Comparative study of complications during Herbst treatment with Cantilever Bite Jumper and removable mandibular acrylic splint

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Abstract

Objective: To assess and compare the type of complications during Herbst treatment with Cantilever Bite Jumper (CBJ) and removable mandibular splint. **Methods:** Twenty one consecutive Herbst patients treated with the CBJ were compared with twenty one consecutively treated Herbst patients with stainless steel crowns on the maxillary first molars and a removable mandibular acrylic splint. The initial mean age for the CBJ group was 12 years and 3 months and for the Splint group was 11 years and 3 months. Both groups used the Herbst appliance for 12 months. Based on the patients' clinical records an occurrence survey of complications during Herbst treatment was performed. **Results:** There were 24 complications for the CBJ and 53 for the Splint group, which were statistically different (Mann-Whitney test, $p<0.05$). The prevalence of patients exhibiting complications during treatment was 66.67% in the CBJ and 85.71% in the Splint group. The frequencies of complications were also statistically different between the groups. **Conclusions:** The CBJ exhibited a significantly smaller number of complications during Herbst appliance treatment than the removable mandibular splint. Herbst appliance with first molar crowns and a cantilever on the mandibular molars is preferable to the removable mandibular acrylic splint because of savings in clinical and laboratory time.

Keywords: Herbst appliance. Class II. Complications.

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INTRODUCTION

Since its reintroduction by Pancherz[13] in 1979, the Herbst[3] appliance has aroused considerable clinical interest. Several changes in the telescopic system have been proposed and different methods to insert the Herbst appliance mechanism in the dental arches have been described in the literature.[4-12] Moreover, along the last 20 years much research[1,11,13,15,16,19] has been conducted to evaluate the dental and skeletal effects of treatment using this appliance.

More recently, two investigations[2,17] on the rate of complications during treatment with Herbst revealed that the pattern of complications depends on the type of appliance used, with more fractures affecting patients who wore the appliance with bands. More debondings were detected in patients who wore the metal splint model. Although no difference was found in the overall frequency of complications between the appliance with bands and with metal splint, the latter has been recommended as it saves both clinical and laboratory time.

In 2007, Schiöth et al[18] compared the prevalence of type and frequency of complications with the use of total (canine to molar) and short (canine to second premolar) metal splints. They concluded that the major complication that takes place during Herbst use concerned maxillary splint debonding. Reducing the length of the lower splint does not increase the prevalence of complications but it reduces costs, and its use can therefore be recommended.

During the past year, various design models were tested for insertion of the Herbst telescopic system for Class II treatment. The challenge lies in finding a model better suited to Brazilian reality. Two models have earned the authors' preference: The Herbst appliance with Cantilever Bite Jumper (CBJ)[5,10] and the Herbst appliance with lower removable acrylic splint (LRAS).[9]

To date, no study has compared the complications that take place with CBJ vs. LRAS models. The aim of this study, therefore, was to compare the complications incurred by these two types of Herbst appliances in order to assess (a) whether one involves more breakage than the other, (b) whether the overall prevalence of patients who exhibited complications is different between the groups, and (c) whether one model would be more appropriate than the other for treating Class II cases.

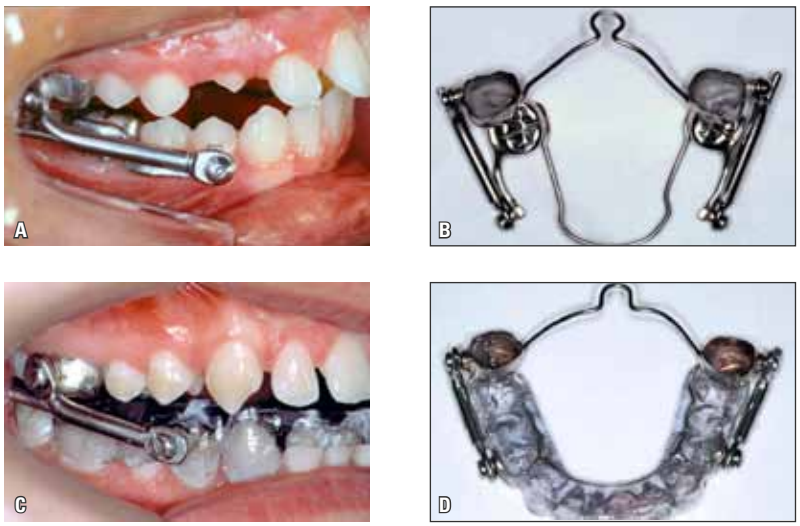

FIGURE 1 - **A**) Side view of CBJ, **B**) occlusal view of CBJ; **C**) side view of Herbst appliance (LRAS), **D**) occlusal view of Herbst appliance (LRAS).

MATERIAL AND METHODS

Sample

The sample used in this study was divided into two groups (Fig 1). Group I consisted of Caucasian patients of both genders (15 men and 6 women) who presented with Class II malocclusion, with a mean age of 12 years and 3 months at the beginning of treatment. These patients were treated with the Herbst appliance with Cantilever Bite Jumper (CBJ) (Ormco - Glendora, CA, USA), which consisted of four steel crowns on the first upper and lower molars. The maxillary molars were connected by a transpalatal arch (TA). The lower molars were connected by a lingual arch passing on the lingual side of the incisors with no occlusal support on the posterior teeth. The telescopic systems on the right and left sides were attached with an Allen-type screw on the upper and lower pivots. Treatment of these patients was performed at the Bauru Dental School Orthodontics graduate clinic.

Group II comprised Caucasian patients of both genders (11 men and 10 women) who presented with Class II malocclusion and mean age of 11 years and 3 months at the beginning of treatment. These patients were treated with the Herbst appliance with steel crowns on the maxillary first molars and lower removable acrylic splint (LRAS). Maxillary molars were connected by a transpalatal arch. The telescopic system used in the Herbst appliance was a Dentaurum type I (Ispringen, Germany). The telescopic systems on the right and left sides were attached with a slotted screw on the upper and lower pivots. Treatment of these patients was performed at a private office by one single professional.

In both groups, patients wore the Herbst appliance for a period of 12 months. In both groups, the steel crowns were cemented with Fuji Ortho LC (GC America Inc. Chicago, IL, USA). All patients were treated until an overcorrected Class I molar relationship was reached.

With the information obtained from the patients' clinical records a survey was conducted of complications occurring during treatment with the Herbst appliance. For the qualitative variables (prevalence and grouping of complications), the treatments were compared using Fisher's exact test or the chi-square test. P values <0.05 indicated statistical significance.

For comparison of treatment with both types of Herbst appliance in relation to the total instances of complications, Mann-Whitney's nonparametric test was applied, which seemed justified given the absence of the condition of normality of this variable in each group.

RESULTS

After reviewing the patients' clinical records it was noted that the total number of instances of complications was 24 in the CBJ group and 53 in the splint group. Table 1 depicts the types and number of instances of complications for the CBJ and splint Herbst appliances.

To assess the prevalence of complications in each treatment the null hypothesis was tested, i.e., that the likelihood of any complication is the same for both types of treatment vs. the alternative hypothesis of different probabilities. Table 2 and Figure 2 show the results.

The statistical test results indicated the acceptance of the null hypothesis at a significance level of 0.05 (p=0.277). Thus, one cannot assert that there are significant differences between these treatments in terms of the likelihood of a complication occurring during treatment.

The above results may be construed as a prevalence of patients with some sort of complication during treatment. This prevalence is equal to 66.67% for patients treated with CBJ, and 85.71% for patients treated with splint.

The null hypothesis that the total number of instances of complications occurring during treatment was the same for both types of treatment vs. the alternative hypothesis of different totals was also tested. Table 3 provides descriptive statistics and p values of the statistical test.

TABLE 1 - Types and number of instances of complications for the CBJ and splint Herbst appliances.

Types of Complications	CBJ	Splint
Crown debond	6	1
Screw loosening	6	24
Lesion in palate due to transpalatal arch	5	6
Lesion in cheek due to cantilever screw	2	
Rod distortion	2	3
Lesion in cheek due to too long rod	1	1
Crown fracture	1	1
Lesion in gingiva due to cantilever	1	
Lower splint breakage		13
Poor use of splint (lack of use)		2
Pivot breakage		1
Breakage of transpalatal arch		1
Total	24	53

TABLE 2 - Prevalence of complications during each treatment using Herbst appliance, evaluated by Fisher's test.

Complications	GROUP	
	CBJ	splint
None	7	3
	33.33%	14.29%
At least 1	14	18
	66.67%	85.71%
Total patients	21	21

Fisher's exact test, p<0.05.

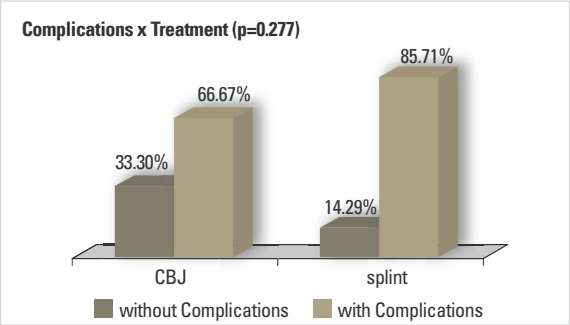

FIGURE 2 - Prevalence of complications in treatments with CBJ and splint.

TABLE 3 - Evaluation of total number of instances of complications during treatment with Herbst appliance.

	n	Sum	Mean	Median	Minimum	Maximum	SD	p
CBJ	21	24	1.1	1	0	3	1.0	0.009
Splint	21	53	2.5	2	0	6	1.8	

Mann-Whitney's nonparametric test, p<0.05.

The statistical test results indicated rejection of the null hypothesis at a significance level of 0.05 (p=0.009). Thus, one can assert that there were significant differences between treatments in terms of the total number of instances of complications occurring during treatment.

Table 4 groups the instances of complications in intervals of 0-1, 2-3 and more than 3. The null hypothesis that distribution of the total instances of complications is equal for both types of treatment vs. the alternative hypothesis of different distributions was tested.

The statistical test results indicated rejection of the null hypothesis at a significance level of 0.05 (p=0.011). Thus, one can state that distribution of the total instances of complications was different for both types of treatment.

TABLE 4 - Distribution (in %) of patients exhibiting 0-1, 2-3, or more than 3 complications during treatment with the Herbst appliance, evaluated by chi-square.

Complications	CBJ		SPLINT	
	Freq	%	Freq	%
0 or 1	12	57.1%	6	28.6%
2 or 3	9	42.9%	8	38.1%
> 3	0	0%	7	33.3%
Total	21	100.0%	21	100.0%

Chi-square test, p<0.05.

DISCUSSION

Despite having been widely used in Europe and the United States for more than two decades it was only in this century that the Herbst appliance has been used more frequently in Brazil.

One explanation for the delay in adopting this treatment modality was the cost of the appliance. A few years ago only one brand of telescopic system was marketed in Brazil, which cost tenfold the price charged in the United States. Today, several affordable brands of telescopic systems are available in Brazil.

Ease of fabrication is the key advantage[11] of the Herbst appliance with Cantilever Bite Jumper (CBJ) since the pivots come prewelded to the upper crown and lower cantilever. In addition, from a clinical viewpoint, the appliance has proven rather sturdy. CBJ disadvantages[11] are as follows: A steep price, a tendency of the lower cantilever to sink, causing molar inclination, and the tendency of the lower pivot to hurt the patient's cheek during the first week of use. On the other hand, the advantages[9] of the Herbst appliance with lower splint are affordability, the possibility of removing the splint to brush the teeth (which facilitates hygiene), easier fit for patients, and a shorter learning curve for professionals. The downside[9] clinically observed in the Herbst appliance with splint was that the lower acrylic splint showed decreased resistance.

To scientifically evaluate the impressions gained in clinical use, two groups of patients were compared. The CBJ group was treated by the students of the postgraduate (master's and doctoral) program in Orthodontics at Bauru School of Dentistry-USP, under the supervision of one of the authors. All patients were treated with the same clinical protocol. The splint group was treated in the private practice of one of the authors, using the same clinical protocol.

When assessing the prevalence of complications, none were observed in 7 patients (33.3%) of the CBJ group and in 3 patients (14.29%) of the splint group. Fourteen patients in the CBJ group and 18 in the splint group displayed some sort of complication. The Fisher test showed no significant difference between groups and also disclosed that both groups were equally likely to exhibit complications during treatment. In their study, Hagg et al[2] found that among the 14 patients treated with metal splints, only 2 showed no complications, and further noted that out of the 14 patients treated with the Herbst appliance with bands, only 3 had no complications. In their 2004 study, Sanden et al[17] found that 33% of the patients who wore the Herbst appliance with bands and 40% of the patients who wore the Herbst appliance with metal splint exhibited no complications during treatment.

In evaluating the total number of instances of complications during treatment with Herbst appliances there were 24 instances of complication with the CBJ (mean of 1.1 per patient) and 53 with the splint (mean of 2.5 per patient), reflecting a statistically significant difference. Therefore, the clinical impression that the CBJ Herbst appliance was sturdier was confirmed. Hagg et al[2] observed a total of 53 instances of complication in 14 patients treated with the Herbst appliance with metal splint (mean of 3.7 per patient), and a total of 41 instances of complications in the 14 patients treated with the Herbst appliance with bands (mean of 2.9 per patient). Sanden et al[17] found a total of 379 instances of complications in 134 patients treated with the Herbst appliance with bands (mean of 2.8 per patient), and 396 instances of complications in 182 patients treated with the Herbst appliance with metal splint (mean of 2.1 per patient). It can therefore be stated that the number of instances of complications with the CBJ appliance is lower than when Herbst appliances with metal splint, acrylic splint or bands are used.

In assessing individual instances of the most common complications in both groups, the CBJ group exhibited crown displacement and loosening of the screw on six occasions. One might avoid crown displacement by blasting the crown with aluminum oxide prior to cementation. As for the screws, some authors[12,14] recommend the use of Ceka Bond adhesive (Preat Corp., Santa Ynez, CA, USA) prior to screw fixation. On 5 occasions, a lesion was found on the palate due to the transpalatal arch (TA) despite the fact that the TA had been fabricated to allow for a 4 mm distance from the palate. This is due to the intrusion force developed by the appliance. Some authors[12] recommend against the placement of a TA, which may risk producing greater molar intrusion on one side than on the other.

In the splint group there were 24 instances of screw loosening. To explain this increased frequency, one might speculate that slotted screws are less efficient than Allen-type screws. Another likely explanation is the fact that as the patient removes the lower splint after meals for oral hygiene, removal and placement may end up forcing the telescopic system and facilitating the loosening of the screw. Another frequent occurrence with the splint appliance was fracture, which took place on 13 occasions. This happened even though the appliances were fabricated with lingual wire reinforcement on lower anterior teeth and a thicker layer of acrylic was applied to the anterior splint. Similarly to the CBJ group, the splint group had a lesion on the palate due to the TA on 6 different occasions. It is also noteworthy that although the lower splint is removable, two patients did not use it correctly and reported not having worn it for some periods of time. Theoretically, this should not happen, because the upper crown with the tube is cemented to the upper molars, and if patients fail to put on the splint, the tube could hurt the lower vestibule.

Schiöth et al[18] compared the complications with the use of total (canine to molar) and short (canine to second premolar) metal splints by dividing the patients into four categories according to the frequency of complications: Low frequency (1-3 complications), moderate frequency (4-6 complications), high frequency (7-10 complications), very high frequency (over 10 complications). Most of the patients exhibited low frequency. About 10% of patients in both groups[18] showed high frequency. Sanden et al[17] found that 55% of the patients experienced 1 to 3 complications, 29% 4 to 6, 13% 7 to 10, and 3% more than 10 instances of complications. After reviewing the 14 patients treated with CBJ and 19 patients treated with splints who exhibited complications, the patients were divided into three groups: 0 to 1, 2 to 3, or more than 3 complications during treatment with the Herbst appliance. In the CBJ group no patient had more than three individual instances of complications, which attests to the good clinical performance of the appliance. In the splint group, 33% of the patients had more than 3 instances of complications during treatment, and the maximum number of 6 was observed in two patients. After comparing the results of this study and those by Schiöth et al[18] and Sanden et al[17], one can conclude that both Herbst appliances, viz. with cantilever and with lower splint, displayed a good clinical performance when compared to the Herbst appliance with metal splint and bands.

CONCLUSIONS

1) The CBJ group showed fewer complications during treatment with the Herbst appliance.

2) No patient in either group had a large number of individual complications.

3) The Herbst appliance with steel crowns on the first molars and cantilever on the lower molars (CBJ) is preferable to the model with lower removable acrylic splint (LRAS) given the savings it provides in both clinical and laboratory time.

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