Efficiency of Class II Division 1 and Class II Division 2 Treatment in Relation to Different Treatment Approaches

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The aim of this study was to assess the efficiency of Class II Division 1 and Class II Division 2 treatment comparing different treatment approaches (conventional and Herbst). Treatment efficiency was defined as a better result in a shorter treatment time. One hundred forty-two patients aged 10 to 15 years treated in the late mixed and permanent dentition were examined. The conventional treatment approach used at the University of Giessen (removable and multibracket appliance) was used in 98 subjects (75 Class II Division 1 and 23 Class II Division 2). The Herbst approach (Herbst appliance followed by a multibracket appliance) was used in 44 subjects (30 Class II Division 1 and 14 Class II Division 2). Pre- and posttreatment dental casts were evaluated using the PAR Index. Active treatment duration was recorded. Subjects treated with the Herbst approach had a shorter treatment duration (Class II Division 1 = 21.0 months, Class II:2 = 30.4 months) than those treated with the Conventional approach (Class II Division 1 = 32.1 months, Class II:2 = 38.3 months). The PAR Score reduction (= improvement) was larger in subjects treated with the Herbst approach (Class II Division 1 = 76%, Class II:2 = 76%) than in subjects treated with the Conventional approach (Class II Division 1 = 68%, Class II Division 2 = 65%). It was concluded that both treatment of Class II Division 1 and Class II Division 2 malocclusions was more efficient using the Herbst approach than using the conventional approach. (Semin Orthod 2003;9:87-92.) *Copyright 20032003, Elsevier Science (USA). All rights reserved.*

*B*ecause of constraints in the public health care system, the assessment of treatment success is of increasing importance. In various studies assessing orthodontic treatment outcome, the influence of patient-related factors (age, sex, cooperation),[1-16] the qualification of the operator,[1,3,8,12,17] and the method of therapy[3,7,8,11,12,15-19] have been examined.

Many indices have been developed to assess orthodontic treatment outcome.[4,20-26] Of these,

the Peer Assessment Rating (PAR Index)[25,26] has become increasingly popular. It is an objective method, and its reliability and validity have been certified in many studies.[12,13,17,25-34]

At the orthododontic department in Giessen, the 2 most common treatment approaches for Class II malocclusions are the conventional approach and the Herbst approach.

Conventional Approach

In Class II Division 1 subjects treated during pubertal growth and in the late mixed dentition, usually an activator is used for mandibular advancement, often preceded by a removable plate for expansion of the upper jaw. Once the patient is in the permanent dentition, multibracket appliances in both jaws, often combined with Class II elastics, are used for final adjustments.

In Class II Division 2 subjects treated during pubertal growth and in the late mixed dentition the upper incisors are first proclined using a removable plate in the upper jaw, thus converting the Class II Division 2 into a Class II Division 1. Thereafter, mandibular advancement is performed by the use of an activator. Once the patient is in the permanent dentition, multibracket appliances in both jaws, often combined with Class II elastics, are used for final adjustments.

Herbst Approach

In Class II Division 1 subjects treated after pubertal growth and in the permanent dentition, the method of jumping the bite with the Herbst appliance is the approach of choice. Once the Class II occlusion has been corrected, the Herbst appliance is removed, and a multibracket appliance in the upper and lower jaw is used for final adjustments.

In Class II Division 2 subjects treated after pubertal growth and in the permanent dentition, the Herbst appliance is also the common approach to correct the Class II malocclusion. However, to be able to perform mandibular advancement, the upper incisors have to be proclined first with a maxillary multibracket appliance. Once the Class II occlusion has been corrected, the Herbst appliance is removed, and a multibracket appliance in the upper and lower jaw is used for final adjustments.

The purpose of this study was to assess the efficiency of Class II Division 1 and Class II Division 2 treatment comparing the Herbst and conventional approaches. Treatment efficiency was defined as a shorter treatment duration with a better outcome. The treatment outcome was assessed using the PAR Index.[25,26]

Subjects

All patients with a Class II Division 1 or Class II Division 2 malocclusion aged 10 to 15 years whose treatment was completed between 1990 and 1997 at the orthodontic department of the University of Giessen were screened. Only those subjects (n = 142) fulfilling the following requirements as determined from pretreatment dental casts were selected for this study:

1. Treatment in the late mixed or permanent dentition.
2. Unilateral or bilateral distal molar relationship $>\frac{1}{2}$ cusp width when the deciduous lower second molars still were present.
3. Unilateral or bilateral distal molar relationship $\geq\frac{1}{2}$ cusp width when the second premolars had erupted.

With respect to the treatment method the patients were divided into 2 groups: (1) Herbst approach (n = 44) and (2) conventional approach (n = 98).

Within each of these groups the patients were subdivided according to their malocclusion: Herbst approach: Class II Division 1 (n = 30) and Class II Division 2 (n = 14) and conventional approach: Class II Division 1 (n = 75) and Class II Division 2 (n = 23).

Methods

The duration of active treatment (before retention) was recorded. Pre- and posttreatment dental casts were evaluated by using the PAR Index. Posttreatment means after retention and full eruption of all permanent teeth, with or without third molars, were calculated.

In the PAR Index,[25,26] the deviation from a normal occlusion and alignment is assessed by using 5 dental components which are weighted differently. The weighted scores of the components are summed to obtain a total score (PAR Index), expressing the severity of the malocclusion. The 5 components are anterior alignment (weighted $\times$ 1), buccal occlusion (weighted $\times$ 1), overjet (weighted $\times$ 6), overbite (weighted $\times$ 2), and midline discrepancy (weighted $\times$ 4). A total score of 0 means a perfect occlusion and alignment. The higher the score, the greater the deviation from normal. To assess treatment success the posttreatment score is compared with the pretreatment score and the reduction in PAR score (improvement) is expressed in percent and/or in points. All registrations are performed with the PAR ruler, a plastic ruler designed especially for this index. In this study, all measurements were made twice, and the mean value was used for the final evaluation. All registrations were performed by one of the authors (JB) calibrated for the use of this index.

Statistical Methods

Because the variables showed an asymmetric distribution, nonparametric Kruskal-Wallis H tests and Hodges Lehmann estimates were applied for the statistical analysis. The significance levels used were $P < .001$, $P < .01$, and $P < .05$. $P \geq .05$ was considered nonsignificant. The results were expressed by box plot diagrams (Fig 1).

Results

Treatment Duration

Class II Division 1 patients had a shorter treatment duration than Class II Division 2 patients ($P < .001$) Furthermore, patients treated with the Herbst approach had a shorter ($P < .001$) treatment duration (Class II Division 1, 21.0 months; Class II Division 2, 30.4 months) than those treated with the conventional approach (Class II Division 1, 32.1 months; Class II Division 2, 38.3 months) (Fig 2).

PAR Index

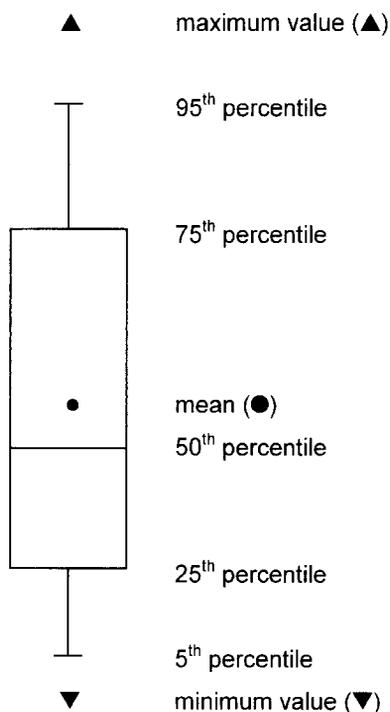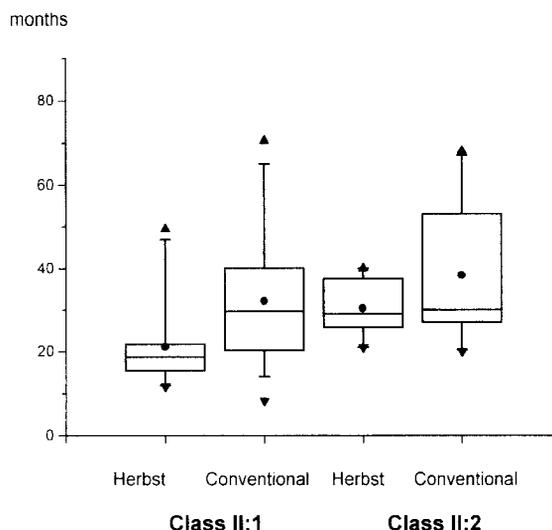The pretreatment PAR score in subjects treated with the Herbst approach (27.0) and

months

Figure 2. Treatment duration (months) in 105 Class II Division 1 and 37 Class II Division 2 patients in relation to the treatment approach. Herbst approach: Class II Division 1 (n = 30), Class II Division 2 (n= 14); conventional approach: Class II Division 1 (n= 75), Class II Division 2 (n = 23).

subjects treated with the conventional approach (26.7) was nearly the same. After treatment, subjects treated with the Herbst approach had a lower ($P < .01$) PAR score (5.7) than those treated with the conventional approach (8.2) (Fig 3).

PAR Score Reduction in Points

Class II Division 1 patients had a higher PAR score reduction ($P < .001$) in points than Class II Division 2 patients. Furthermore, subjects treated with the Herbst approach had a higher PAR Score reduction ($P < .01$) in points (Class II Division 1, 24.6; Class II Division 2, 13.7) than subjects treated with the conventional approach (Class II Division 1, 20.2; Class II Division 2, 13.5) (Fig 4).

PAR Score Reduction in Percent

Class II Division 1 patients had about the same PAR score reduction as Class II Division 2 patients. Subjects treated with the Herbst approach had a higher PAR score reduction ($P < .001$) in percentage (Class II Division 1, 75.9; Class II Division 2, 76.4) than subjects treated with the conventional approach (Class II Division 1, 68.1; Class II Division 2, 65.3) (Fig 5).
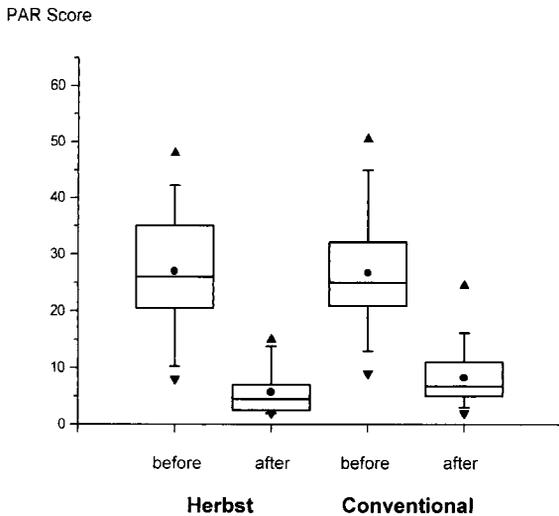

Figure 1. Explanation of the box plot diagram.

Figure 3. PAR score before and after treatment in 105 Class II Division 1 and 37 Class II Division 2 patients in relation to the treatment approach. Herbst approach: Class II Division 1 (n = 30), Class II Division 2 (n = 14); conventional approach: Class II Division 1 (n = 75), Class II Division 2 (n = 23).

Discussion

In interpreting the present findings, it must be kept in mind that all patients were treated by orthodontic postgraduate students. However, the treatment of the patients was supervised by
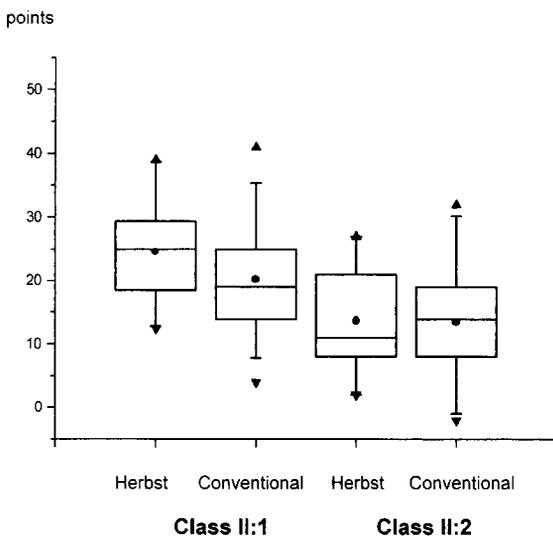

Figure 4. PAR score reduction (points) in 105 Class II Division 1 and 37 Class II Division 2 patients in relation to the treatment approach. Herbst approach: Class II Division 1 (n = 30), Class II Division 2 (n = 14); conventional approach: Class II Division 1 (n = 75), Class II Division 2 (n = 23).

Figure 5. PAR Score reduction (%) in 105 Class II Division 1 and 37 Class II Division 2 patients in relation to the treatment approach. Herbst approach: Class II Division 1 (n = 30), Class II Division 2 (n = 14); conventional approach: Class II Division 1 (n = 75), Class II Division 2 (n = 23).
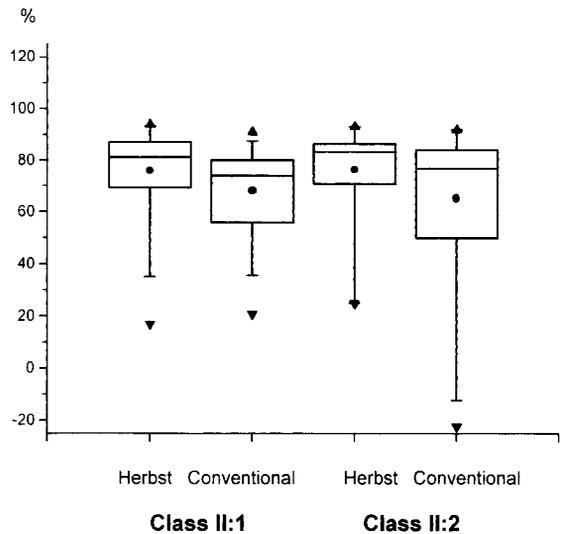
the same team of instructors, thus ensuring uniformity in therapeutical approaches.

Treatment Duration

The duration of active treatment for all 142 patients ranged between 8 and 71 months, with a median of 30.6 months. Using exclusively fixed appliances, a similar treatment duration (4-91 months) was reported by Vig et al[16] with a mean of 31 months. A shorter mean duration was described by Alger[18] with 22 months and Fink and Smith[7] with 23 months. The present study, however, showed that treatment time was shorter when using the Herbst approach (Class II Division 1, 21 months; Class II Division 2, 30 months) than when using the conventional approach (Class II Division 1, 32 months; Class II, Division 2, 38 months.) In both treatment approach groups, Class II Division 2 patients generally had a longer treatment duration than Class II Division 1 patients, probably because a Class II Division 2 had to be converted into a Class II Division 1, before mandibular advancement could be performed.

PAR Index

The average (median) pretreatment PAR score of all 142 patients was 26.8 points. Similar

scores (27-31 points) were found by Turbill et al[32,34] when assessing the orthodontic standard of the General Dental Services in England and O'Brien et al[12] and Hamdan and Rock[35] when examining patients treated in dental schools. Lower scores (16-25 points) were found by Pangrazio-Kulbersh et al[13] and Firestone et al.[8] Pangrazio-Kulbersh et al[13] examined 103 consecutively treated cases (average pretreatment age, 9.8 years), and Firestone et al[8] patients treated at a dental school. The majority were treated with fixed appliances. The low pretreatment PAR Score of Pangrazio-Kulbersh et al[13] might be explained by the young patient material and the fact that deciduous teeth are not evaluated in the PAR Index.

After treatment, the average (median) PAR score of all 142 patients was 7.3 points. This score is in accordance with that (5-12 points) of other studies.[8,25,26,32,34] Richmond et al[25,26] remarked that a final PAR score below 10 is an acceptable result and scores under 5 are close to a perfect occlusion and alignment. That means that, on average, an acceptable result was reached in the present patient material.

Furthermore, Richmond et al[25,26] pointed out that a high treatment standard is characterized by a PAR score reduction of at least 70%. A high PAR score reduction is, of course, reached easier in subjects with a high pretreatment PAR Index than in subjects with a low pretreatment index. This means, the worse the pretreatment malocclusion, the greater the possible improvement through treatment. This is in agreement with Taylor et al,[15] who also found that a high pretreatment PAR Score had a positive effect when assessing the quality of orthodontic therapy. Similar results were found by Kerr et al[11] and Al Yami et al.[2]

PAR Score Reduction in Relation to the Treatment Approach

Patients treated with the Herbst approach had a greater PAR score reduction in points and in percent than patients treated with the conventional approach. Other authors[9,12,17] also reported about a correlation between treatment method and outcome. They found that fixed appliances in both arches had the greatest effect in improving a malocclusion. However, neither Pangrazio-Kulbersh et al[13] nor Ahlgren[1] found

any association between the appliances used and the treatment success.

In the present study Class II Division 1 subjects achieved a greater PAR score reduction in points than Class II Division 2 subjects. This can be explained by a higher pretreatment PAR score in Class II Division 1 subjects because of the great overjet (weighted $\times$ 6). However, the PAR score reduction in % was about the same in Class II Division 1 and Class II Division 2 subjects. That means, that in relation to the severity of the pretreatment malocclusion, the amount of improvement was about the same in both malocclusion groups.

Conclusion

Both with respect to treatment duration and to treatment outcome, Class II Division 1 and Class II Division 2 treatment was more efficient with the Herbst approach than with the conventional approach.

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