The Rate of Treatment Success among the Orthodontics Patients Based on the PAR index and related factors

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Abstract

Aim and Background:

Treatment success is one of the main concerns of orthodontists. Treatment outcomes may be assessed using various indices like the PAR index. The present study was conducted to evaluate the treatment success rate and the related factors in the Department of Orthodontics of the Dentistry School of Islamic Azad University based on the PAR index from 2009 to 2014.

Method and Materials:

The present cross-sectional study was among 100 eligible patients. The pre- and post-treatment casts were assessed by evaluating the archives through contact point displacement, buccal occlusion (anterior, posterior, transverse and vertical planes), vertical anomalies (open bite and deep bite), transverse anomalies (cross bite), anterior-posterior anomalies (over jet) and midline anomalies. Their pre-treatment casts were presented, examined and recorded along with the patients' time to the orthodontics department. The type of malocclusion, gender, and age were also rated based on the PAR index.

Results:

The present study was conducted on 200 pre-treatment and post-treatment study models obtained from 100 treated patients (32% males and 58% females). The participants had a mean age of 17.6±4.29 ranging from a minimum of 10.4 to a maximum of 33.6, among whom, 36% had extracted teeth and 54% did not. The mean duration of treatment was 2.3 years ± 0.6 months, with a minimum duration of 16 and a maximum of 48 months. 66% of the participants were suffering from CL I, 24% from CL II, and finally 10% from CL III malocclusion. The distribution of the patients' success and failure showed an 85% complete success (more than 70%), 13% relative success (30% to 70%) and 2% failure (less than 30%).

Conclusion:

The mean difference and reduction in the weighted PAR score was calculated as 21.3; while the mean reduction was 89.98%, revealing significant progress in the orthodontic treatments. A total of 85% of the cases were completely successful (more than 70%), 13% were relatively successful (30% to 70%) and 2% were unsuccessful (less than 30%), suggesting a standard treatment with very high quality. No significant difference was observed between the treatment success rate and the variables including age, gender, duration of treatment, having or not having extracted teeth and type of malocclusion.

Keywords: Assessment of orthodontic treatment, the PAR index, orthodontic treatment, fixed orthodontics.

Introduction

The aim in the orthodontic profession is to treat all the cases to gain results that are as excellent as possible (15). Success or failure in treatment is a major concern of orthodontists, especially those who are active within the system of education (1), since there has always been an excuse for having a resident to perform the operation and in this regard no place for the patients' complaint. Orthodontics has inherent demands, requiring regular appointments and active patient engagement, although little is established towards the treatment completion rate and possible factors affecting successful completion (14). There is no established criterion for the assessment of orthodontic treatments and this assessment is carried out based on the orthodontists' subjective opinions and experiences(2). Having a criterion to assess is so vital that, in some countries, insurance contracts are drafted based on it (3). The Index of Treatment Need (IOTN) and the Occlusion Index can be used for the assessment of treatment outcomes (4). The IOTN is an epidemiological indicator based on the individuals' treatment needs. However, given its use in epidemiological studies with large sample sizes, occlusion details are often overlooked in this index. In contrast, the PAR index is a more accurate criterion that compares different occlusion details against the ideal conditions (4). Ever since Richmond's emphasis on the importance of becoming informed about failure rates and the choice of the PAR index for the assessment of treatments, this index has been widely used across the UK and Europe (5) and a specific score has been assigned to all the occlusal anomalies of a malocclusion (5). The PAR index has become more popular compared to the Occlusal Index, perhaps due to its clear, exact definitions and its special ruler (the PAR ruler) for improving treatment assessment. Considering the PAR assigned score indexes for each occlusal parameter, there is a possibility, for it, in the assessment of a variety of malocclusions and different modes of treatment. Moreover, it has shown a high level of repeatability (R>0.91) and reliability (r=0.85) (5). The PAR index have also produced a standard, valid and reliable assessment of treatments and thus enables a uniform interpretation of them (1). A standard treatment requires a mean reduction of about 70% in the PAR score (6).

Assessment of orthodontic treatment outcomes could not only help to establish standards but also helps clinicians to learn from their previous treatments (17). For the time being the available information about the assessment of success rate using this method is dispersed and limited to studies conducted abroad (except for one domestic study). An assessment indicating a high rate of treatment failure undermines the assistants, professors and the entire orthodontics education system besides a great waste of time, energy and money.

Maxillary canines are the most involved teeth that can undergo impaction after the third molars. A combined orthodontic-surgical treatment is commonly used to guide the favorably located impacted canines into their normal positions (16). The present study was conducted to answer the following three questions: If the PAR index indicate treatment failure among the patients admitted to the Orthodontics Department of the school or not? If so, what the rate of failure in this regard is and what factors can affect the success or failure rate of treatments? Yet, these questions have not been fully addressed in the Orthodontics Department of this school or anywhere else in Iran, the given previous study shortcomings (will be explained in the discussion) a countrywide information gap on the success rate of fixed orthodontics, since the arrival of assistants into the school, the present study sought to investigate the orthodontic treatment success rate at the Orthodontics Department of the Dentistry School of Islamic Azad University between 2009 and 2014 in 100 patients by examining their pre- and post-treatment study models.

Method and Materials:

The present descriptive cross-sectional study was conducted on 200 intact pre- and post-treatment casts obtained from 100 eligible patients who were referred to dental assistants for fixed orthodontic treatments between 2009 and 2014. Sampling was conducted through the census method by visiting the school archives and reviewing the records of patients whose casts could be accessed. Indices including contact point displacement, buccal occlusion (the anterior, posterior, transverse and vertical planes), vertical anomalies (open bite and deep bite), transverse anomalies (cross bite), anterior-posterior anomalies (over jet) and midline anomalies were assessed by the pre-treatment casts and then recorded in data form 1 along with the patients' time of presenting to the orthodontic department, type of

malocclusion, gender and age. Each patient was assigned a code and post-treatment casts were examined and recorded in data form 2.

A specific score was assigned to different problem levels or lack of it based on the PAR index including:

Contact point displacement: The dental arch was divided into 3 points, including left buccal, right buccal and the anterior areas. Contact point displacement was rated as 0 for a displacement of 0-1mm, 1 for 1.1-2mm, 2 for 2.1- 4mm, 3 for 4.1-8mm, 4 for >8 mm and finally 5 for impacted teeth and were recorded for both jaws and then added together.

The buccal area: Measurement began from the distal contact point of the canine to the mesial contact point of the first permanent molar in the same side.

Anterior area: The anatomical distal contact point of the canine was measured from one side to the opposite and it was then recorded. In case of missing canine, a discrepancy is estimated due to an extend from the mesial of the first premolar to the distal of lateral incisor. When the space available for tooth eruption was 4mm or less, the tooth was considered impacted and rated 5. Non-erupting teeth, palatal, lingual and buccal teeth erupting outside the arch, due to insufficient space, were also considered impacted. An erupted and displaced tooth was rated 1 to 4. Contact points were not recorded for the deciduous teeth. If there was no potentiality of crowding during the mixed dentition, a lack of space would be estimated at 8 mm for the Maxillary canine, 7 mm for the first and second premolars and 7 mm for the mandibular premolars and canines. When the patient wanted to replace the space of the extracted teeth with prosthesis, we neither paid attention nor recorded it; although, it was much the better for the space to be closed and recorded.

If contact displacement of the teeth was the result of faulty restoration and crown, it would not be recorded.

Buccal occlusion assessment: In cases of tooth occlusion, an assessment was made on both sides of the tooth from the canine to the posterior as follows:

The anterior-posterior plane: Good inter digitation of CL I, II and III=0, discrepancy of less than a half unit=1 and discrepancy of a half unit=2.

The vertical plane: Absence=0 and a lateral open bite exceeding 2mm, in at least two teeth, =1

The transverse plane: Absence of cross bite=0, tendency to cross bite=1, single tooth cross bite=2, multiple tooth cross bite=3 and more than one scissor bite =4.

Over jet measurement: The over jet was measured from one side of the lateral tooth to the opposite side (a canine cross bite is conventionally taken to be in the anterior segment) and rated as follows: 0-3mm=0, 3.1-5mm=1, 5.1-7mm=2, 7.1 to 9mm=3 and >9mm=4.

Anterior cross bite: Absence=0, one or more teeth of edge-to-edge occlusion =1, single tooth cross bite=2, double tooth cross bite=3 and multiple tooth cross bite=4. As an example, the casts with two upper central teeth and two lower central teeth had a 4mm over jet, upper lateral teeth with the lower lateral teeth that were in cross had an over jet of 1 and the anterior cross bite rated 3.

Overbite measurement: An overbite is the overlapping of the lateral teeth from one side of the maxilla to the opposite side to the mandibular teeth. The teeth with the greatest overlap were recorded as follow:

Open bite: absence=0, $\geq$1mm=1, 1.1-2mm=2, 2.1 to 4mm=3 and $\leq$4mm=4

Overbite: Lower anterior teeth overlapping $\geq$1/3=0, overlapping between one third and two thirds of the lower anterior teeth =1, overlapping of more than two thirds of the lower anterior teeth =2 and overlapping of all or most of the crown of the lower anterior teeth =3.

Assessment of the midline, the mandibular central incisors was measured, and no measurement was recorded when one mandibular central incisor was extracted. Measurements and ratings were as

follows: Coinciding with the midline and up to one fourth of the width of the lower central incisor=0, between one fourth to half of the width =1 and equal to or more than half the width =2.

Each weighed parameter was rated as follows: Contact point displacement and buccal occlusion=1, over jet and anterior crossbite=6, overbite and open bite=2 and midline measurement=4.

Success rate was determined by comparing the mean and the standard deviation of the pre- and post-treatment PAR index. A success rate of higher than 70% represented a complete successful treatment, a rate between 30% - 70% illustrated a relatively successful treatment and a rate less than 30% showed a treatment failure.

The Chi-square test was implemented to assess the prevalence of unacceptable casts, the failure to fill out form 2 and the treatment success rate and it was evaluated as very good, good to bad and it also determined the role of all the related factors.

Results:

The present study was conducted on 100 patients (a total of 200 pre- and post-treatment casts), 32% of whom were male and 58% female. The participants had a mean age of 17.6 ± 4.29 years, Ranging from 10.4 to 33.6. 36% had at least one extracted tooth while 54% none. Their mean duration of treatment was 20.6 ± 2.3 months, Ranging from 16 to 48 months. A total of 66% of the participants were suffering from CL I malocclusion, 24% CL II and 10% CL III. Figure 1 represents the patients' distribution in terms of success rate, showing that 85% of the treatments were fully successful (more than 70%), 13% showed a relative success (between 30% to 70%) and 2% (less than 30%) failed. With the respect to the fact that, 15% of the cases indicated a treatment failure, the actual rate of treatment failure was estimated to be between 8% to 22% with a confidence interval of 95%.

Figure 1: The distribution of the patients admitted to the Orthodontics Department of the Dentistry School of Islamic Azad University between 2009 to 2014 based on the success rate of PAR index and related factors**.**
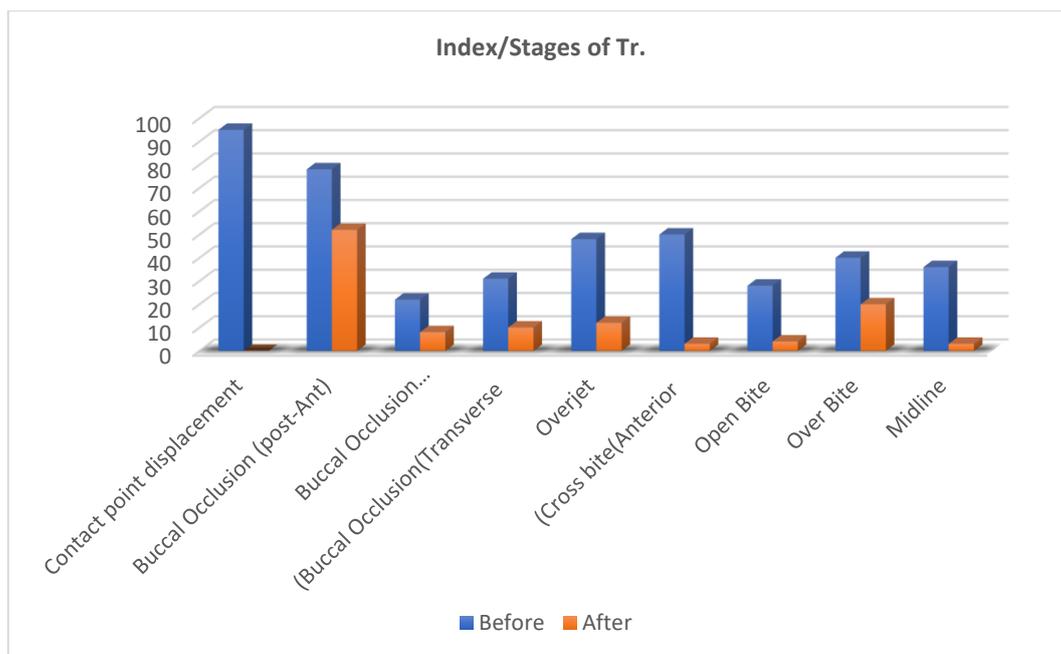
Figure 2: Distribution rate of 100 patients based on their pre- and post-treatment PAR index

Table 1: Distribution rate of the orthodontics patients based on their pre- and post-treatment PAR index

Index / Stages	Midline	Over Bite	Open Bite	Anterior Cross bite	Over jet	Buccal Occlusion (Transverse)	Buccal Occlusion (Vertical)	Buccal Occlusion (Ant-Post)	Contact point displacement
Before	36	40	28	50	48	31	22	78	95
After	3	20	4	3	12	10	8	52	0
Result	P<0/01	P<0/01	P<0/001	P<0/001	P<0/001	P<0/01	P<0/05	P<0/001	P<0/0005

Table 1 represents patients' distribution based on pre- and post-treatment PAR index by their conditions:

Contact point displacement which existed in 95% of the patients before the treatment, was reduced to 0 after the treatment, comprising a statistically significant difference according to Fisher's Exact Test (P<0.0005).

A total of 78% of the patients with **anterior-posterior** problems in **buccal occlusion**, wasreduced to 58% after the treatment (P<0.001).

A total of 22% of the patients with **vertical problems** in **buccal occlusion**, was reduced to 8% after the treatment (P<0.05).

A total of 31% of the patients with **transverse** plane in **buccal occlusion**, was reduced to 10% after the treatment (P<0.01).

Over jet was observed in 48% of the patients; while, the number was reduced to 12% after the treatment (P<0.001).

Anterior cross bite was observed in 50% of the patients, but the number was reduced to 3% after the treatment (P<0.001).

Open bite was observed in 28% of the patients, but the number was reduced to 4% and the condition severity decreased after the treatment (P<0.001).

Overbite was observed in 40% of the patients, but the number was reduced to 20% after the treatment (P<0.01).

The **midline** assessment showed a deviation in 36% of the patients, but the number was reduced to 3% after the treatment (P<0.01).

Table 2: Patients' distribution by success rate and related factors

Success Rate / Related Factors	yes $N_1=85$	No $N_1=15$
Sex		
Male	29(34.1)	4(26.7)
Female	56(65.9)	11(73.3)
Age		
Before Growth	30(35.3)	4(26.6)
After Growth	55(64.7)	11(73.4)
Extracted		
yes	30(35.3)	6(40)
No	55(64.7)	9(60)
Time of treatment		
Less than 2 year	18(21.2)	4(26.7)
More than 2 year	67(78.8)	11(73.3)
Type of malocclusion		
CI I	57(67.1)	(60)9
CI II	20(23.5)	4(26.7)
CI III	8(9.4)	2(13.3)

Table 1 represents patients' distribution by success rate and the related factors. It shows 15 cases of treatment failure which accounts for 11 female (73.3%), 85 cases of treatment success which accounts for 56 female (65.9%). However, the Chi-square test showed that the difference was not statistically significant (P<0.9). No difference was observed between the cases of treatment success or failure in terms of age (before and after growth spurt), having extracted teeth, duration of treatment and type of occlusion, or if there was any difference, it was not statistically significant (P<0.8).

Discussion:

The success rate at the Orthodontics Department of School of Dentistry showed the standard of 89.9% reduction in the PAR index, suggesting that this standard treatment was performed by a group of dental assistants under the supervision of experienced professors. Compared with a study conducted by S.S. Gasgoos (7) with a similar sample size, very good treatment results, non-random sample selection and with a reference to samples with the highest rate of recovery, the achieved success rate was successfully done by the Orthodontics Department of Dental Faculty in Islamic Azad University. In a study conducted by Ahmad Nazir (2010) in Pakistan, the weighted PAR was reported to be reduced by 92.2% [1]. In a study conducted in the US, J. K. Holmann reported a reduction by 79.41% in the PAR index of an extraction group and a 77.63% in a non-extraction group. Similarly, the weighted PAR index had a reduction of 76.9% in a study conducted by Birkeland (1997) (8), 70% in a study by Piskorski (9), 66% in a study by Fox (10) and finally 86.2% in a study by Chukwudi (11).

Dyken (4) reported a reduction of 87.9% in the PAR index for the board-accepted cases and a reduction of 81.7% for the graduate students. The difference may be attributed to the use of fixed braces, which allows a greater control of tooth movement; also, the department assistants and professors' attentive care who were treating the patients.

Richmond classifies changes of the PAR index into three groups, including "greatly improved", "improved" and "worse or no difference". In the present study, 85% of the cases showed a fully successful treatment (greatly improved), 13% showed a relative successful treatment (30-70% or improved) and 2% a treatment failure (less than 30% or worse). Ahmad Nazir(1)also used this classification in his study and reported that 60% of the cases greatly improved, 38% improved and 2% were not improved at all. The number he reported for failed treatments was equal to the number he reported for cases that became worse in our present study, with a difference that his reserarch had a sample size of 50 (1). Kerr (12) reported 89.3% of the examined cases have greatly improved and improved. 10.7% have become worse or there was no difference. In T_1 and T_2, Birkeland reported 52.2% of the cases greatly improved, 44.7% improved and 3.1% became worse. In the study by Piskorski, 18% of the treated patients greatly improved, 73% improved and 9% became either worse or showed no difference (9). Fox reported 41% of the patients greatly improved, 47% improved and 12% became worse or were not different (10). In a study by Onyeaso (11), 50% of the patients greatly improved, 47% improved and 3% became worse or showed no difference. In a study conducted by Dr. Abtahi with patients who were treated by dentistry students, using removable appliances only 4.3% of the patients were greatly improved, 57.1% improved and 38.6% became worse or showed no difference.

The mean pre- and post-treatment PAR index obtained in the present study was 23.67 and 2.07, respectively. These figures were 24.06 and 1.5 in the study by Ahmad Nazir(1), 28.7 and 6 in the study by Birkeland (8) and, in a study by Dyken, 27.9 and 3.1 for the board-accepted cases and 25.6 and 4 for the graduated students.

The obtained results showed a significant relationship between the weighted pre- and post-treatment PAR index, with the greatest change occurred in cases with CLI malocclusion (67.1%), which was consistent with the results obtained by S. S. Gasgoos (97.2%) and inconsistent with the results obtained by K. Birkeland, who examined 224 cases and reported the greatest success that occurred in the cases with CL II division 2. Taking this matter into consideration, it was realized that anterior crowding (weighted X1)has a great effect on over jet(weighted X6), and also the lack of relationship between malocclusion classes (CL I, II and III) and success rate. Therefore, the best results can be occurred in cases of CL I malocclusion compared to cases of CL II and III malocclusions, which is consistent with the results obtained by W. J. Kerr (12). No significant relationship was observed in the present study between gender and success rate, which is consistent with the results of studies conducted by S. Richmond (6), Ahmad Nazir(1) and S. S. Gasgoos(7). In the study by Birkeland, the differences were not reported by gender; however, age was found to be related to success rate. In contrast, S. Richmond(6) and S. S. Gasgoos(7) reported no significant relationship between success rate and age or growth period, which is consistent with the results of the present study.

The duration of treatment and tooth extraction were the two parameters that showed no relationship with success rate in the present study, which is consistent and the same with the results obtained in the studies conducted by Ahmad Nazir (1), K.Birkeland (8), S. S. Gasgoos (7) and S. I. Robb (13) that had the same impact on duration treatment in adults and adolescents. S. S. Gasgoos (7) found no significant relationship between the duration of treatment and its outcomes, but he reported a significant relationship between the duration of treatment and the success rate in cases with CL I malocclusion, with no extracted teeth and a treatment duration of 14.4 months, compared to cases with CL II and III malocclusions with a treatment duration of 21.25 months with extracted teeth. S. I. Robb reported a duration treatment of 30.6±8.8 months in adults and 29.4±8.8 months in adolescents, suggesting no significant relationship (P>0.05), which is inconsistent with the results obtained by R. A Dyken(4).

The limitations of the present study included lack of acceptable study models and no conformity with patients' age.

The researchers recommend further studies to assess orthodontic treatments performed by the general dentistry students of school based on the PAR index and also re-assessing treatment outcomes in the patients who were treated by the school's graduate students within a few coming years.

Conclusion:

The mean difference and reduction in the weighted PAR score was reckoned as 21.3; while, the mean reduction was 89.98%, showing an outstanding significant and improvement in the orthodontic treatments. A total of 85% of the cases were completely successful (more than 70%), 13% were relatively successful (30% to 70%) and 2% were failures (less than 30%), suggesting a standard treatment with a very high quality. There was no significant difference between the treatment success rate and variables such as age, gender, duration of treatment, extracted or not extracted teeth and sort of malocclusion.

Acknowledgments:

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