A retrospective study of two-stage treatment outcomes assessed with two modified PAR indices

M. Mary McKnight, BDS, MSc, MOrth, FDSOrth; Charles P. Daniels, BDS, FDS; Lysle E. Johnston, Jr. DDS, MS, PhD

An orthodontic index records the traits of a malocclusion in either numerical or categorical form.[1] Several orthodontic indices have been developed to assess treatment need or outcome.[2,3] Some basic requirements of such an index are that it is reliable and valid, easy to use, and amenable to modification.[4] Although the strengths and limitations of the various indices are well documented,[2-5] one such index—the peer assessment rating or PAR—has gained a considerable measure of acceptance.

The PAR index was developed in 1993 by Richmond et al.[6] It measures occlusal characteristics and has been used, both in the UK[7-10] and the US,[11] to study treatment outcomes. The PAR index is a weighted combination of seven occlusal traits: upper and lower anterior alignment, right and left buccal occlusion, overjet, overbite, and centerlines. Weightings for the separate components have been derived from validation studies in which panel assessments serve as the "gold standard." Weighted scores for each of the components are combined to form a single summary score, the peer assessment rating. The effects of treatment can be inferred from changes in this composite score.

Presently, there are separate British and American weightings. The American weighting emphasizes overbite, the buccal segments, and the midline. Lower labial segment alignment is excluded because it is not thought to influence the perception of treatment outcome. In contrast, the British version includes the lower labial segment and places greater emphasis on overjet.

In the treatment of Class II Division 1 malocclusion, functional appliances are commonly

Abstract

This retrospective study was undertaken to evaluate the long-term outcome of two-stage (functional/fixed) Class II treatment. A modified peer assessment rating (PAR) was applied to the records of 27 patients who had been recalled an average of 9 years after the completion of the second phase of treatment. UK and US weightings were applied. Analysis of variance identified significant differences among treatment stages. The greatest change in PAR score occurred during the first (functional) phase of treatment. By the end of the second phase, there had been an 83% reduction in PAR score. At recall, however, the PAR scores had increased significantly, due largely to relapse in overjet and in the lower labial segment. These results call into question the ultimate utility of early, two-stage treatment regimens. Although the differences between the UK and USA weightings were smaller than anticipated, the nature of the relapse seen here argues against the American exclusion of the lower labial segment.

Key Words

PAR index • Two-stage treatment • Nonextraction treatment • Functional appliances

Submitted: August 1997 **Revised and accepted:** April 1998 Angle Orthod 1998;68(6):521-526.

Table 1
PAR weightings proposed for USA and UK

	USA PAR weighting	UK PAR weighting
Overjet	4.5	6
Overbite	3	2
Midline	3.5	2
Buccal occlusion	2	1
Upper labial segment	1	1
Lower labial segment	0	1

Table 2
Mean PAR scores (using UK weighting) for different treatment stages

Time 1-4	Mean PAR (UK)	SD	95% confidence interval
Pretreatment	31.3	6.45	28.7 to 33.81
Post-functional	15.8	8.68	12.21 to 19.38
Post-fixed	5.2	5.85	2.82 to 7.55
Postretention	11.6	7.38	8.71 to 14.54

used in the first phase of two-stage treatments that employ fixed appliances for finishing. In the US, there is growing controversy surrounding the relative merits of one- and two-phase treatments.[12] However they work (and this, too, is the subject of great controversy), functional appliances are said to improve the profile and anteroposterior jaw relationships.[1-3] Unfortunately, many workers (for example, Pancherz[14] and Wieslander[15]) have reported that the effects of the functional phase may be short-lived. Indeed, at the completion of treatment, Livieratos and Johnston[16] could find no significant differences between one-stage and two-stage alternatives. They concluded that longer, more expensive functional/fixed combinations confer no obvious skeletal benefits. Their study, however, did not examine long-term effects and employed no accepted index of occlusal improvement.

The present study was designed to characterize the time-course of PAR score improvement in two-phase (activator/edgewise) patients recalled for evaluation as adults and to compare the UK and US weightings.

Materials and methods

The subjects were treated at Louisiana State University. All presented with Class II Division 1 malocclusion and an overjet >6 mm. They were treated with a Shaye-LSU (Dr. Robert Shaye, Louisiana State University) activator followed by upper and lower fixed edgewise appliances. They were recalled for records an average of 9 years posttreatment (SD = 3.5), an interval that extends well beyond the probable retention period. As a result, each subject had four sets of study models: pretreatment (T1), end of functional phase (T2), end of fixed appliance phase (T3), and recall (T4). No appliances were in place at recall (T4). Given these records, each treatment was assessed by the first author according to both the British and American versions of the PAR index. To assess intraexaminer reliability, the scoring was repeated 2 weeks later. Analysis of variance (ANOVA) was used to test for significant among-times differences. Post hoc contrasts were effected by way of *t*-tests and Bonferroni corrections.

Results

Intraexaminer agreement was high, with a mean difference between replications of only 0.28 PAR points, a difference that is insignificant clinically and nonsignificant statistically ($p>0.9$). UK-weighted PAR scores for each stage are summarized in Table 2. One-way ANOVA revealed significant differences among treatment stages ($F_{3,63} = 64.1$, $p<0.0001$). Post hoc tests showed that the T1, T2, and T3 scores were significantly different; the T4 scores, however, had regressed to within 5 PAR points of the T2 level.

The average pretreatment score was 3.04, an overjet between 6 and 9 mm. As summarized in Table 3, there was an 83% reduction in the UK-weighted PAR scores, a good standard of treatment. O'Brien[17] reported that pretreatment PAR score was the only independent variable that influenced the percentage change in PAR. Indeed, at debond (T3), the average score implies an almost ideal occlusion (<5); however, at recall, the mean PAR score was 11.6, better than at the end of the functional phase, but still indicating a substantial residual malocclusion.[18] The US weightings produced much the same picture. The relapse in the UK scores was investigated in greater detail by examining the disaggregated PAR scores (Table 4). It is evident that all the component scores, especially overjet and the lower labial segment, increased markedly during the posttreatment (T3-4) period.

Discussion

At the outset, it must be noted that the present study looked at nonconsecutive patients, thereby introducing a potential bias because of the exclusion of altered and abandoned treatments. Selection, however, was not based on outcome, and an attempt was made to recall every two-stage patient in the Louisiana State University sample.

The PAR index was developed as an epidemiological tool to study samples from caseloads (to assess practitioner or service performance), rather than to evaluate individual patients.[19] Indeed, as noted by Shaw,[5] the PAR index has a number of obvious limitations that must be considered when it is used in the evaluation of treatment outcomes. It cannot identify inappropriate arch expansion[20] or incisor inclination, and it cannot measure improvements in appearance or psychosocial well-being. As deciduous teeth are excluded from PAR, it does not score highly for the mixed dentition,[21] and when treatment starts early, as in the present study, underscoring may occur. Indeed, a recent paper by Turbill[22] has also highlighted the limitation of the UK weightings, suggesting that the buccal occlusion weighting is too low and the overjet weighting too high. Moreover, it should be noted that the present sample was treated quite some time ago and is quite homogeneous; contemporary orthodontic populations throughout the world, however, are becoming progressively more diverse, a trend that must be recognized in future iterations of the PAR index. Despite these various potential shortcomings, the PAR index and the present sample provide an interesting picture of the long-term pattern of change in contemporary two-stage functional/fixed-appliance treatments.

It is beyond the scope of PAR to predict from the initial malocclusion and pretreatment severity any relapse tendency. The long-term results seen here imply that treating early, even with functional appliances, does not grant the patient immunity from relapse. The fluctuations and final state of the PAR index raise the question of cost/benefit ratio. In the long run, would a single phase of treatment, early or late, have been as effective? Viewed from the standpoint of treatment effects, there is evidence that an early functional phase does not seem to add anything special to the outcome vis-à-vis a single bout of fixed-appliance treatment.[16] To be fair, it could be argued that a single *functional* phase (in conjunction with the usual pattern of posttreatment growth) might also produce a comparable result. In their effects on the skeleton, fixed and functional appliances may well turn out to be interchangeable; however, it is unlikely that they are equal in terms of their capacity to regulate* teeth. Thus, from the standpoint of the PAR index and its emphasis on the occlusion, it is probable that a single phase of edgewise treatment would be the most cost-effective means of achieving an optimal, as opposed to adequate, correction.

Table 3
Overall PAR reduction

Stage	Percentage reduction UK	US
End of fixed	83.3	77.6
End of retention	62.9	59.8

Table 4
Disaggregated PAR scores to show relapse

PAR component	Initial raw score (unweighted) (T1)	Raw score post-fixed (T3)	Raw score post-retention (T4)	% increase in raw score following active tx
Overjet	3.04	0.15	0.66	340
Overbite	1.74	0.56	0.9	60.7
Centerline	0.33	0.15	0.41	173
Buccal segments	3.37	1.31	2.07	58
Upper labial segment	3.81	0.93	1.34	44.1
Lower labial segment	1.04	0.11	0.90	718

Although the difference between the scores generated by the British and American weightings was relatively small, the lower-incisor relapse argues that lower labial segment alignment be included in the US version.

Conclusions

The present recall data argue that short-term treatment comparisons may paint an unduly optimistic picture of the success of orthodontic treatment. As judged by the PAR index, even the use of early, two-stage treatments leading to an almost perfect occlusion does not guarantee an absence of relapse. Meaningful exploration of various treatment options with the PAR index thus must be based on long-term data and weightings that are appropriate, both to the population and to the nature of the expected relapse.

Acknowledgments

We would like to thank the National Institute of Dental Research (grant DE08716) and the Anglia and Oxford Health Authority for their support.

*A useful, once-popular verb, long lost from an impoverished orthodontic lexicon that no longer contains a good alternative to the lay term, straighten.

Author address

M.M. McKnight
Department of Orthodontics
John Radcliffe Hospital
Oxford, England
OX3 9DU

M.M. McKnight, senior registrar, Department of Orthodontics, John Radcliffe Hospital, Oxford, England.

C.P. Daniels, postgraduate registrar, Department of Orthodontics, Dental Hospital, University of Wales College of Medicine, Cardiff, Wales.

L.E. Johnston Jr., Robert W. Browne Professor of Dentistry chair, Department of Orthodontics and Pediatric Dentistry, School of Dentistry, University of Michigan, Ann Arbor, Michigan.

References

1. Muir JD. Report of the occlusal index committee. Dental Practice 1987, September 9-12.
2. Pickering EA, Vig P. The occlusal index used to assess orthodontic treatment. Br J Orthod 1975; 2: 47-51
3. Elderton RJ, Clark JD. Orthodontic treatment in the General Dental Service assessed by the occlusal index. Br J Orthod 1983; 14: 178-86.
4. Shaw WC, Richmond S, O'Brien KD. The use of occlusal indicies: A European perspective. Am J Orthod Dentofac Orthop 1995; 107: (1) 1-10
5. Shaw WC. A comparison of orthodontic services in England and Wales, the Netherlands and Scandinavia. Eur J Orthod 1983; 5: 295-305
6. Richmond S. Personal audit in orthodontics. Br J Orthod 1993; 20: 131-140
7. Richmond S, Shaw WC, O'Brien KD, Buchanan IB, Jones R, Stephens CD, et al. The development of the PAR index (peer assessment rating): Reliability and validity. Eur J Orthod 1992; 14: 125-39.
8. Richmond S, Shaw WC, Stephens CD, Webb WA, Roberts CT, Andrews M. Orthodontics in the General Dental Services of England and Wales: A critical assessment of standards. Br Dent J 1993; 174: 315-329
9. O'Brien KD, Shaw WC, Roberts CT. The use of occlusal indices in assessing the provision of orthodontic treatment by the hospital orthodontic service of England and Wales. Br J Orthod 1993; 20: 25-35.
10. O'Brien KD, Weyant RJ. Process analysis of treatment provided by the hospital orthodontic service. Br J Orthod 1993; 2: 131-4.
11. DeGuzman L, Bahiraei D, Vig KWL, Vig PS, Weyant RJ, O'Brien KD. The validation of the PAR (peer assessment rating) for malocclusion severity and treatment difficulty. Am J Orthod Dentofac Orthop 1995;107: 172-6.
12. Edwards IG. Righting the wrong paradigm. Am J Orthod Dentofac Orthop 1996; 110: 16A-8A.
13. Meach CL. A cephalometric comparison of bony profile changes in Class II Division 1 patients treated with extra-oral force and functional jaw orthopaedics. Am J Orthod 1966; 52: 353-370.
14. Pancherz H. The nature of Class II relapse after Herbst appliance treatment: A cephalometric long-term investigation. Am J Orthod Dentofac Orthop 1991; 100: 220-233.
15. Wieslander L. Long term effect of treatment with headgear - Herbst appliance in the early mixed dentition. Stability or relapse? Am J Orthod Dentofac Orthop 1993; 104: 319-329.
16. Liveratos FA, Johnston LE Jr. A comparison of one- and two-stage nonextraction alternatives in matched Class II samples. Am J Orthod Dentofac Orthop 1992; 108: 118-31.
17. O'Brien KD, Robbins R,Vig KWL,Vig PS, Shnorhokian H, Weyant R. The effectiveness of Class II Division 1 treatment. Am J Orthod Dentofac Orthop 1995;107:329-34.
18. Richmond S, Shaw WC, Roberts CT, Andrews M. The PAR index (peer assessment rating): Methods to determine outcome of orthodontic treatment in terms of improvements and standards. Eur J Orthod 1992; 14: 180-187.
19. Turbill EA, Richmond S. Assessment of GDS Orthodontic standards: The DPB's gradings compared to PAR and IOTN. Br J Orthod 1996; 23: 211-220.
20. Hinman C. The Dental Practice Board: Orthodontics - the current status. Practice Management Forum. Br J Orthod 1995; 22: 287-90.
21. Fox NA. The first 100 cases: A personal audit of orthodontic treatment assessed by the peer assessment rating (PAR) index. Br J Orthod 1993; 174: 290-297.
22. Turbill EA, Richmond S,Wright JL. A critical assessment of orthodontic standards in England and Wales (1990-1991) in relation to changes in prior approval. Br J Orthod 1996; 23: 221-228