Original Article

Occlusal Changes of Class II Malocclusion Treatment between Fränkel and the Eruption Guidance Appliances

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Abstract: The objective of this study was to compare the occlusal changes of Class II malocclusion treatment provided by two different types of appliances. Group 1 comprised 25 patients treated with the Fränkel appliance and group 2 comprised 30 patients treated with the eruption guidance appliance. Evaluations were performed on the initial and final study models of the patients using the peer assessment rating (PAR) index. The final mean PAR index, the mean PAR change, and the percent PAR reduction of each group were compared using the Student's *t*-test. Results demonstrated that there were no statistically significant differences between the final PAR index, the PAR changes, and the percent PAR reduction of the two groups. Therefore, it was concluded that the occlusal changes provided by the two appliances are similar, as evaluated by the PAR index. (*Angle Orthod* 2004;74:521–525.)

Key Words: Occlusal changes; Fränkel appliance; eruption guidance appliance

INTRODUCTION

Because Class II anteroposterior discrepancy is one of the most common malocclusion characteristics, its treatment approaches have been thoroughly investigated.[1,2] Two available therapeutic approaches for Class II malocclusion treatment are the Fränkel appliance (FRI)[3,4] and the eruption guidance appliance.[5]

The FRI[3] was introduced in 1966, initially named a functional corrector and then functional regulator, and is indicated for correction of Class II division 1 malocclusion during the mixed or the early permanent dentition.[4] This appliance requires exercises of the orofacial musculature and modifies their pattern of action. The appliance also repositions the mandible forward by means of a construction bite, into an edge-to-edge incisor relationship. Although the outcomes are basically dentoalveolar,[6] some investigations have observed improvements in maxillomandibular relationships and lateral expansion of the arches.[7,8]

The eruption guidance appliances (Occlus-o-Guide—Ortho-Tain Inc., PO Box 4296, Bayamon Gardens, Puerto Rico) are considered a combination of a functional appliance and a tooth positioner. The Occlus-o-Guide places the mandible forward to correct the Class II relationship and acts as a tooth positioner because it is constructed of an elastomeric material that can produce minor tooth movement. The Occlus-o-Guide is prefabricated in 13 different sizes to fit 95% of the cases.[5] This appliance is indicated for patients with Class II malocclusions associated with deep overbite and overjet,[5] during the mixed dentition and follows the same indications as most functional appliances.[5,9,10]

The choice for a specific type of treatment is based on its efficiency in correcting several aspects of the malocclusions, especially the occlusal characteristics. The choice is also associated with the ease of use by the clinician as well as patient-compliance level. For this reason, selection of an appliance for Class II malocclusion treatment requires knowledge of its efficiency as compared with other methods. Currently, no study has been conducted to assess the occlusal changes of these two treatment modalities.

Therefore, the objective of this work was to compare the occlusal changes of the FRI and the eruption guidance appliance, using the peer assessment rating (PAR) index.[11,12] The following null hypothesis was tested ie, there is no difference in the occlusal changes between the FRI and the eruption guidance appliance.

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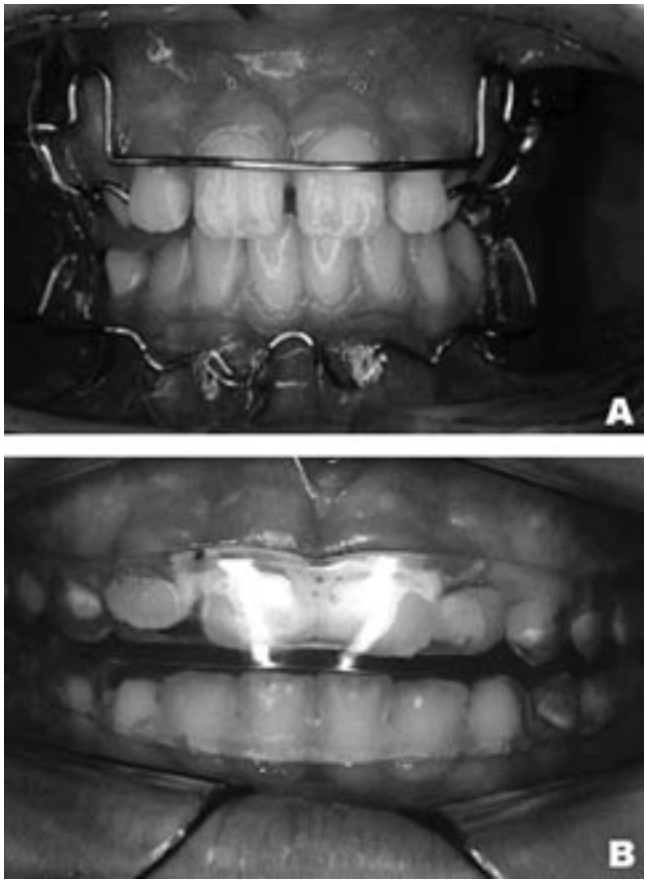

FIGURE 1. The two different types of appliances studied. (A) Fränkel appliance. (B) Eruption guidance appliance.

MATERIALS AND METHODS

From the treated-patients' records of the Orthodontic Department, Bauru Dental School, two samples of Class II patients were retrospectively drawn. One group had been treated with the FRI and one group with the eruption guidance appliance. The samples consisted of Class II patients that had been assigned for treatment using these appliances from the beginning and had completed treatment with them, without any changes in the treatment strategy.

Group 1 consisted of 25 patients (11 girls and 14 boys) with an initial mean age of 9.29 years (range eight to 11.6 years) treated with the FRI[4] during a mean treatment time of 24 months (range 18 to 34 months) (Figure 1A). The construction, adaptation, and use of the FRI were according to Fränkel and Fränkel[4] and McNamara.[13] In patients with an overjet smaller than six mm, the mandible was advanced until an edge-to-edge incisor relationship was obtained, as proposed by McNamara.[13] In those patients with an overjet larger than six mm, an initial mandibular advancement of six mm was performed and a second advancement was needed.[4]

Group 2 included 30 patients (15 girls and 15 boys) with an initial mean age of 9.45 years (range 8.1 to 11.1 years) treated with the G series of the eruption guidance appliance, known as Occlus-o-Guide[5,14] during a mean time of 28 months (range 12 to 40 months) (Figure 1B). Each patient was instructed to use the appliance while sleeping and for four hours during the daytime. These four hours were to be divided into four periods of one hour each. In each one-hour period, the patient was instructed to bite heavily into the appliance for one minute and gently for the following minute for the first half hour. During the following half hour, the patient was instructed to only bite gently into the appliance, always keeping the lips in contact. Each patient was given a printed form and was asked to keep a daily record of appliance wear. Patients were asked to bring the forms to each visit for tabulation. An additional check on their cooperation was made by the appearance change in the appliance material, which is made to alter according to the number of hours it is in the mouth actively. The cooperation of the patients in wearing the appliance was monitored by each student, but a variation in the degree of cooperation was possible. The occlusion changes were monitored monthly.[15]

Selection criteria required that all patients have both the maxillary and mandibular first molars erupted and the radiographic presence of the permanent teeth up to the second molars. Patients that had one of these appliances assigned as their treatment were included, regardless of compliance level. The patients selected for the study had to possess both pre- and posttreatment study models.

PAR index

The patient's pretreatment and posttreatment study models were scored with the American weighted PAR index.[12] The degree of improvement as a result of orthodontic treatment was assessed by two methods. The first method used the PAR change, which is the difference between the pretreatment and posttreatment scores. The second was the percent PAR reduction, which reflects the PAR change relative to the pretreatment score. This is determined by the formula: $X1-X2/X1 \times 100\%$, where X1 is the pretreatment PAR score and X2 is the posttreatment PAR score.

Statistical analysis

The comparison between the groups was performed using independent Student's *t*-tests. Results were considered significant for $P < .05$.

Error study (intrarater reliability)

Forty pairs of dental study models were remeasured by the same examiner. The casual error was calculated according to Dahlberg formula ($S^2 = \Sigma d^2/2n$) and the systematic error with dependent Student's *t*-test, for $P < .05$.

TABLE 1. Results of the intraexaminer systematic and casual errors investigation

	1st Measurement		2nd Measurement			
	Mean	SD	Mean	SD	*P*	Dahlberg
Initial PAR	14.90	4.45	15.20	4.03	.2845	0.88
Final PAR	4.25	3.80	4.00	3.30	.2044	0.62
PAR changes	10.65	3.82	11.20	3.30	.1183	1.13

TABLE 2. Results of the comparison between the two groups (*t*-test)

	Group 1 (n = 25)		Group 2 (n = 30)		
Variable	Mean	SD	Mean	SD	*P*
Initial age	9.29	1.06	9.45	0.72	.5097
Initial PAR	16.60	3.54	15.23	3.73	.1729
Final PAR	6.12	3.27	4.26	3.71	.0571
PAR changes	10.48	4.39	10.97	3.50	.6469
Percent PAR reduction	63.13	20.20	72.71	18.49	.0722

RESULTS

Table 1 shows the intrarater reliability investigation results. There were no statistically significant differences between the initial mean ages and between the initial PAR index, the final PAR index, the PAR changes, and the percent PAR reduction of the two groups. These results are shown in Table 2. The power of the statistical tests for each variable was calculated. The power of 80 percent for the test was able to detect the following differences between the groups for each variable: initial age = 0.62 years; initial PAR = 2.56; final PAR = 2.46; PAR changes = 2.75; and percent PAR reduction = 13.55.

DISCUSSION

Patients included in this study necessarily presented a Class II molar relationship. No criteria of severity were established because of the retrospective study design. The evaluation was based on the inclusion of as many cases as possible that had been submitted to treatment with the two different types of appliances for the same time period. The observation of the initial PAR indexes of the two groups in Table 2 demonstrates that the degree of malocclusions were mild as compared with other investigations using this index.[16,17] This mild degree of malocclusion in such study might be criticized, with the suggestion that the Class II anteroposterior discrepancy should be more severe. However, prospective studies that have investigated removable appliance effects also show samples comprising mild Class II malocclusions.[18,19]

In the first study, the sample consisted of considerable numbers of half Class II cases, even though they reported only 38% of success with the bionator and 50% success with the headgear after Phase I treatment.[18] Other prospective studies demonstrating successful correction of complete Class II cases with functional appliances consisted of those treated with the Herbst appliance, that is, in fact, a fixed appliance and does not require patient compliance in using it.[20] Therefore, the severity of the Class II malocclusion studied is similar to others in the literature. In addition, the rate of success of nonextraction therapies for severe Class II malocclusions is quite low with removable appliances.[18,21]

Compatibility of the groups

The groups presented comparable mean ages at the pretreatment stage (Table 2), but they could still present characteristics that would affect the types of treatment under investigation. Thus, to test the comparableness of their initial occlusal characteristics, the initial PAR indexes were compared before treatment onset. Table 2 demonstrates that the initial PAR index was similar in both groups. To match the initial mean malocclusion severity of the groups according to the PAR index, some patients of group 2 that presented the smallest indexes were excluded.

Methodology

Ideally it would be interesting to have a matched control group to differentiate the treatment effects from normal growth. However, the use of a Class II untreated control group was not considered to be essential because the purpose was not to evaluate the changes with the appliances as compared with normal growth changes but rather to compare the changes between the two types of appliances. This approach has also been used by other workers who have compared the treatment effects of different appliances.[22,23]

Usually, the standard approach to study anteroposterior malocclusion characteristics or treatment uses cephalometric variables to select the cases with skeletal anteroposterior malrelationships.[24] Furthermore, the cephalometric variables are used to measure the percentage of changes due to mandibular growth, maxillary forward growth restriction, and maxillary and mandibular dentoalveolar changes.[19] Therefore, it will allow one to learn about the skeletal as well as the dentoalveolar changes of the Class II during treatment. However, it does not provide information regarding the occlusal changes consequent to treatment. It may even be that, despite considerable dentoskeletal changes in a case, the occlusal relationship may still be deficient.

Therefore, this study departs from the standard approach because it is only interested in evaluating the amount of occlusal changes that are consequent to treatment with these appliances, regardless of the dentoskeletal nature of these changes. In a certain perspective, these results may be even more interesting because the patients and parents can understand and notice the occlusal changes more easily as compared with the cephalometric dentoskeletal changes.

Further investigation can study the correlation between the occlusal changes observed in this study with the cephalometric dentoskeletal changes produced by these appliances.

The PAR index was used because it was specially designed to evaluate treatment changes and outcome. It has proven valid and reliable in this assessment. However, it is not sensitive to fine details of the occlusion.[17]

Posttreatment changes

Results demonstrated that the final PAR indexes, its changes and the percent PAR reduction were statistically similar between the two groups (Table 2). It is interesting to note that the percent reduction with the eruption guidance appliance (Occlus-o-Guide, OG: 72.71%) was almost significantly greater than with the Fränkel appliance (63.13%).

Because the PAR index is resultant of the addition of several malocclusion irregularities, the effects of the appliances on each of the most important irregularities will be analyzed separately to ascertain the reasons for the results obtained.

Anteroposterior correction

This is the most important malocclusion characteristic to be corrected in nonextraction Class II cases and also the one with considerable weight in the American weighted PAR index.[12] Therefore, it can be concluded that substantial treatment changes evaluated were in the anteroposterior relationship. Among the several abnormalities presented in these cases, the anteroposterior discrepancy depended on the compliance of the patients in wearing the appliances. The Fränkel appliance has a small forward growth restriction on the maxilla.[25] However, what may compensate this limited influence on maxillary growth is the condylar remodeling potential of this appliance.[26] Though controversial, studies have demonstrated a certain remodeling and consequent increase in mandibular length when this appliance is used.[27] The eruption guidance appliance is considered a combination of a functional appliance and a tooth positioner.[5,9,15] Therefore, its effects in correction of the Class II anteroposterior discrepancy and on mandibular growth are similar to functional appliances.[9,15]

Overjet correction

Overjet plays a major role in the weighted PAR index,[12] and correction of the anteroposterior discrepancy consequently improves the overjet.[28] In addition, palatal tipping of the maxillary and labial tipping of the mandibular incisors add to the decrease in this abnormality. In both the Fränkel and the eruption guidance appliances, the mandibular advancement for Class II correction will produce a distal force on the maxillary and a labial force on the mandibular incisors. Therefore, these teeth will tend to tip palatally and labially, respectively.[4,5]

Overbite correction

The overbite also has a great importance in the weighted PAR index.[12] With the eruption guidance appliance, correction is accomplished because of the greater thickness of elastomeric material between the mandibular and maxillary incisors and a lack of contact between the posterior teeth. The greater thickness at the incisors restricts their vertical development, whereas concurrently, the lack of contact between the posterior teeth allows them a greater vertical development, which will also contribute to correction of the overbite.[5,29] However, the Fränkel appliance that presents neither resin nor wires on the anterior teeth is the least effective in correcting this abnormality because of the absence of restriction of the vertical development of the anterior teeth. Therefore the Fränkel appliance will depend primarily on the greater vertical development of the posterior teeth to correct overbite.[29] This difference in efficiency between the two appliances probably explains the numerically greater percent PAR reduction of the OG as compared to the Fränkel appliance.

Crowding correction

The eruption guidance appliances are able to correct crowding of the anterior teeth, yet only 22.8% of the patients treated with this appliance did not subsequently need fixed appliances for the detailed individual tooth positioning. In the group with the Fränkel appliance, only 5.2% did not need detailed tooth positioning with fixed appliances at the end (the final PAR indexes for these groups were obtained before the use of the fixed appliances). However, in the two groups, the amount of crowding was only mild. Because the cases were treated without extraction, it is obvious that they could not present severe crowding initially.

Posterior crossbite correction

Correction of this problem probably did not play a major role in the differences in treatment changes because cases with posterior crossbites were not included in the Fränkel and eruption guidance appliance groups.

Clinical considerations

The results of this research allow the conclusion that there is a similar effectiveness in producing occlusal changes in the two investigated appliances, regardless of treatment time. Hence, the choice of one of these appliances must not be exclusively based on its effectiveness but rather on other specific features. The main shortcoming of the Fränkel appliance is its large size and the initial discomfort until the patient gets accustomed to it.[30] The mean treatment time with this appliance was 24 months.

The eruption guidance appliance presents advantages over the Fränkel appliance because it is smaller but presents a slightly greater mean treatment time (26 months). Con-

sequently, the orthodontist, when selecting one of these appliances, must take all these factors into account as well as the patients and parents' chief complaints and preferences. Comparisons of the appliance effects on the aforementioned discrepancies, individually, should be made to disclose their best effectiveness in each area.

CONCLUSION

The null hypothesis was accepted because, based on the PAR index, no difference was demonstrated in the amount of occlusal changes between the two appliances.

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