ASSESSMENT OF STRAIGHTWIRE vs STANDARD EDGEWISE ORTHODONTIC TREATMENT USING THE PAR INDEX

By: Zia Beg, DDS

Submitted in Partial Fulfillment of the
Requirements for a Certificate in
Orthodontics
Oregon Health & Sciences University
June 2002

TABLE OF CONTENTS

INTRODUCTION

The Peer Assessment Rating or PAR Index was developed by a group of 10 experienced orthodontists, collectively known as the British Orthodontic Standards Working Party, over a series of six meetings. It was developed as a simple, reproducible, and objective measure of the severity of dental malocclusions and the efficacy of orthodontic treatment. Using a series of 11 measurements, the score provides an estimate of how far a case deviates from normal alignment and occlusion.

Orthodontic appliances have changed considerably during the history of the profession. Edward Angle's original edgewise appliance was developed in 1928 as an improvement of his earlier appliance systems, and this system has itself been subsequently modified numerous times. The standard edgewise brackets require the practitioner to place extensive 1st, 2nd, and 3rd order bends in the wire him or herself. The straightwire appliance was developed by Lawrence Andrews in the mid 70's to diminish chair-side time by incorporating the proper tip, torque, and in-out dimensions, into the brackets themselves, thereby minimizing the amount of wire bending required.

The purpose of this study was to assess the outcome of Class I crowded cases treated with standard edgewise appliances and compare it with the outcome of Class I crowded cases treated with straight-wire appliances, using the PAR index. 25 cases of each group (standard edgewise cases and straight-wire cases) were selected randomly from the graduate orthodontic clinic at the Oregon Health and Sciences University. The PAR Index was used to score the pre- and post-treatment study models of each of the cases.

ABSTRACT

The purpose of this study was to assess the outcome of Class I crowded cases treated with standard edgewise appliances and compare it with the outcome of Class I crowded cases treated with straight-wire appliances, using the PAR index. 25 cases of each group (standard edgewise cases and straight-wire cases) were selected randomly from the graduate orthodontic clinic at the Oregon Health and Sciences University. The PAR Index was used to score the pre- and post-treatment study models of each of the cases.

The results of the study show that the pretreatment PAR scores were not statistically different with the straight-wire cases having a mean score of 21.16 ± 8.7 and the standard edgewise cases having a mean score of 21.52 ± 11.1. The post-treatment PAR scores were also found not to be significantly different (straight-wire 3.28 ± 2.5, standard edgewise 4.36 ± 3.99). The net PAR score reductions were statistically identical with the straight-wire cases showing a reduction of 17.88 ± 8.7 and the standard edgewise cases showing a reduction of 17.16 ± 10.7. Although the straight-wire cases showed a greater percent PAR score reduction (82.6%) than the standard edgewise cases (77.4%), the difference was not statistically significant ($P > 0.05$). The average treatment time for the straight-wire cases was 24.16 ± 7.2 months compared with 21.56 ± 7.4 months for the standard edgewise cases. The difference in treatment time was not statistically significant. In conclusion, the results demonstrate that good orthodontic results can be obtained using either the straight-wire or standard edgewise appliances.

LITERATURE REVIEW

OCCLUSAL INDICIES

Orthodontic treatment success has traditionally been determined using subjective analyses of post-treatment study models, cephalometric radiographs, and facial esthetics. Using these tools, the practitioner can grade treatment results, although inexactly, and be provided with valuable insight in setting goals for improving future treatment.[1]

Early methods used in the evaluation of occlusion were through indices developed in the 1950's which were meant to gather epidemiologic data on the prevalence of childhood malocclusions. The Handicapping Labio-lingual Deviations Index was introduced by Draker in 1958.[2] When the HDL Index was first described, a distinction was made between the concept of a malocclusion and an orthodontic handicap. Having a "malocclusion" implied a diagnosis had been made, a process achieved by consideration of the etiology. An orthodontic handicap was defined from a statement developed at the White House Conference on Child Health and Protection as: the point, with respect to each trait under consideration, at which some definite handicap or dysfunction begins to be associated with extreme variation. Draker developed his index to be quantitative, since it must indicate the severity of the condition, and it should be suitable for statistical evaluation. The HDL Index measured overbite, overjet, mandibular protrusion, open bite, and labio-lingual spread (the deviation transversely from a 'normal' arch width). Measurements totaling 13 mm and over were considered an orthodontic handicap. A shortcoming of this index was that equal weights were given to each of the five measurements. For example an overjet of 5 mm was judged to be of equal severity as an open bite of 5 mm. Also, the measurements were not mutually exclusive, so that a subject could not have an open bite and an overbite. The HDL Index also indicated that a subject with an end-to-end anterior relationship (i.e. 0 mm overbite and overjet) had no occlusal handicap; whereas a subject with a more ideal 2 mm of overbite and overjet would be judged to have some tendency towards an occlusal handicap. Therefore, the HDL Index was best utilized for the identification of serious handicapping occlusions and not as an index for assessing the degree of malocclusion.

Another method of assessing the incidence of malocclusion in large population groups of children age 14-18 was proposed by Massler and Frankel.[3] Their method used individual teeth as the unit of occlusion rather than a segment of the arch. Individual teeth were examined and it was determined whether or not it was in the correct position or in a state of malocclusion. Only those patients in whom the malpositioning of the teeth was sufficiently severe in degree to require orthodontic treatment, were designated as having a 'malocclusion'. Additionally, those with ten or more malpositioned teeth were considered to have a malocclusion.

Grainger[4] developed the orthodontic Treatment Priority Index (TPI), which summed six occlusal features into a score that differentiated persons with normal occlusion from those with varying degrees of malocclusion. The six occlusal features were: first molar relationship, overjet (horizontal incisor relation), overbite and open bite (vertical incisor relation), tooth displacement (crowding, rotations), congenitally missing teeth, and posterior crossbite. The United States Public Health Service used the TPI when it surveyed occlusion in children and adolescents between 1963 and 1970.

Salzman, in 1967 developed a malocclusion assessment designed to establish treatment priority.[5] The Handicapping Malocclusion Assessment Record was adopted by the Council on Dental Health of the American Dental Association. The potential caseload within the child population of a community could be established knowing the frequency and range of severity of malocclusions. Scoring could be done either indirectly using study models, or directly from the examination of the mouth. The assessor scored two points for each affected maxillary incisor, and one point each for each of the other affected teeth in the dentition. The presence of positive or negative overjet and overbite and anteroposterior relationship of the dental bases, constituted the other scores.

In 1971 the Occlusal Index (OI) was developed by Summers[6] who felt that the variations in terminology, concepts and methodology were reasons for the absence of a universally accepted index of occlusion. He included what he felt the requirements for all dental indices should be in a 1966 World Health Organization report:

i) Reliability: The index should be reproducible by other examiners or by the same examiner at some other point in time.

ii) Validity: The index should measure what it was intended to measure.

iii) Validity during time: The index should consider the normal development of the occlusion, i.e. a distinction is made between a basic orthodontic defect and a symptom of a developmental change.

In determining the Occlusal Index, nine characteristics were scored, including dental age, molar relation, overbite, overjet, posterior crossbite, posterior open bite, tooth displacement, midline relations, and missing permanent teeth. Despite the fact that the application of the Index was time consuming and complicated, it was the first system to adequately provide a means of measuring occlusion and assessing orthodontic treatment need.

In 1975, Gottlieb designed a system specifically to 'grade' orthodontic treatment results[7]. He utilized a 'standard group of tooth relationships' that were generally accepted criteria for orthodontic correction. These included:

i) Class I molar relationship

ii) Class I canine relationship

iii) Cuspal interdigitation

iv) Overbite

v) Overjet

vi) Midlines

vii) Rotations

viii) Crowding or spacing

ix) Arch form

x) Torque and parallelism

He realized that model analysis was 'not the whole story of treatment' and that other factors could be added to more comprehensive grading systems such as the use of cephalograms and photographs. In his system for grading the treatment characteristics he assigned the following point scale: 5 points- condition corrected

4 points- condition almost corrected

3 points- condition half corrected

0 points- condition not corrected

-1 points- condition worsened

With the point grading system it was assumed that each characteristic was of equal importance in the treatment of malocclusion. A large potential for inaccuracies also existed when deciding to what degree a condition had been corrected.

Gottlieb arrived at the following interpretation of his grading system:

85% or better corrected - good result

75-85% corrected - satisfactory result

65-75% corrected - mediocre result

50-65% corrected - poor result

< 50% corrected - unsatisfactory result

He was surprised to find that many of what he believed to be his most successfully treated cases were in fact, less than satisfactory results.

The variation in criteria used by different orthodontists made it difficult to compare the results of treatment. In the field of research, the need for accurate measures is thought to be even more critical. The use of precise criteria is essential, requiring a quantitative objective method of measuring malocclusion and efficacy of treatment. To fulfill this criteria, the Peer Assessment Rating (PAR) index was developed to record the dental malocclusion at any developmental stage.[8]

The PAR Index was formulated over a series of six meetings in 1987 by a group of ten experienced orthodontists (known as the British Orthodontic Standards Working Party). Over two hundred dental casts representing developmental as well as pre- and post-treatment stages were examined and discussed until agreement was reached regarding the individual features which would be assessed in obtaining an estimate of alignment of occlusion.[9]

The PAR index is applied to an individual's pre- and post-treatment study casts. Scores are assigned to the various occlusal traits that make up the malocclusion, using the specially designed PAR ruler. The individual scores are summed to obtain a total that represents the degree a case deviates from normal alignment and occlusion. A score of zero indicates good alignment and higher scores indicate increased levels of irregularity. The difference between

the pre- and post-treatment PAR scores indicates the degree of improvement as a result of orthodontic intervention.

The 5 components of the PAR Index are:

1) Upper and lower anterior segments
2) Left and right buccal occlusion
3) Overjet
4) Overbite
5) Centerline

Anterior Segments

Scores are recorded for both upper and lower anterior segment alignment. The recording zone is from the mesial contact point of the canine on one side to the mesial contact point of the canine on the opposite side. The features recorded are crowding, spacing and impacted teeth (Table 1). Contact point displacement is recorded as the shortest distance between the contact points of adjacent teeth parallel to the occlusal plane. The greater the contact point displacement the greater the score.

Table 1. Contact point displacement scores.

SCORE	DISCREPANCY
0	0 mm to 1 mm
1	1.1 mm to 2 mm
2	2.1 mm to 4 mm
3	4.1 mm to 8 mm
4	Greater than 8 mm
5	Impacted teeth

Buccal Occlusion

The buccal occlusion is recorded for both left and right sides. The fit of the teeth is scored in all three planes of space; anteroposterior, vertical and transverse. The recording zone is from the canine to the last molar. All features are recorded when the teeth are in occlusion.

Table 2: Buccal occlusion assessments.

SCORE	DISCREPANCY
Antero-posterior	
0	Good interdigitation Class I, II or III
1	Less than half unit from full interdigitation
2	Half unit discrepancy (cusp to cusp)
Vertical	
0	No open bite
1	Lateral open bite on at least 2 teeth greater than 2mm
Transverse	
0	No crossbite
1	Crossbite tendency
2	Single tooth in crossbite
3	More than one tooth in crossbite
4	More than one tooth in scissors bite

Overjet

Positive overjets as well as anterior teeth in crossbite are recorded (Table 3). The recording zone includes all incisor teeth. The most prominent incisor overjet is identified and the overjet is recorded to the labial aspect of the incisal edge. When recording the overjet, the ruler is held parallel to the occlusal plane.

Table 3. Overjet assessment.

SCORE	DISCREPANCY
Overjet	
0	0 to 3 mm
1	3.1 mm to 5 mm
2	5.1 mm to 7 mm
3	7.1 mm to 9 mm
4	Greater than 9 mm
Anterior crossbites	
0	No crossbite
1	One or more teeth edge to edge
2	One single tooth in crossbite
3	Two teeth in crossbite
4	More than two teeth in crossbite

Overbite

Overbite is recorded in relation to the coverage of the lower incisors or the degree of open bite (Table 4). The worst vertical overlap or open bite of any of the four incisors is recorded.

Table 4. Overbite assessment.

SCORE	
Open bite	
0	No open bite
1	Open bite less than or equal to 1 mm
2	Open bite 1.1 mm to 2 mm
3	Open bite 2.1 mm to 3 mm
4	Open bite greater than or equal to 4 mm
Overbite	
0	Less than or equal to 1/3 coverage of the lower incisor
1	Greater than 1/3 but less than 2/3 coverage of the lower incisor
2	Greater than 2/3 coverage of the lower incisor
3	Greater than or equal to full tooth coverage

Centerline

The difference between the upper and lower dental midlines is recorded in relation to the lower dental midline (Table 5).

Table 5. Centerline assessment.

SCORE	
0	Coincident and up to ¼ lower incisor width
1	¼ to ½ lower incisor width
2	Greater than ½ lower incisor width

The difference between the pre- and post-treatment PAR scores reflects the success or degree of improvement. Richmond et. al.[9] proposed that a score of 10 or less indicated an acceptable alignment and occlusion, and 5 or less suggested an almost ideal occlusion. Additionally Richmond et. al.[10] proposed that in terms of assessment of improvement, a case was considered to be "improved" when there was at least a 30 percent reduction in PAR score. A decrease of 22 points in the PAR score brought about a "great improvement" in the case. A

score that decreased less than 30% was considered to be in the "worse or no different" category of improvement.

The PAR index has been validated in accordance with current British orthodontic opinion (Richmond[10]). Various degrees of importance were determined by a panel of 74 practitioners for the 5 components. Weightings for the various components that were derived (and that were used in this study) are as follows:

Components	Weightings
1. Upper and lower anterior segments	x 1
2. Left and right buccal occlusions	x 1
3. Overjet	x 6
4. Overbite	x 2
5. Centerline	x 4

Validation of the PAR index was also tested by DeGuzman et. al.[11] The purpose of the study was to validate the PAR index by a group of orthodontists in the United States. This study sampled 200 sets of study casts representing all malocclusion types, and rated them for malocclusion severity and perceived treatment difficulty. Multiple regression techniques showed that the panel placed an emphasis on certain morphological features of a malocclusion namely, overjet, overbite, midline discrepancy, upper anterior alignment and buccal segment relationships. Unlike the British study, this study found that the lower anterior segment crowding did not have a predictive effect and so was not weighted. The overbite weighting was 3 (2 in the British study), the overjet weighting was 5 (6 in the British study), the midline weighting was 3 (4 in the British study), and the buccal segment relationship weighting was 2 (1 in the British study).

THE STANDARD (NONPROGRAMMED) EDGEWISE APPLIANCE

Edward Hartley Angle's compulsion for order led him to create, in 1888, the "Angle System". He believed that an orthodontic appliance should possess five important qualities: 1) simplicity - ability to push, pull, and rotate teeth, 2) stability - fixed to the teeth, 3) efficiency - based on Newton's third law and anchorage, 4) delicacy - must be kind to the soft tissues and 5) inconspicuousness - esthetically acceptable.

Angle designed a standard appliance with the basic components being traction screws, attachment tubes, jackscrews, lever wires, band material and archwire. By mass-producing these components into efficient, workable appliances, universal application by other practitioners allowed for more patient treatments at less cost and with better results.

During Angle's life, his fixed appliance approach to treating malocclusion evolved through four basic appliance design systems. They included the E-arch (late 1800's), the Pin and Tube (1910), the Ribbon Arch (1915) and finally the Edgewise appliance (1925) which he once referred to as the "latest and the best". His edgewise appliance was the result of his lifetime of research and was one of the reasons he carries the title of the founder of modern orthodontics.

Angle's original edgewise appliance consisted of bands on all teeth to which a single wing bracket was soldered. The rectangular slot was 0.022" x 0.028" and was designed for use with gold archwires. These brackets required accurate bending of the archwire to attain proper positioning of the teeth in all three planes of space. Intended only for nonextraction treatment, his appliance requires even more wire bending when teeth have been extracted. The original edgewise bracket was only 0.050" wide, which resulted in poor control of tooth rotations. Angle compensated for this through the use of small eyelets soldered to the bands.

Dr. Angle recognized that three orders of tooth movement may be accomplished by means of his edgewise arch appliance. First order bends produce buccal, labial, lingual, rotative, depressive and elongating tooth movements. These first order movements are usually accomplished first to make possible the engagement of all the teeth directly through the brackets by the ideal archwire. The second order bends produce mesial and distal tipping of the

teeth, and finally, the third order bends refer to torque of the wire and are employed in facial or lingual root and crown movements.

The standard edgewise appliance became the appliance of choice for fixed orthodontic treatment for nearly half a century. However, many improvements were subsequently made on Angle's original design. Some of these modifications included: twin brackets, slot size, slot shape, direct bonding, lingual appliances, and the straight-wire appliance.

THE STRAIGHT-WIRE (FULLY PROGRAMMED) APPLIANCE

The straight-wire appliance was developed by Dr. Lawrence Andrews in the mid 70's to diminish chair-side time and improve the quality of finished cases. Andrews' idea was to create an appliance that would transfer the work that was normally done through wire bending (1st, 2nd, and 3rd order bends) to the brackets themselves. Brackets were fabricated to fit ideals for each tooth, with proper tip, torque, and in-out dimensions. Essentially he tried to create an appliance that would utilize a straight archwire with a minimum amount of bends.

Andrews referred to Angle's "latest and best" appliance as the oldest and among the least efficient of all edgewise appliances.[12] He states that extensive wire bending is required with the standard edgewise system because each bracket is the same but the optimal positions differ for most tooth types in a dentition. Andrews described the Angle design shortcomings as being due to six factors. These six factors cause the slot of nonprogrammed edgewise brackets to be sited in ways that always require archwire bends. Each factor may cause the slot to be misdirected by more than 2° from its optimal angulation and inclination and by more than 0.5 mm occlusogingivally, mesiodistally, and faciolingually. The six factors are 1) bracket bases are perpendicular to the bracket stems; 2) bracket bases are not contoured occlusogingivally; 3) slots are not angulated; 4) bracket stems are of equal faciolingual thickness; 5) maxillary molar offset is not built in; and 6) bracket-siting techniques are unsatisfactory.[12]

STANDARD EDGEWISE VS STRAIGHT-WIRE APPLIANCES

Surprisingly few studies have compared the treatment outcomes of standard edgewise appliances versus the straight-wire appliance. Kattner and Schneider[13] did a retrospective

comparison of Roth appliance and standard edgewise appliance treatment results using two indices. The first, the ideal tooth relationship index (ITRI), scored dental casts for the presence of ideal tooth contacts, and the second judged post-treatment dental casts on the basis of criteria established by Andrews[14] in his "Six Keys to Normal Occlusion". The sample consisted of 120 orthodontically treated cases completed by two practitioners who had used both the Roth and standard edgewise appliances. Thirty cases of each appliance type were collected from each practitioner. The overall post-treatment ITRI percentage scores showed no significant differences between the appliances. The results of the Six Keys Analysis showed that the angulation and inclination of the maxillary posterior teeth were better with the Roth appliance. However, success in achieving some components of the six keys did not translate into an increased percentage of ideal tooth contacts as measured by the ITRI. Despite using the Roth appliance, the experienced clinicians still found it difficult to achieve all six keys to normal occlusion.

Galicia-Ramos et. al.[15] compared the standard edgewise, preadjusted edgewise, and the Tip-Edge appliances in Class II extraction treatment. They retrospectively examined the treatment of 105 similar malocclusions treated by eight experienced orthodontists from six private practices: two standard edgewise practices, two preadjusted practices, and one Tip-Edge practice. All the pre- and post-treatment cephalograms were digitized and measured, and the pre- and post-treatment casts were evaluated using the PAR Index. The examiners found that all three appliance systems achieved similarly good results as measured by the PAR index.

Ugur and Yukay[16] examined the faciolingual inclinations of normal tooth crowns and compared them with treatment groups of standard and pretorqued brackets. Measurements were done on 10 subjects for normal anatomic occlusion, standard edgewise and Roth bracket groups. On the study models, crown inclinations of right and left central incisors to second molar in the upper and lower dental arches were measured to the functional occlusal plane and mean tooth inclinations were calculated. In the normal occlusion group, upper centrals and laterals inclined lingually, lower centrals inclined slightly labially and lower laterals inclined lingually but the standard deviations of mean values for upper and lower anterior teeth were high. Upper posterior teeth, from canine to molar, had a lingual inclination and lower posterior

teeth had a progressively increasing lingual inclination from lateral to molar. In the treatment groups (i.e. standard edgewise and Roth brackets) upper centrals and laterals had labial crown inclination and lower molars had more lingual inclination as compared with the normal occlusion group. No significant variation was found between the mean torque values of the standard edgewise and Roth appliance treatment groups.

Mavragani et. al.[17] compared the severity of apical root resorption occurring in patients treated with a standard edgewise and a straight-wire edgewise technique. The sample consisted of 80 patients with Class II division I malocclusions, treated with extraction of at least two maxillary first premolars. Numerous variables were recorded using study casts, treatment records, and radiographs. Forty patients were treated with a standard edgewise and 40 with a straight-wire edgewise technique, both with 0.018-inch slot brackets. Crown and root lengths of the maxillary incisors were measured on pre- and post-treatment periapical radiographs corrected for image distortion. Percentage of root shortening and root length loss in millimeters were then calculated.

The investigators found significantly more apical root resorption of both central incisors in the standard edgewise group compared to the straight-wire group. No significant difference was found for the lateral incisors. They did note that the central incisors in the standard edgewise group had a greater history of trauma which may have explained the difference in resorption between the two groups. They also explain the decrease in apical root resorption in the straight-wire group as perhaps being due to the more efficient force control offered by the technique.

MATERIALS AND METHODS

Subjects were selected randomly from cases treated at the Oregon Health Sciences University, School of Dentistry graduate orthodontic clinic. In order to be included in the study, cases required accurate pre- and post-treatment models along with other clinical records from which type of appliances used, treatment duration, etc. could be determined. All data was gathered from models taken within six months prior to initiation of treatment and within three months following completion of active treatment. Criteria for inclusion were pre-treatment models showing a Class I molar relationship tendency with crowding. Both extraction and non-extraction cases were included. Cases with primary dentition remaining were not included, nor were cases that were treated by means of any orthognathic surgery. Patients with congenital craniofacial defects, such as cleft lip and palate, were also excluded from the study.

Including those cases currently in active retention and out of retention at the orthodontic clinic, 25 were selected in each of two categories: a) cases treated with standard edgewise appliances (0.022" standard brackets by Dentaurum) designated as standard edgewise cases and: b) cases treated using straight-wire appliances [0.022" pretorqued, preangulated brackets with the Roth prescription (with minor variations) by GAC] designated as straight-wire cases. The PAR Index was then applied to each of the pre- and post-treatment study models to obtain a score. A complete description of the PAR index is presented in *An Introduction to Occlusal Indices*. Briefly, each set of study models is occluded in maximum intercuspation and the calibrated PAR ruler is used to assign a value to each of the seven weighted components. To test intraexaminer reliability, ten cases from each category were selected and the PAR Index scoring was repeated one week later. Treatment outcome was assessed on the difference between the pre- and post-treatment PAR scores. The percentage reduction in the scores was used to assess the degree of improvement or the effectiveness of treatment. It was classified into three categories: "worse or no difference" (< than 30% reduction in PAR score), "improved" (at least a 30% reduction in PAR score), and "greatly improved" (a reduction of at least 22 points in the PAR score).

Pre- and post-treatment images of the models for standard edgewise case #1 are shown in figure 1 and figure 2. A copy of the work sheets used to record the pre- and post-treatment PAR scores for standard edgewise case #1 are seen in figures 3 and 4 respectively.

Figure 1. Pre treatment images for standard edgewise case #1.

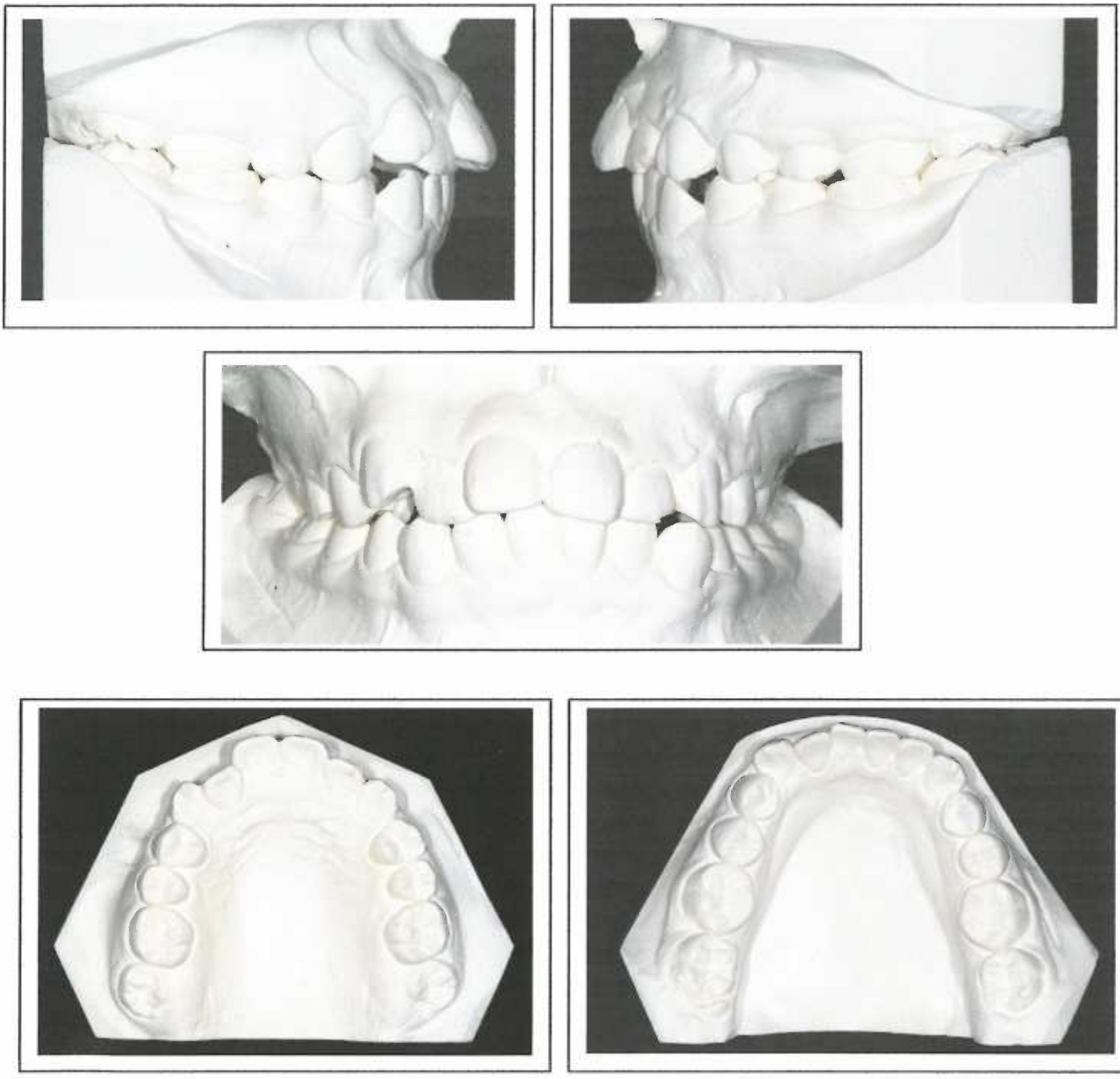

Figure 2. Post treatment images of standard edgewise case #1.

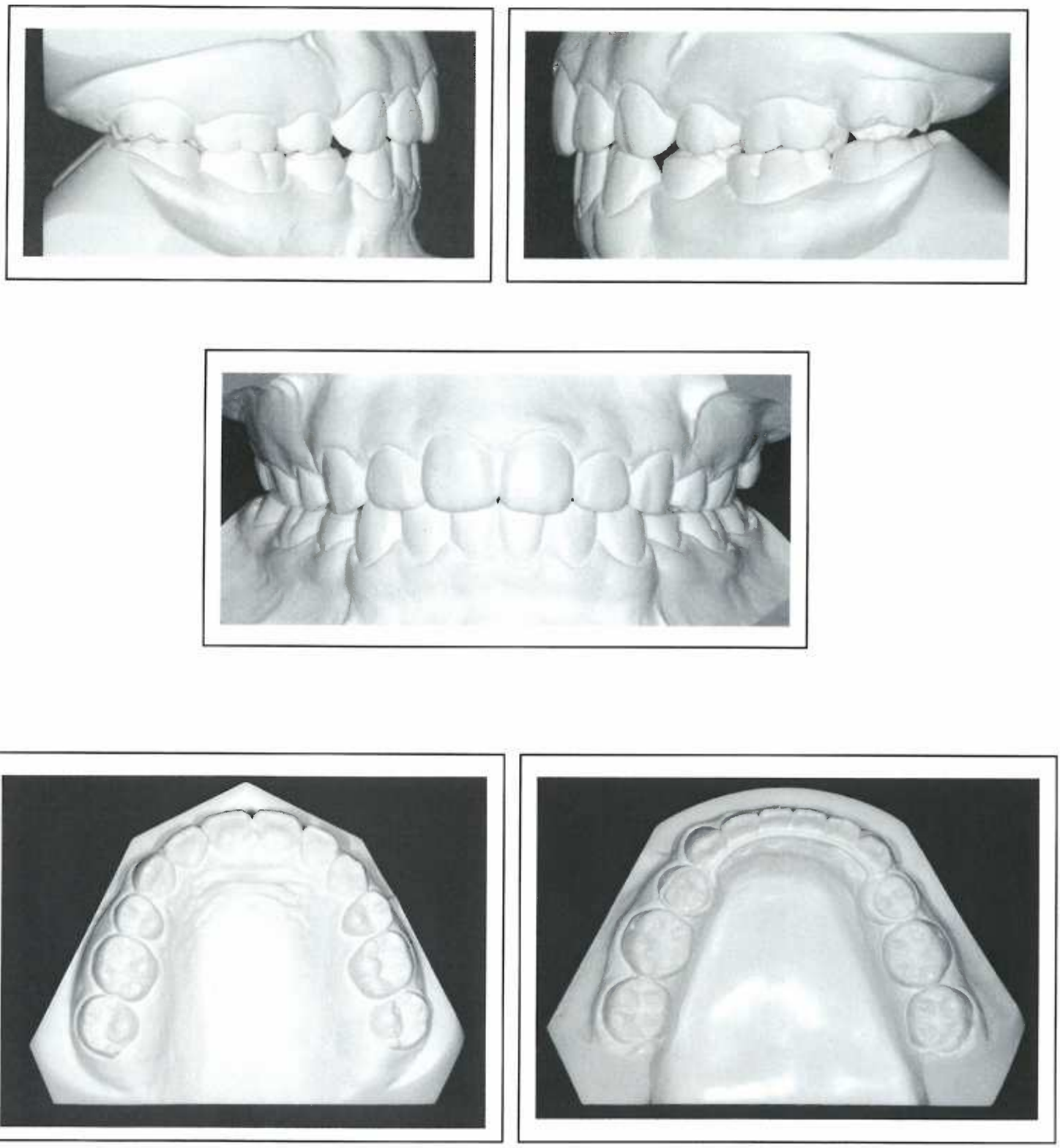

Figure3. Pre-treatment PAR index worksheet for standard edgewise case #1.

PATIENT #: 1 — (PRE)/POST OP RECORD

SEX: F AGE: ____ — STRAIGHTWIRE/(STD. EDGEWISE)

TX DURATION: 21 (months)

	SCORE	WEIGHT	FINAL SCORE
1. UPPER SEGMENT:	2	x 1	2
2. LOWER SEGMENT:	1	x 1	1
3. RIGHT BUCCAL OCCLUSION:			
ANT-POST.	1		
VERTICAL	0		
TRANSVERSE	0		
TOTAL:	1	x 1	1
4. LEFT BUCCAL OCCLUSION:			
ANT.-POST.	1		
VERTICAL	0		
TRANSVERSE	1		
TOTAL:	2	x 1	2
5. OVERJET:			
OJ	2		
ANT X-BITE	0		
TOTAL:	2	x 6	12
6. OVERBITE:			
OPENBITE	0		
OVERBITE	0		
TOTAL:	0	x 2	0
7. MIDLINES:	1	x 4	4
Total PAR Score:			22

Figure 4. Post-treatment PAR index worksheet for standard edgewise case #1.

PATIENT #: 1 **PRE/POST OP RECORD**

SEX: F **AGE:** _____ **STRAIGHTWIRE/STD. EDGEWISE**

TX DURATION: 21 (months)

		SCORE	WEIGHT	FINAL SCORE
1. UPPER SEGMENT:		0	x 1	0
2. LOWER SEGMENT:		0	x 1	0
3. RIGHT BUCCAL OCCLUSION:				
	ANT-POST.	1		
	VERTICAL	0		
	TRANSVERSE	0		
	TOTAL:	1	x 1	1
4. LEFT BUCCAL OCCLUSION:				
	ANT.-POST.	1		
	VERTICAL	0		
	TRANSVERSE	0		
	TOTAL:	1	x 1	1
5. OVERJET:				
	OJ	0		
	ANT X-BITE	0		
	TOTAL:	0	x 6	0
6. OVERBITE:				
	OPENBITE	0		
	OVERBITE	0		
	TOTAL:	0	x 2	0
7. MIDLINES:		0	x 4	0
			Total PAR Score:	2

RESULTS

Data for the Standard edgewise cases are presented in table 6. Treatment duration was recorded in the form of months, beginning with the date the appliances were placed to the date the case was debonded and debanded. Along with pre- and post-treatment PAR scores, net PAR score reduction and percent PAR reduction were calculated. Similar data for the straight-wire cases is presented in table 7.

TABLE 6: Data for Standard Edgewise Cases.

Sample #	Tx. Duration	Pre-Tx PAR	Post-Tx PAR	Net PAR Reduction	% PAR Reduction
1	21	22	2	20	91
2	17	14	4	10	71
3	24	27	1	26	96
4	17	14	0	14	100
5	30	9	1	8	89
6	19	17	2	15	88
7	20	9	0	9	100
8	33	52	3	49	94
9	29	23	13	10	44
10	18	31	4	27	87
11	21	28	10	18	64
12	43	36	16	20	56
13	21	36	4	32	89
14	14	17	1	16	94
15	10	16	4	12	75
16	19	7	7	0	0
17	12	11	2	9	82
18	18	31	6	25	81
19	28	17	6	11	65
20	31	40	3	37	93
21	19	18	3	15	83
22	14	13	3	10	77
23	17	16	9	7	44
24	21	15	1	14	93
25	23	19	4	15	79
MEAN	**21.56**	**21.52**	**4.36**	**17.16**	**77.4**
Std. Dev.	**7.38**	**11.1**	**3.99**	**10.7**	**22.5**

TABLE 7. Data for Straight-wire Cases.

Sample #	Tx. Duration	Pre-Tx PAR	Post-Tx PAR	Net PAR Reduction	% PAR Reduction
1	22	39	7	32	82
2	15	28	0	28	100
3	35	21	3	18	86
4	38	17	2	15	88
5	19	19	5	14	74
6	21	15	2	13	87
7	24	16	4	12	75
8	32	14	2	12	86
9	31	36	3	33	92
10	16	14	1	13	93
11	35	26	5	21	81
12	22	16	1	15	94
13	32	24	7	17	71
14	18	23	2	21	91
15	18	30	1	29	97
16	17	25	5	20	80
17	27	23	5	18	78
18	31	17	4	13	77
19	17	12	3	9	75
20	24	39	4	35	90
21	28	14	11	3	21
22	12	6	2	4	67
23	25	16	2	14	88
24	28	11	1	10	91
25	17	28	0	28	100
MEAN	**24.16**	**21.16**	**3.28**	**17.88**	**82.56**
Std. Dev.	**7.23**	**8.68**	**2.53**	**8.7**	**15.63**

Pre-treatment PAR scores for the standard edgewise and the straight-wire cases were analyzed and are represented in figure 6. The average mean difference of 0.36 with the straight-wire cases scoring lower, was not found to be statistically significant ($P > 0.05$) using an unpaired t-test.

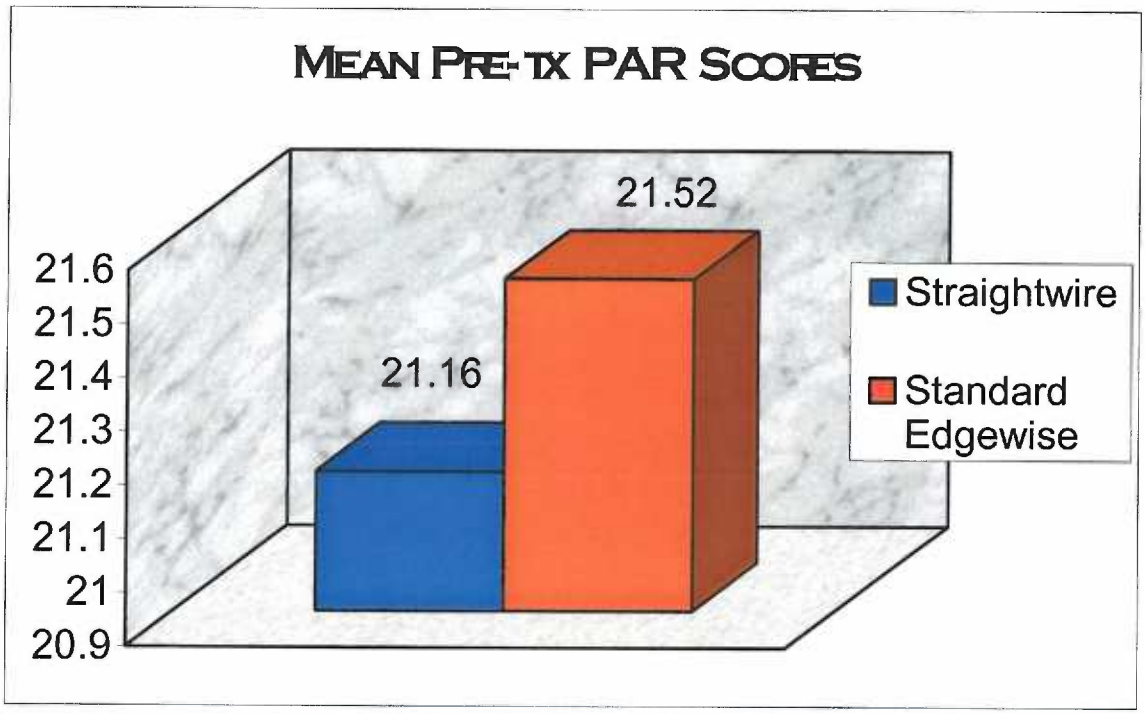

Figure 6. Mean pre-treatment PAR Scores for Straight-wire and Standard edgewise cases.

Post treatment PAR scores for the standard edgewise and straight-wire cases were analyzed and are represented in figure 7. The average mean difference of 1.08, with the straight-wire cases scoring lower, was found not to be significant ($P > 0.05$) using an unpaired t-test.

When combined as a group or left individually as standard edgewise and straight-wire cases, the mean differences between pre- and post-treatment PAR scores was statistically significant ($p < 0.0001$) suggesting a positive overall treatment effect.

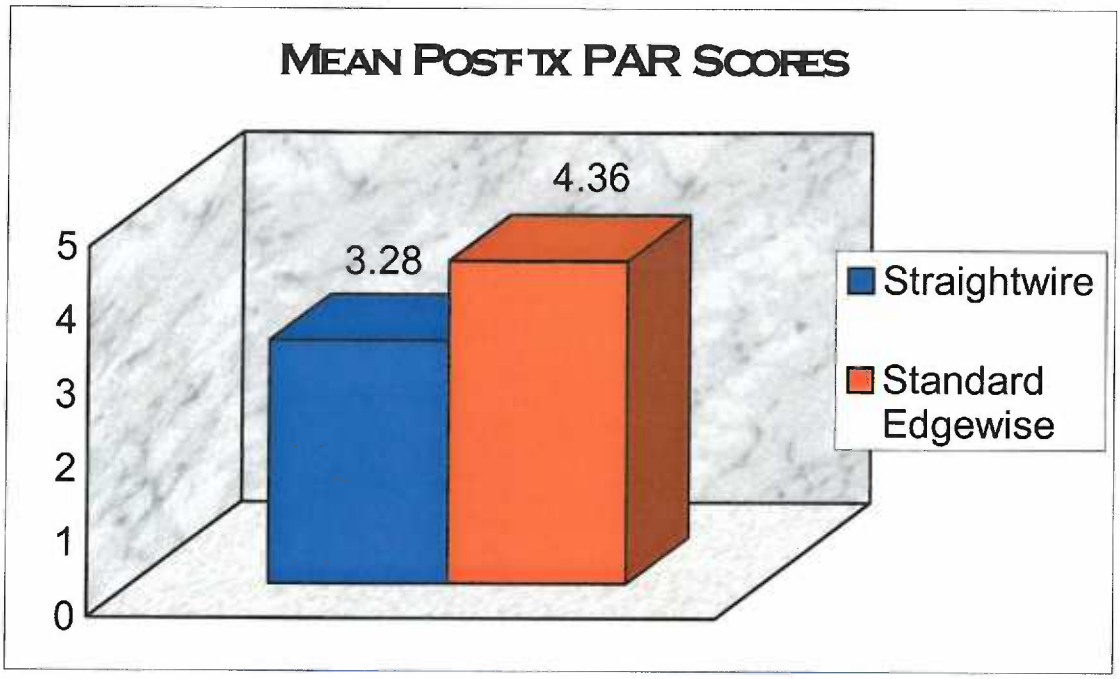

Figure 7. Mean post-treatment PAR scores for Straight-wire and Standard Edgewise cases.

Net PAR score reduction for the straight-wire and standard edgewise cases were analyzed and are represented in figure 8. The average mean difference of 0.72 was found not to be statistically significant ($P > 0.05$) using an unpaired t-test.

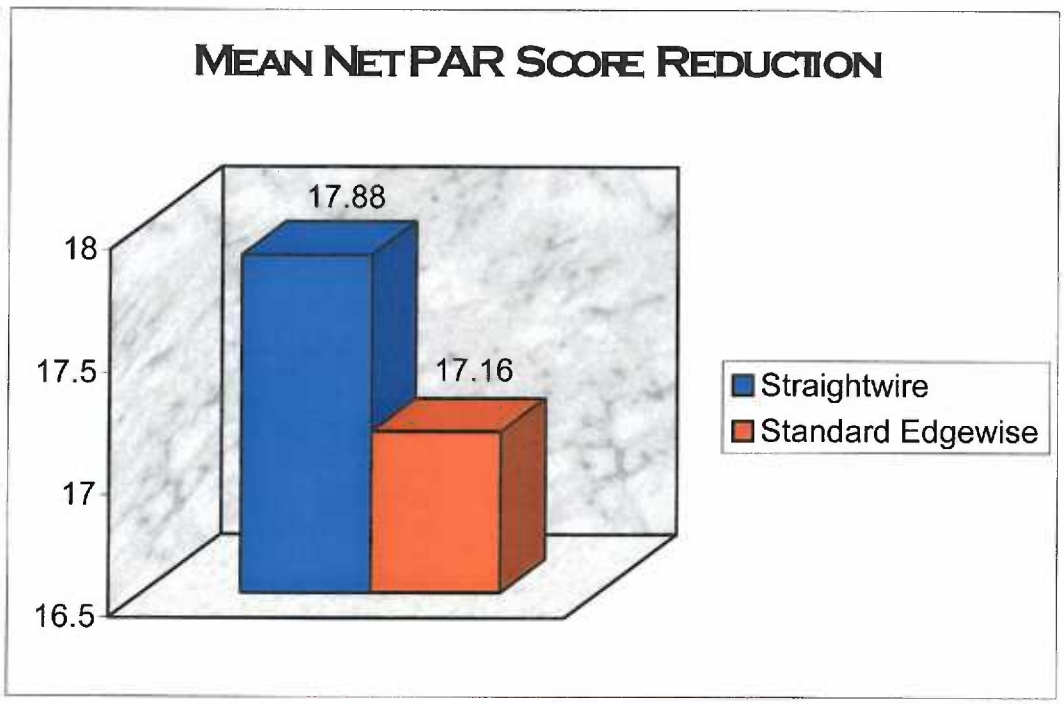

Figure 8. Mean net PAR score reduction for the Straight-wire and Standard Edgewise cases.

Percent PAR score reduction for the straight-wire and standard edgewise groups were computed and are represented in figure 9. The average mean difference of 5.16, with straight-wire cases showing a greater percent reduction in PAR score, was not found to be statistically significant ($P > 0.05$), using an unpaired t-test.

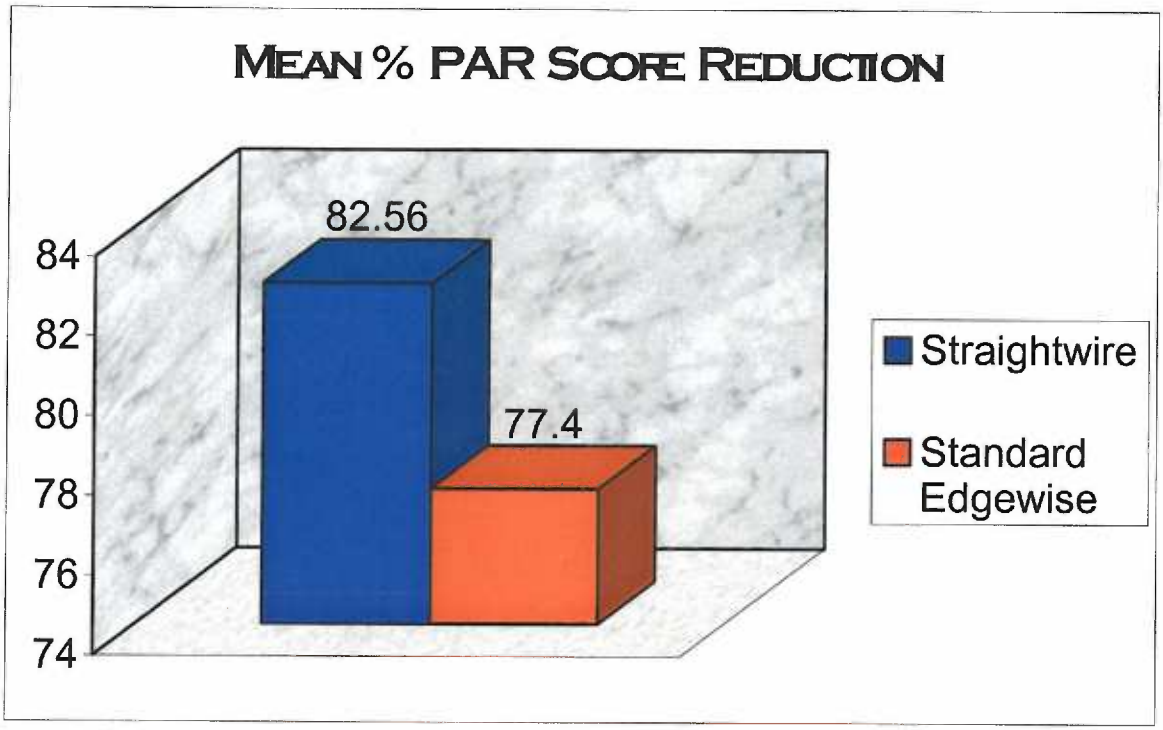

Figure 9. Mean percent PAR reduction of the Straight-wire and Standard Edgewise cases.

While the results conclusively show a significant decrease in mean PAR score from pre- to post treatment for both groups, figures 10 and 11 show the categorization of improvement for the standard edgewise and straight-wire cases. As mentioned previously, a case is considered "greatly improved" with a reduction of 22 points in the PAR score, "improved" when there is at least a 70% reduction in the scoring, and "not improved" with a reduction in score of less than 30%. Both groups were identical in terms of their improvement with 72% of the cases being "greatly improved", 24% of the cases having "improved", and only 4% of the cases were "not improved".

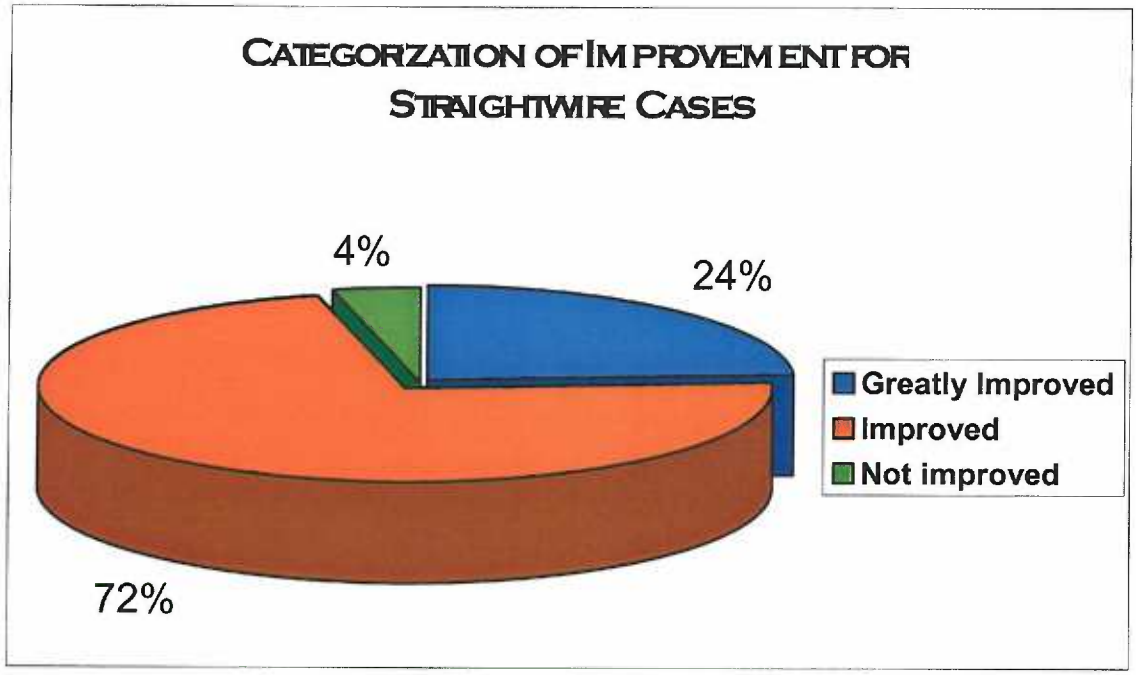

Figure 10. Categorization of improvement for the Straight-wire cases.

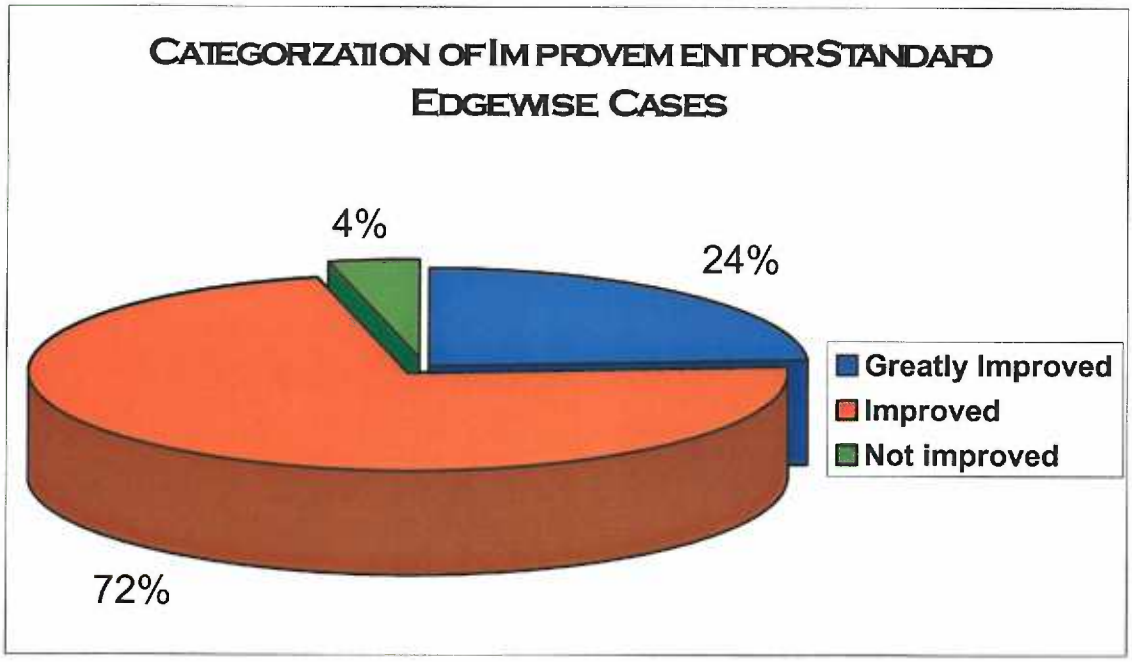

Figure 11. Categorization of improvement for the Standard Edgewise cases.

Intraexaminer reliability was evaluated by randomly repeating 10 pre- and 10 post-treatment PAR Index measurements for each of the standard edgewise and straight-wire cases. The mean differences between the repeated and original pre and post-treatment PAR scores were not found to be statistically significant ($p > 0.05$) using unpaired t-tests.

Treatment duration information was collected and recorded in months. The mean treatment duration for the standard edgewise cases was 21.56 ± 7.38 months, while the mean treatment duration for the straight-wire cases was 24.16 ± 7.23 months (see figure 12). The mean difference in treatment duration between the two groups was 2.6 months. Using an unpaired t-test, this was found to be not statistically significant ($P > 0.05$).

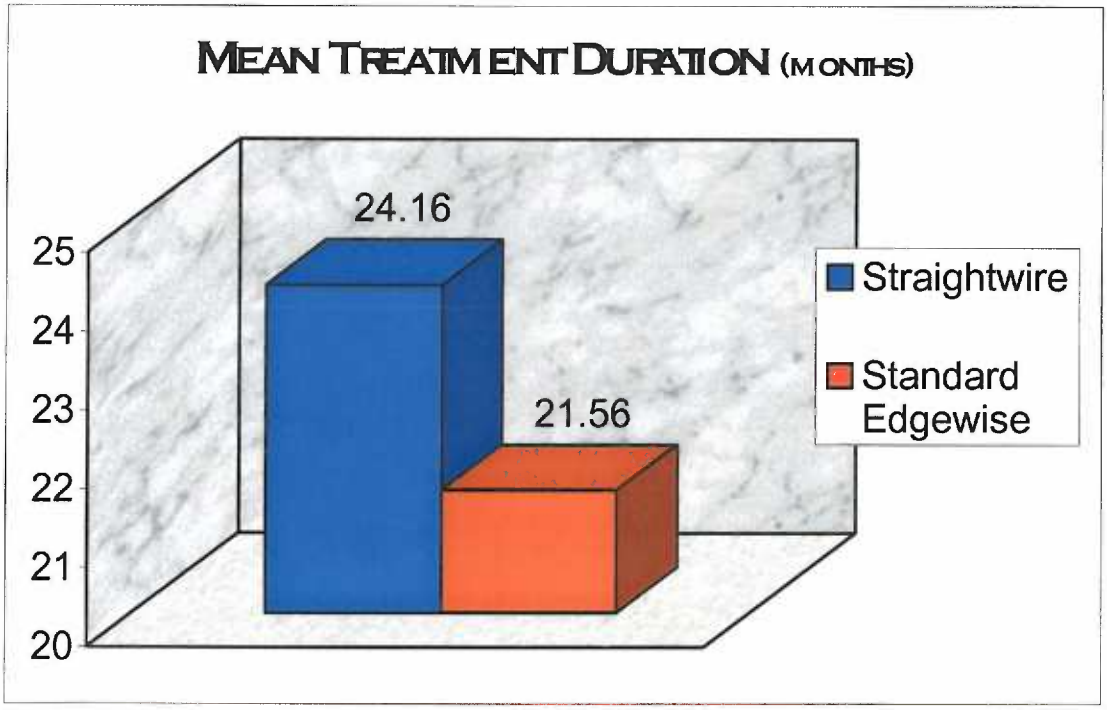

Figure 12. Mean treatment duration for Straight-wire and Standard Edgewise cases in months.

DISCUSSION

The intent of this study was to identify differences in dental parameters between Angle Class I crowded patients treated with standard edgewise appliances and those treated with straight-wire appliances. Changes in dental parameters can be measured in two ways using the PAR index: numerical reduction in PAR score and percentage reduction in the weighted PAR score. Previous studies have shown that a 65% reduction in PAR score can be considered a great improvement in occlusal factors.[11] In this study, the standard edgewise group showed a 77.4% average reduction in PAR score with 20 out of 25 patients having a percentage reduction of at least 65%. The mean percent reduction in PAR scores for the two groups were not statistically significant. Similarly, the straight-wire group had a percentage reduction of 82.56%, with 24 out of 25 patients having percentage changes of at least 65%. In terms of the categorization of improvement the results from both treatment groups were identical, with 72% of the cases being "greatly improved", 24% of the cases having "improved", and only 4% of the cases were "not improved". Therefore, good to excellent dental results were achieved for both groups.

Studies have suggested that the sensitivity of the PAR Index is sufficient to detect differences in treatment outcome when using different treatment methods.[9,18,19,20] A higher percent reduction in PAR score has been demonstrated for patients treated with fixed appliances when compared with patients treated with removable appliances.[18,19,20] Richmond and coinvestigators[9] observed that a higher reduction was achieved with orthognathic surgical cases versus cases treated by orthodontics alone. All of the patients in the present study were treated with upper and lower fixed appliances, however the sample did not include patients treated with orthognathic surgery. Holman et. al.[21] investigated the treatment outcome of extraction versus nonextraction orthodontic cases using the PAR Index, and found that in all five components of the PAR index, the extraction and nonextraction groups were indistinguishable at the end of treatment. The present study included both extraction and nonextraction cases.

In the study carried out by Buchanan et. al.[22] two different types of fixed appliances were compared in a group of 82 cases, treated by one consultant orthodontist (or under his

supervision). It was found that that preadjusted edgewise group (pretreatment PAR score=28) achieved a significantly greater reduction in PAR score that the group treated with the Begg appliance (pretreatment PAR score=32) (81% reduction for the first group versus 65% for the latter). In the present study no statistically significant difference was found between the two fixed appliance groups, namely the standard edgewise group (77.4% reduction) and the straight-wire group (82.56% reduction).

In this study only class I crowded, non-surgical cases were examined. The mean pretreatment PAR scores for the standard edgewise and straight-wire cases were 21.52 and 21.16 respectively and the mean post-treatment PAR scores were 4.36 and 3.28 respectively. These values were similar to those found by Willems et. al.[22]

Although the PAR index was found to be highly reproducible in this study, it has obvious limitations in assessment of treatment outcome. The PAR index measures only dento-occlusal change which, although important, is not the only factor in orthodontic treatment. The index does not take into account changes in the soft tissue, nor does it measure orthodontic treatment need. The PAR index does not measure inclinations/angulations of teeth, residual buccal spacing (extraction space closure), posterior alignment, or changes in arch dimensions, and it does not penalize orthodontic treatments involving inappropriate dental arch expansion. Iatrogenic damage such as decalcification, root resorption, gingival recession, periodontal breakdown and facial esthetics are obviously not measured in any way although they undoubtedly contribute to the 'quality' of treatment.[22]

Even with the above stated shortcomings, the PAR Index remains a valuable adjunctive, epidemiological tool to audit orthodontic treatment outcomes more objectively, and to assess the performance of practitioners or services.

SUMMARY AND CONCLUSIONS

The results of this study suggest that when the PAR index is used as a measure of outcome (in terms of dento-occlusal change) both the standard edgewise and straight-wire appliances provide treatment of a high standard (>70% reduction in mean PAR score).

The mean pretreatment PAR scores for the two groups were not statistically different nor were the mean post-treatment PAR scores. The net PAR score reductions were statistically identical in both the standard edgewise and straight-wire groups. Although the straight-wire cases showed a greater percent PAR score reduction (82.6%) compared to the standard edgewise cases (77.4%), this difference was found not to be statistically significant ($P>0.05$). It should be noted however that in the sample of standard edgewise cases, sample # 16 showed no net reduction in PAR score. This outlier may have affected the mean scores, making the difference between the two groups appear larger. Also, a larger sample size may also have masked the percentage difference between the standard edgewise and straight-wire cases. In terms of treatment duration, the standard edgewise and straight-wire groups demonstrated similar average treatment times (21.56 and 24.16 months respectively).

REFERENCES

1. Hickham, J.H.: Directional edgewise orthodontic approach. *JCO.* 9:143-154.

2. Draker, H.L.: Handicapping labio-lingual deviations: a proposed index for public health purposes. *Bul. Pub. Health Dent.* 1958; 18:1-17.

3. Massler, M., Frankel, J.M.: Prevalence of malocclusion in children aged 14-18 years. *AJO.* 1951; 37:751-768.

4. Graiger, R.M.: Orthodontic treatment priority index. *Vital Health Stat.* 1967; 2:1-49.

5. Salzman, J.A.: Handicapping malocclusion assessment to establish treatment priority. *AJO.* 1968; 54:749-765.

6. Summers, C.J.: The occlusal index: A system for identifying and scoring occlusal disorders. *AJO.* 1971; 59:552-567.

7. Gotlieb, E.L.: Grading your orthodontic treatment results. *JCO.* 1975; 155-161.

8. Richmond, S., O'Brien, K., Buchanan, I., Burden, D.: An introduction to occlusal indices. 1994.University of Manchester, West Yorkshire, England.

9. Richmond, S., Shaw, W.C., O'Brien, D., Buchanan, I.B., et al.: The development of the PAR (Peer Assessment Rating) Index: reliability and validity. *Eur. J. Orthod.* 1992; 14:125-139.

10. Richmond, S., Shaw, W.C., Roberts, C.T., and Andrews, M.: The PAR Index: methods to determine outcome of orthodontic treatment in terms of improvement and standards. *Eur. J. Orthod.* 1992; 14:180-187.

11. DeGuzman, L., Bahiraei, D., Vig, K.W., Vig, P.S., Weyant, R.J., O'Brien, K.: The validation of the Peer Assessment Rating index for malocclusion severity and treatment difficulty. *AJO.* 1995; 107:172-176.

12. Andrews, L.F.: Straightwire. The concept and appliance. L.A. Wells Co. San Diego, 1989.

13. Katner, P.F., Schneider, B.J.: Comparison of Roth appliance and standard edgewise appliance treatment results. *AJODO.* 1993; 103(1):24-32.

14. Andrews, L.F.: Six keys to normal occlusion. *AJO.* 1972; 62:296-309.

15. Galicia-Ramos, G.A., Killiany, D.M., Kesling, P.C.: A comparison of standard edgewise, preadjusted edgewise, and tip-edge in Class II extraction treatment. *JCO*. 2001; 35(3):145-153.

16. Ugur, T., Yukay, F.: Normal faciolingual inclinations of tooth crowns compared with treatment groups of standard and pretorqued brackets. *AJODO*. 1997; 112(1):50-57.

17. Mavragani, M., Vergari, A., Selliseth, N.J., Boe, O.E., Wisth, P.L.: A radiographic comparison of apical root resorption after orthodontic treatment with a standard edgewise and straightwire edgewise technique. *Eur. J. Orthod*. 2000; 22(6):665-74.

18. O'Brien, K.D., Shaw, W.C., Roberts, C.T.: The use of occlusion indices in assessing the provision of orthodontic treatment by the hospital orthodontic service of England and Wales. *Br. J. Orthod*. 1993; 15:7-15.

19. Kerr, W.J.S., Buchanan, I.B., McColl, J.H.: Use of the PAR index in assessing the effectiveness of removable orthodontic appliances. *Br. J. Orthod*. 1993; 20:351-357.

20. Fox, N.A.: The first 100 cases; a personal audit of orthodontic treatment assessed by the PAR index. *Br. J. Orthod*. 1993; 174:290-297.

21. Holman, J.K., Hans, M.G., Nelson, S., Powers, M.P.: An assessment of extraction vs. nonextraction orthodontic treatment using the PAR index. *Angle Orthod*. 1998; 68(6):527-534.

22. Willem, G., Heidbuchel, R., Verdonck, A., Carels, C.: Treatment and standard evaluation using the Peer Assessment Rating Index. *Clin. Oral Investig*. 2001; 5(10):57-62.