfect. We found that a non-extraction or all first premolar extraction approach can facilitate in attaining ideal occlusal characteristics as represented by the post treatment PAR scores.

The PAR index accurately assesses the occlusal characteristics but it does have a number of shortcomings. The index is not helpful in evaluating the changes in the soft tissues and facial profiles, the skeletal relationships, periodontal health, root resorption, and white spot lesions. Another very important factor which is not evaluated by the PAR index is the treatment duration. In order to determine treatment efficiency, we must minimize the time taken to achieve ideal occlusion. It is also not designed to assess the psycho-social well-being of the patient.[27,30]

CONCLUSIONS

This study investigates the improvement in occlusal characteristics after non-extraction treatment or all first premolar extraction treatment for class I malocclusion cases. The following conclusions can be drawn from the study:

- The patients who underwent non-extraction treatment and all first premolar extraction treatment had a mean percentage improvement in PAR scores that fell under the greatly improved category.
- The degree of improvement in occlusal characteristics was comparable in patients treated with non-extraction and all first premolar extraction.

AUTHORS' CONTRIBUTION

All authors were involved in study conception, design and planning. ATK performed data collection and analysis. Manuscript was approved by all the authors.

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