Treatment results in dental school orthodontic patients in 1983 and 1993

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Abstract: The effect of incremental changes in materials and techniques on orthodontic treatment outcomes is difficult to evaluate objectively. Treatment results for two groups of patients whose treatments were completed approximately 10 years apart were evaluated using the peer assessment rating (PAR) index and the index of orthodontic treatment need (IOTN) using the Wilcoxon matched-pairs signed-rank test. Patients in the later group who had been treated by postgraduate students primarily (using fixed appliances) had significantly lower IOTN and PAR scores at the end of treatment and showed a significantly greater reduction in the PAR score than a similar group of patients in the earlier group. There were no significant differences in treatment results between patients in the early and late groups who were treated with removable appliances. Differences in treatment results were most likely the result of changes in materials and techniques that had occurred in the 10 intervening years.

Key Words: Orthodontic treatment results, PAR, Peer assessment rating index, IOTN, Index of orthodontic treatment need

In general, indices have been used in orthodontics to either assess the need for treatment or to evaluate the effect of treatment. The index of orthodontic treatment need (IOTN), developed to record treatment need, consists of two components.[1] The first, the aesthetic component (AC), categorizes need for treatment on aesthetic grounds, while the second, the dental health component (DHC), examines need from a dental health perspective. The index has been applied to a sample of children in the United Kingdom and to a sample of patients treated in the General Dental Service and Hospital Orthodontic Service in England and Wales.[2-4]

The peer assessment rating (PAR) index was developed to provide a summary score for occlusal anomalies and provide an estimate of how far a case deviates from normal alignment and occlusion.[5] The PAR index has been weighted to match the judgment of a panel of British orthodontists and general dentists on the deviation of a case from normal.[5] The qualitative categories ("greatly improved," "improved," and "worse or no difference") used to describe and categorize treatment outcome have also been matched to the evaluation of treatment results by the same panel of British orthodontists and general dentists.[6]

The PAR index has been used to evaluate treatment standards among general practitioners and orthodontic specialists, to evaluate the results of treatment with fixed and removable appliances, and to compare treatment using different types of fixed appliances.[2,3,6-10]

In general, evaluations with these and other indices have concentrated on a fixed point in time. Few investigators have evaluated the need for treatment or treatment results over time.[11-12] The purpose of the present study was to investigate the objective need for treatment and the treatments results for two groups of patients who were treated in a dental school orthodontic clinic approximately 10 years apart. Further aims were to investigate factors predictive of change in PAR score and the length of treatment. A final aim was to investigate the change in the separate components that constitute the PAR index score.

Materials and methods

Two groups of patients were identified for the study. Patients in the first group had been discharged from recall in the clinic (Department of Orthodontics, School of Dentistry, University of Bern) in 1983 and the second group, 10 years later, in 1993. Patients were included in the study if a complete record of treatment in-

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dicating that the patient had completed therapy was available, along with plaster models of the pretreatment and end of active treatment occlusion. Patients were excluded from the study if they had not received active treatment, if therapy had been interrupted either by the patient or by the operator, if surgery was planned but not completed, or if the primary complaint was pain or dysfunction. There were 128 patients in the 1983 group and 104 in the 1993 group. The groups of patients were further divided, based on the kind of treatment they had received. Patients whose treatment, primarily with fixed appliances, was delivered by postgraduate students during their orthodontic training in 1983 numbered 95; those similarly treated in 1993 numbered 70. The remaining patients, 33 and 34, respectively, were treated by dental students using primarily removable appliances (including headgear and functional appliances) and minor fixed appliances (mainly lingual arches). The age at the start of treatment and the sex of the patients are summarized in Table 1.

The IOTN and the PAR index were used to evaluate the pretreatment models and the end of active treatment models.[1,5,6] The IOTN was used to determine if the need for treatment/severity of the malocclusion for cases treated in the clinic had changed over time and to check whether treatment had in fact reduced the objective need for treatment. The PAR index was used to quantify the extent of malocclusion at the beginning of treatment and after treatment. In addition, the PAR index was used to quantify and categorize the change in the patient's occlusion as a result of treatment. In addition, the age and sex of the patients, the type of appliance(s) used (fixed, removable, or both), extraction of permanent teeth, and the duration of active treatment were recorded. The extent of pretreatment malocclusion

Table 1
Age and sex distributions for the 1983 and 1993 patient groups

	Sex	N	Percent	Mean age (S.D.)
1983	Male	63	49.2	12.0 (2.7)
	Female	65	50.8	11.8 (2.2)
	Total	128	100.0	11.9 (2.5)
1993	Male	53	51.0	12.6 (5.0)
	Female	51	49.0	12.6 (4.6)
	Total	104	100.0	12.6 (4.8)

Table 2
Mean (S.D.) for selected variables for patients treated by postgraduates. N=95 and 70 for 1983 and 1993, respectively

Parameter	Mean (S.D.) 1983	Mean (S.D.) 1993	Signif.
IOTN			
Aesthetic component			
Pretreatment	6.5 (2.0)	6.1 (2.0)	ns
Posttreatment	2.3 (1.1)	1.7 (1.0)	0.0001
Change	-4.2 (2.1)	-4.4 (2.0)	ns
Dental health component			
Pretreatment	4.1 (0.8)	3.9 (0.7)	ns
Posttreatment	2.4 (0.8)	2.1 (0.5)	0.0021
Change	-1.6 (1.0)	-1.8 (0.8)	ns
PAR index score			
Pretreatment	25.0 (9.9)	24.8 (9.1)	ns
Posttreatment	8.3 (5.5)	5.3 (4.8)	0.0001
Change	-16.7 (10.3)	-19.5 (9.4)	0.046
Age at begin (years)	12.0 (2.6)	13.6 (5.5)	ns
Treatment duration (years)	3.3 (1.6)	3.3 (1.5)	ns

Table 3
Mean (S.D.) for selected variables for patients treated by dental students. N=33 and 34 for 1983 and 1993, respectively

Parameter	Mean (S.D.) 1983	Mean (S.D.) 1993	Signif.
IOTN			
Aesthetic component			
Pretreatment	5.5 (2.0)	5.7 (2.0)	ns
Posttreatment	2.5 (1.0)	2.1 (0.9)	ns
Change	-3.0 (1.9)	-3.6 (2.0)	ns
Dental health component			
Pretreatment	3.7 (0.7)	3.8 (0.7)	ns
Posttreatment	2.5 (0.6)	2.6 (0.8)	ns
Change	-1.2 (0.9)	-1.2 (0.9)	ns
PAR index score			
Pretreatment	21.0 (6.9)	21.3 (8.0)	ns
Posttreatment	10.2 (4.7)	8.4 (5.0)	ns
Change	-10.7 (8.1)	-12.8 (8.8)	ns
Age at begin (years)	11.3 (1.9)	10.7 (1.6)	ns
Treatment duration (years)	2.6 (1.6)	2.8 (1.6)	ns

Table 4
Dental health component grade. Percent of patients in each group

DHC grade	Postgraduate				Dental student				All	
	1983		1993		1983		1993			
	Begin	End	Begin	End	Begin	End	Begin	End	Begin	End
1	0.0	4.1	0.0	2.9	0.0	0.0	0.0	0.0	0.0	2.6
2	4.1	59.2	4.4	84.1	6.7	56.7	2.9	60.0	4.3	66.4
3	14.3	25.5	15.9	10.1	23.3	36.7	22.9	17.1	17.2	21.1
4	52.0	10.2	63.8	2.9	66.7	6.7	62.9	22.9	59.1	9.5
5	29.6	1.0	15.9	0.0	3.3	0.0	11.4	0.0	19.4	0.4

Table 5
Degree of improvement in PAR index score after orthodontic treatment. Percent of patients in each group

Change	Both groups (1983 + 1993)			Both operators (Postgrads + students)		Postgraduates		Students	
	Postgrads + students	Post-grads	Students	1983	1993	1983	1993	1983	1993
Worse/no difference	12	8	22	13	11	10	6	23	20
Improved	61	59	66	63	57	62	54	67	65
Greatly improved	27	33	12	24	32	28	40	10	15

in extraction cases was compared with that in nonextraction cases using the PAR index. Two examiners previously trained and calibrated in the use of the IOTN and the PAR index evaluated all the models. Means and standard deviations were calculated for all the appropriate parameters. The Student's *t*-test and the Wilcoxon matched-pairs signed-rank test were used to compare groups. Statistical significance was set at $p<0.05$.

Possible predictors of change in PAR index score after orthodontic therapy and treatment duration were investigated using multiple regression to identify significant variables (GLM, SAS Institute, Inc, Cary, NC). Initial PAR score, sex, and level of education of operator have been reported to be highly correlated with change (reduction) in PAR score, so these factors, as well as age, type of appliance, initial IOTN dental health component (DHC) scores, and the extraction of permanent teeth, were included in the analysis.[9,13,14] The analysis was carried out for all groups of subjects (postgraduate and dental student operators for both 1983 and 1993 groups) and for all subjects pooled. In the analysis of the pooled subjects, the factor "group" (1983 or 1993) was also included.

Factors included in the analysis of duration of active treatment included the initial PAR and IOTN scores, level of operator education, (postgraduate or dental student), type of appliance (fixed or removable), the use of extraction therapy, age, sex, and dental stage. Dental stage was defined as either (a) the presence of some or all permanent incisors, (b) the presence of some permanent canines or premolars, or (c) the presence of all permanent incisors, canines, and premolars.

The errors of the method for the recording of the PAR index were evaluated from double recordings of 16 randomly selected cases. Casts from the beginning and from the end of treatment of each case were evaluated a second time; 32 double recordings were analyzed. The random or accidental error for the weighted and unweighted PAR index scores was evaluated with the formula

$$S_i = \sqrt{\frac{\sum d_i^2}{2n}}$$

where d is the difference between the double determinations and n is the number of double determinations.[15] A further measure of the reliability of the measurements, the intraclass correlation coefficient, was calculated from the 32 duplicate PAR scores.[16] In addition, the Kappa statistic was evaluated for IOTN scores and for the individual components of the PAR score for the 32 duplicate recordings in order to evaluate the reproducibility of the method.[17]

Results

From the 32 double recordings the s_i value was 0.73 for the unweighted total PAR index and 1.66 for the weighted total PAR index. There was no systematic bias between the two sets of PAR scores for the double recordings, and the intraclass correlation coefficient was 0.98. Kappa scores for components of the PAR index ranged from 0.55 (anteroposterior discrepancies in the posterior segments) to 1.0 (vertical discrepancies in the posterior segments). Kappa for the IOTN scores was 0.46 for the aesthetic component and 0.91 for the dental health component.

The values for the parameters pre- and posttreatment are presented in

Table 6
Mean pre- and posttreatment values, mean change in value, and mean change in value as a percent of pretreatment value and as a percent of the change in PAR score for the individual weighted components of the PAR score for all groups

	Displacement		Posterior segment			Overjet	Overbite	Midline
	Max	Mand	A-P	Trans	Vert			
1983 Postgraduate, N=95								
Pretreatment	3.3	1.6	1.2	0.4	0.0	12.1	2.3	2.2
Posttreatment	0.7	0.6	1.1	0.2	0.0	2.7	1.1	0.6
Change	-2.7	-1.0	-0.1	-0.3	0.0	-9.4	-1.2	-1.6
Change (%):								
Pretreatment	62	30	1	25	0	64	40	37
Change in PAR	18	4	1	2	3	47	10	8
1993 Postgraduate, N=70								
Pretreatment	3.4	2.4	1.2	0.5	0.0	11.8	2.3	1.3
Posttreatment	0.3	0.3	1.0	0.1	0.0	1.9	0.7	0.1
Change	-3.4	-2.2	-0.2	-0.4	0.0	-9.9	-1.6	-1.1
Change (%):								
Pretreatment	74	59	6	27	0	74	50	30
Change in PAR	19	10	1	3	1	34	14	5
1983 Dental students, N=33								
Pretreatment	3.0	1.0	1.2	0.2	0.0	12.2	2.0	0.7
Posttreatment	1.2	1.0	1.1	0.1	0.0	4.2	1.5	0.5
Change	-1.8	-0.0	-0.1	-0.1	0.0	-8.0	-0.5	-0.2
Change (%):								
Pretreatment	48	8	8	19	0	51	21	15
Change in PAR	16	12	4	0	0	53	12	1
1993 Dental students, N=34								
Pretreatment	2.4	0.9	1.2	0.2	0.0	12.7	1.8	0.6
Posttreatment	0.4	0.8	1.0	0.2	0.0	2.8	1.9	0.2
Change	-2.0	-0.2	-0.2	-0.0	0.0	-9.9	0.1	-0.4
Change (%):								
Pretreatment	63	5	9	8	0	69	14	12
Change in PAR	12	5	3	4	1	76	9	4

Tables 2 and 3 for postgraduate and dental students, respectively. Distribution of the dental health component scores for all patients are presented in Table 4.

There were no statistically significant differences between the groups at the beginning of treatment for any of the parameters (Tables 1 to 3). At the end of treatment, for patients treated by dental students, there were no statistically significant differences between the 1983 group and the 1993 group for any of the parameters investigated. The relatively small size of the groups treated by dental students and the minimal differences between the two groups suggest that the results should be viewed conservatively. Larger treatment groups may have shown a significant difference in final PAR scores. For the patients in the 1993 group treated by the postgraduate students, there was a significantly lower final IOTN score (DHC and AC), lower final PAR index score, and reduction in PAR score compared with patients in the 1983 group. There were no other significant differences between the groups for the parameters measured. The results of treatment for the groups as characterized by the PAR nomogram are presented in Table 5.[6]

The mean values for the individual components of the PAR score and the mean change in the components during treatment are given in Table 6. In the present case material, there were practically no problems with posterior vertical discrepancies. The mean change in the individual components as a percent of the pretreatment values and the mean change in the components as a percentage of change in PAR score during treatment are also presented in Table 6. For percent of the pretreatment score and for percent change in PAR score, the greatest changes were: decrease in overjet > decrease in maxillary anterior displacement (crowding/spacing) > decrease in overbite (Table 6).

The results for all cases in 1993 (N = 104) for changes in anterior displacement (crowding and spacing), transverse posterior malocclusion (crossbite and buccal nonocclusion), and anterior vertical malocclusion (openbite and deepbite) are presented in Table 7.

There were no significant differences in pretreatment PAR scores for

nonextraction cases compared with extraction cases for cases treated by student operators or for cases treated by graduate students (Table 8). For all cases pooled there was a statistically significant greater pretreatment PAR score for extraction cases, although the difference was small.

The models for predictors of change in PAR score (= posttreatment PAR score - pretreatment PAR score) for the four subgroups yielded pretreatment PAR score, pretreatment DHC, age, and sex as significant factors and R-square values of 0.73 to 0.96. For predictors of change in PAR scores during treatment for all patients pooled, the model developed had an R-square of 0.78. The significant predictors in the final model were the pretreatment PAR score, sex, and group. Patients with a high initial PAR score and females demonstrated a greater absolute change (improvement) in the PAR score (Table 9).

For the predictors of treatment duration, the model developed had an R-square of 0.38; significant predictors in the final model were type of appliance, developmental stage, and age (Table 10). The use of both removable and fixed appliances in the same patient resulted in the longest treatment time, and the use of removable appliances only resulted in the shortest treatment time. The younger the patient and the earlier the dental developmental stage, the longer the duration of treatment. Beginning treatment in the early mixed dentition, i.e., before the loss of deciduous canines or molars, added significantly to the length of treatment.

Table 7
Selected components of initial malocclusion and their status after treatment for the 1993 group of patients. N = 104

	Pretreatment	(N)	Posttreatment (N)	
OK	Crowding	81	Aligned	62
			Crowding	14
			Spacing	5
	Spacing	12	Aligned	7
			Crowding	0
			Spacing	5
	Aligned	11	Aligned	10
			Crowding	1
			Spacing	0
UK	Crowding	66	Aligned	47
			Crowding	19
			Spacing	0
	Spacing	6	Aligned	2
			Crowding	1
			Spacing	3
	Aligned	32	Aligned	21
			Crowding	11
			Spacing	0
	Crossbite (left and/or right)	33	Aligned transverse	24
			Crossbite	9
			Nonocclusion	0
	Buccal nonocclusion (left and/or right)	1	Aligned transverse	1
			Crossbite	0
			Nonocclusion	0
	Aligned transversely (left and/or right)	70	Aligned transverse	62
			Crossbite	8
			Nonocclusion	1
	Deepbite (PAR ≥ 2*)	23	Aligned vertical	22
			Deepbite	1
			Openbite	0
	Openbite (PAR ≥ 1***)	10	Aligned vertical	9
			Deepbite	0
			Openbite	1
	Aligned vertically (PAR ≤ 1** deepbite)	71	Aligned vertical	66
			Deepbite	4
			Openbite	1

*Greater than 2/3 of the buccal surface of the mandibular incisor is covered
**Up to 1/3 of the buccal surface of the mandibular incisor is covered
***Greater than 1 mm openbite.

Discussion

This study investigated the need for orthodontic treatment and the treatment results for two groups of patients discharged from the Department of Orthodontics, University of Bern, in 1983 and 1993. There were no significant differences in the need for treatment of the two groups of patients at the beginning of treatment (Tables 2 and 3). The two components of the IOTN indicated a need for treatment. The mean DHC rating for the two groups was approximately 4, slightly lower for patients treated by dental students (Table 3), indicating a great need for treatment.[1,2] The mean aesthetic component was 6 for patients treated by the postgraduate students and approximately 5.5 for patients treated by the dental students. Grades 5 to 7 have been characterized as indicating a moderate/borderline need for treatment.[18]

The mean PAR index scores at the beginning of treatment for both groups were approximately 25 and 21 for the patients of the postgraduates and dental students, respectively. The beginning PAR score for

the postgraduate group, 25, is lower than the beginning scores reported by other investigators for groups of patients treated with fixed appliances and four premolar extraction (PAR score 32) or preadjusted edgewise or Begg appliances (PAR score 30).[6,7] In the present study, there were no significant differences in beginning PAR scores between extraction and nonextraction cases for dental student and postgraduate operators (Table 8). There was a difference in pretreatment PAR scores, extraction versus nonextraction, when all cases were pooled, but this was because most of the patients treated by the dental students were simpler, i.e., they had lower PAR scores and could be treated nonextraction (Table 8).

Table 8
Pretreatment PAR scores (SD) for nonextraction and extraction cases for dental student, graduate student cases, and all cases pooled

	N	Pretreatment PAR	Signif.
Student cases			
Extraction	10	21.85 (9.42)	n.s.
Nonextraction	57	21.09 (7.30)	
Graduate cases			
Extraction	83	26.11 (10.25)	n.s
Nonextraction	82	23.64 (8.51)	
All cases			
Extraction	93	25.78 (10.21)	
Nonextraction	139	22.60 (8.11)	0.013

Posttreatment, there were no significant differences in any of the parameters measured for the groups of patients in 1983 and 1993 whose treatment was delivered by dental students. The final DHC and AC grades indicate little or no need for further orthodontic treatment (Table 3). The scores are comparable to those reported by the General Dental Service in England and Wales for patients treated with removable appliances in both arches.[2] The final mean PAR index score and the percent reduction in PAR score are comparable to the results obtained by others using removable appliances.[2,3]

Posttreatment, for those patients treated by postgraduate students, the final DHC and AC grades indicate little or no need for further orthodontic treatment (Table 2). The final PAR scores of 8.3 and 5.3 for 1983 and 1993, respectively, are comparable to results reported for an orthodontic specialist using fixed appliances and for graduate students in Norway using fixed appliances.[7,10] The mean percent reductions in PAR scores of 63% and 73% for 1983 and 1993, respectively, are comparable to the 71% to 78% reported in the literature for patients treated with fixed appliances in both arches in England and Wales and in Norway.[2,3,6,10]

Richmond and coworkers suggested that in order for a practitioner to demonstrate high standards in cases in great need of treatment, the mean percentage reduction in PAR should be high (greater than 70%), the percentage of cases that are greatly improved should also be high (greater than 40%), and the number of cases in the "worse-or-no-difference" category should be negligibly small.[6] It might appear from the nomogram results (Table 5) that in the present study, although the results as characterized by the percent reduction in PAR score were satisfactory, too many posttreatment cases were classified as "worse or no difference."

In order for a case to be classified as "greatly improved" at the end of treatment, it must have had a beginning PAR score of at least 22.[6] Moreover, even small changes in the PAR score due to error or bias can lead to marked changes in the results of the nomogram evaluation.[7] Other investigators have demonstrated that when the initial IOTN dental health component is 3 or less there is less improvement in the PAR nomogram compared with cases with DHC scores of 4 or 5.[7] In the present study, beginning DHC grades were 3 or below for 18% to 20% of the postgraduate cases and 26% to 30% of the dental student cases (Table 4). Thus, in the opinion of the authors, while the relatively large number of cases in the "worse-or-no-difference" category and the relatively small number of cases in the "greatly improved" category are regrettable, it is an indication that the initial need for treatment for many patients in this study was only moderate, and not an indication of inadequate treatment.[6]

Treatment was most effective in reducing maxillary and mandibular anterior displacements (crowding/spacing), overjet, and overbite (Table 6). The changes in three components of the PAR score—overjet, maxillary anterior displacement, and overbite—contributed two-thirds or more of the change in PAR score (Table 6). Treatment was least successful in changing the anteroposterior relationships in the buccal segments. This is most likely the result of the criteria used in assessing this component, rather than a judgment about the ability of therapy to effect a change in this relationship.[8] Analysis of the individual cases in the 1993 group (Table 7) indicates that treatment was successful for the reduction of maxillary anterior crowding (79%). There was residual or new crowding in only 14% of all cases posttreatment. Treatment of preexisting mandibular crowding was less successful, with 71% of cases completely resolved. However, there was residual or new crowding in 31 cases (30%) posttreatment. Correction of

posterior crossbite was also only moderately successful, with 24 of 33 pretreatment crossbite cases (73%) completely resolved during treatment; unresolved and new crossbites during treatment left 16 cases (15%) with posterior crossbite posttreatment.

One group of authors presented data that the departmental aspirations and attitudes can significantly influence the effectiveness of treatment.[3] Leadership of the Department of Orthodontics in Bern changed in 1982, and the new department head was responsible for the direction of treatment for the patients discharged in 1993, but not in 1983. Thus the change in department leadership may help explain the statistically significant differences in the final IOTN and PAR scores and the change in PAR score for the two groups of patients. On the other hand, treatment results have been shown to depend on the type of appliances, fixed or removable, and, in the case of fixed appliances, the specific kind of appliance.[2,3,7,11] There were also changes in treatment techniques after 1983. So an alternative explanation for the significant differences in treatment results could be changes in materials, e.g., the introduction of nitinol and superelastic nitinol and titanium-molybdenum alloy archwires, and/or changes in treatment techniques, e.g., the elimination of treatment with the Begg appliance, the introduction of a full set of preadjusted brackets (straight-wire technique), the introduction of procedures from the segmented arch technique, and the introduction of the Jasper Jumper.

Cases assigned to dental students were selected because the malocclusion was thought to be amenable to treatment through growth modification, serial extraction, and/or the application of removable or semiremovable appliances, such as mandibular lingual arches, maxillary transpalatal arches, and tongue rakes. For growth modification, maxillary headgear or functional appliances were used, i.e., primarily activators as described by Herren and van Beek.[19,20] In the dental student clinic, treatment techniques and materials did not change substantially in the interval between 1983 and 1993. The lack of significant differences in the treatment results for the patients treated by dental students suggests that any changes in attitudes and aspirations associated with the change in departmental leadership in 1982 did not have as significant an effect on the effectiveness of therapy as the changes in materials and methods introduced after 1983. For the same reasons, we considered and rejected the hypothesis that the differences in results for the two groups of patients treated by the postgraduates may have been the result of differences in ability between the two groups of operators. The dental students were directed and supervised in the treatment of their patients by the postgraduates, thus any differences in skill between the two groups of postgraduates should also have been reflected in the results of the dental students, and this was not the case.

In agreement with the results of other investigators, pretreatment PAR index score and sex were significant factors affecting the change in PAR score.[9] Why sex is a factor in the change in PAR score, specifically why females reach a more favorable result, is unclear from the data in the present investigation. It should be noted that other investigators have found no effect of sex on change in PAR score.[10,13]

It is not surprising that the use of both removable and fixed appliances led to significantly greater treatment times. Other investigators have noted that duration of treatment increases as the number of appliances (functional appliances, headgear, and upper removable appliances) increases or as the number of treatment phases increases.[9,13,21] In the present investigation, it may have been the desire for further correction after a period of treatment with removable appliances that led to the use of fixed appliances. Whether this two-phase treatment was planned from the beginning or was a result of re-evaluation was not analyzed in this study.

In conclusion, this study has presented evidence that changes in treatment techniques and the introduction of new materials have had a significant positive effect on treatment outcome in a postgraduate dental school orthodontic clinic. In this study, improvement in occlusion and alignment was primarily the result of a

Table 9
Predictor variables in model of change in PAR score

Predictor variable	β	*p*	SE
Pre-PAR score	-0.93	0.001	0.05
Sex			
Male=1	1.66	0.026	0.74
Female=0	0.00		
Group			
1983=1	2.36	0.002	0.76
1993=0	0.0		

Change in PAR score after treatment = 4.86 + β_PrePAR + β_Sex + β_Group.

Table 10
Predictor values in model of duration of treatment

Predictor variable	β	*p*	SE
Appliance:			
Fix=1	-0.70	0.026	0.31
Removable=2	-1.43	0.0001	0.27
Both=3	0.00		
Devel. stage:			
Incisors=1	4.26	0.0001	0.38
Canines/ premolars=2	1.76	0.0795	0.28
Permanent=3	0.00		
Age	-0.07	0.0378	0.033

Duration of treatment = 4.26 + β_Appliance + β_Developmental stage + β_Age.

reduction in overjet, an increase in the alignment of the maxillary anterior teeth, and a reduction in overbite.

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