

## A RADIOGRAPHIC COMPARISON OF APICAL ROOT RESORPTION BETWEEN HERBST AND JUMPER TWIN BLOCK BITE APPLIANCES

Mahasen A Taha<sup>1</sup>, Shaza M Hammad<sup>2</sup>

### *ABSTRACT:*

**Objectives:** *The objectives of this study were to compare the amount of apical root resorption after orthodontic treatment with Herbst and Twin Block Bite Jumping screw (TBBJS) functional appliances, also to determine the prevalence of root resorption in the maxillary and mandibular incisors and the dental arches.*

**Methods:** *30 patients were divided into two groups 15 patients each. The first group was treated with Herbst appliance and the second group with TBBJS appliance. After treatment, periapical radiographs were obtained of the maxillary and mandibular incisors with the long-cone paralleling technique. Root resorption was scored according to the method of Levander and Malmgren.*

**Results:** *Results of the Mann-Whitney U test showed that there were no statistically significant differences between the Herbst and TBBJS groups. The amounts of root resorption were predominantly small. The prevalence of resorption for the incisors was greatest for the maxillary central, followed by the maxillary lateral, mandibular central, and mandibular lateral incisors.*

**Conclusions:** *There was no difference in the amount of root resorption between the Herbst and TBBJS groups with more resorption in maxillary arch than mandibular arch.*

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1- Lecturer of Orthodontics, Faculty of Dentistry, Mansoura University.

2- Lecturer of Orthodontics, Faculty of Dentistry, Mansoura University.

## INTRODUCTION

Apical root resorption is an iatrogenic problem associated with orthodontic treatment. External root resorption is initiated 14-20 days after the application of orthodontic force, and may continue for the duration of force application<sup>1</sup>. In most cases root resorption will be minor and therefore of no clinical importance. However about 4% of patients experience generalized resorption of more than 3mm and about 5% of adults and 2% of adolescents are likely to have one or more teeth that undergo more than 5mm of resorption during appliance therapy<sup>2,3</sup>.

Root resorption associated with orthodontic treatment, commences adjacent to an area of hyalinization and is more likely to occur in cases where compression is strong and of some duration<sup>4,5,6</sup>. Elimination of hyalinized compressed tissue is carried out by an invasion of cells from adjacent undamaged periodontium. This results in removal of both cementoid and the mature collagen adjacent to the cementum, with subsequent alteration of the normal barriers to root resorption<sup>7</sup>. Once the force application is removed, repair of resorped tooth surface occurs by formed precementum which act as a barrier against further resorption<sup>8</sup>.

Many factors have been implicated in the initiation and progression of external root resorption during orthodontic treatment. These can be divided into local factors and factors related to mechanotherapy<sup>3</sup>. Local factors are: individual susceptibility<sup>9</sup>, stage of root development<sup>3,10</sup>, tooth type<sup>11</sup>, deviating root apex form<sup>2,12</sup>, traumatized teeth<sup>3,13,14</sup>, endodontically treated teeth<sup>15</sup>, root apex contact with the cortical plate<sup>16,17</sup>, and adverse habits such as nail biting<sup>18</sup> and tongue thrust<sup>19</sup>. Mechanical factors are, types of tooth movement<sup>3,20,21,22</sup>, the magnitude of force applied<sup>3,11,18,22</sup>, treatment duration<sup>3,11,16,23</sup>, the use of Class II elastics and rectangular wire<sup>3,10</sup>, and certain types of orthodontic appliances<sup>24,25,26</sup>.

Although many studies have been done to compare the effects of removable and fixed appliances on root resorption<sup>27-33</sup>, there is still a debate about the effects of fixed and removable functional appliances on root resorption of maxillary and mandibular incisors.

The primary aim of this study was to compare the amount of root resorption of the upper and lower incisors after treatment with Herbst

(fixed functional appliance) and Twin Block Bite Jumping Screw (TBBJS) (removable functional appliance) appliances. Also to determine the prevalence of root resorption in the maxillary and mandibular incisors and the dental arches.

## **MATERIALS AND METHODS**

The sample of this study consisted of thirty female patients treated in Orthodontic Department, Faculty of Dentistry, Mansoura University, with age range 9-11 years (mean age of 10 years 3 months) presenting with Class II Division 1 malocclusion due to mandibular retrusion. The inclusion criteria were patients with vital, intact, and caries free incisors. Patients with history of trauma, periapical inflammation, endodontic treatment, root resorption of the incisors prior to orthodontic treatment, dilaceration of the incisors roots, anodontia, or habits were excluded.

The patients were divided into two groups of 15 patients each;

Group 1, patients were treated with banded Herbst appliance\*. A telescope mechanism on each side of the jaws was attached to bands on maxillary first molars and mandibular first premolars to keep the mandible in a continuous anterior jumped position. Each telescope consists of a tube and plunger fit together. The tube is attached to the maxillary molar band and the plunger to the mandibular premolar band. The tube and plunger are attached to their respective bands with screws. The length of the tube determines the amount of anterior bite jumping. The length of the plunger is adjusted to the length of the tube. To increase the anchorage, maxillary first premolars were banded and a palatal wire was soldered to molar and premolar bands. In the lower arch, first molars were banded and lingual arch was soldered to them<sup>34,35</sup>. The mean treatment time was 9.8 months.

Group 2, patients were treated with Twin Block Bite Jumping Screw (TBBJS). The same design of Clark<sup>36</sup> with the addition of bite jumping screw\*\* to allow gradual advancement of the bite. Bite jumping screw incorporated longitudinally in the upper bite blocks, with the screw head

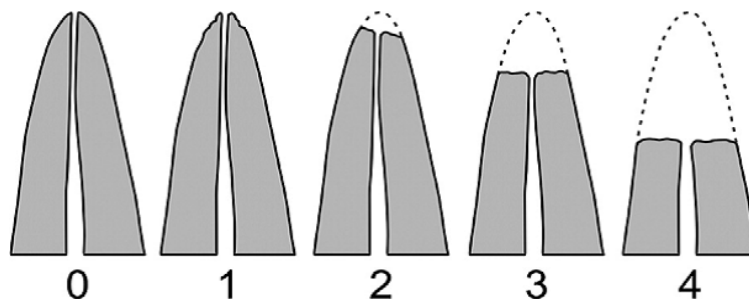
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\*Dentaurum Group ,Turnstraße 31 ,75228 Ispringen, Germany.

\*\*ForestadentUSA, 2301 Weldon Parkway, St. Louis, MO 63146.

at 70 degree angle to the lower bite blocks. The initial wax bite was taken with the mandible protracted approximately 5mm and opened vertically about 4mm. The bite jumping screw was opened with a special stainless steel key to be active after eight weeks of twin block wear to give 2mm advancement of the bite. Then another 2 mm was obtained by activation of the screw after another eight weeks. If further correction was needed, there was still 2mm of advancement left in the system. The mean treatment time was 11.7 months.

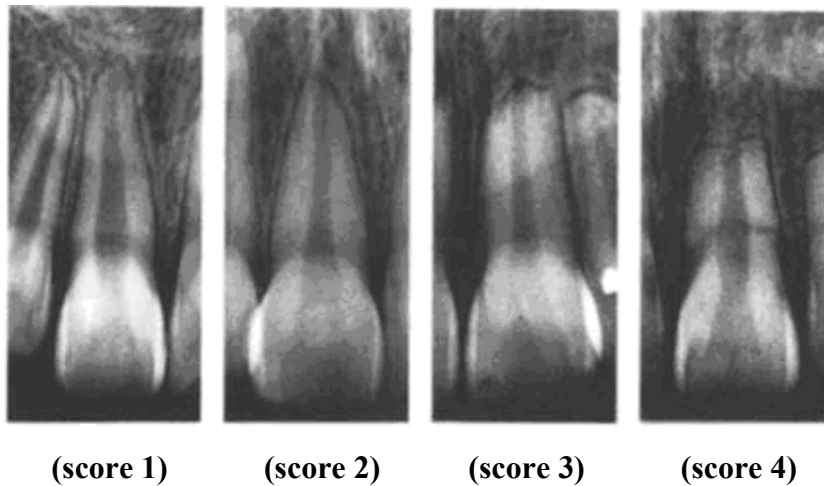
To quantify resorption, post treatment periapical radiographs of the maxillary and mandibular incisors, totaling 240 teeth, were examined. The post treatment periapical radiographs were obtained with the DABI 70 Spectro 1070X x-ray machine (Dabi Atlante, Ribeirão Preto, Brazil), set up for 70 kV, 10 mA, and an exposure time of 1 second, with the long-cone paralleling technique. Kodak Ektaspeed EP 21 films (Eastman Kodak, Rochester, NY) were used, and the angles were obtained by an intraoral XCP positioner (Rinn-Dentispaly, Elgin, Ill)<sup>37</sup>. All radiographs were processed automatically. All films were scanned, and the images were displayed and analyzed on a large computer monitor at 2-times magnification. Resorption was evaluated by the subjective score system of Levander and Malmgren<sup>12</sup> (Fig 1,2). The scores were blindly assigned by one examiner.



**Fig.(1): Score system of Levander and Malmgren:**

grade 0, no root resorption; grade 1, mild resorption-root with normal length and only irregular contour; grade 2, moderate resorption-small area of root loss with apex having almost straight contour; grade 3, accentuated resorption-loss of almost one third of root length; grade 4, extreme resorption-loss of more than one third of root length.

**Fig.(2): Application of the score system on upper central incisors:**



The resorption score was determined for each tooth; there were 8 evaluations per subject. Additionally, a mean resorption score was calculated for each subject. Thereafter, a mean for each group, based on the mean for each subject, was calculated and compared between the groups<sup>38</sup>.

### **STATISTICAL ANALYSIS**

The comparisons between root resorption in the two groups were performed by means of nonparametric statistics (Mann-Whitney U test) with a social science statistical package (SPSS 10.0, SPSS, Chicago, Ill). Statistical significance was tested at  $P < .05$ . Descriptive statistics were used to evaluate the prevalence of root resorption grades in each group and the prevalence of root resorption in the incisors and the dental arches.

### **RESULTS**

The results revealed that there were no statistical differences in the degree of root resorption between the two groups. The total mean of root resorption in the Herbst group was 1.03 and 1.12 in the TBBJS group

(P=0.76), (Table 1). Both groups had a greater prevalence of mild resorption; grade 1 in 70% of the Herbst group and 72.5% of the TBBJS group. Extreme apical root resorption was not observed (Table 2).

The prevalence of root resorption was greater in the maxillary arch than in the mandibular arch; 56% in the maxillary arch in both groups and 40% and 39% in the mandibular arch in the Herbst and TBBJS groups respectively. Furthermore, it occurred in decreasing order, maxillary central incisors, maxillary lateral incisors, mandibular central incisors, and mandibular lateral incisors ( Table 3).

**Table 1.** Comparison of the mean for each tooth and the total mean of each group.

	<b>Group 1 (n - 15)</b>	<b>Group2 (n - 15)</b>	
<b>Tooth</b>	<b>Median (mean)</b>	<b>Median (mean)</b>	<b>P</b>
11	1.00 (1.4)	1.5 (1.5)	0.69
21	1.5 (1.5)	2.00 (1.6)	0.60
41	1.00 (0.95)	1.00 (1.2)	0.80
31	1.00 (0.75)	1.00 (0.75)	0.69
12	1.00 (1.1)	1.5 (1.5)	0.06
22	1.00 (1.2)	1.00 (1.3)	0.70
42	1.00 (0.7)	0.00 (0.4)	0.20
32	1.00 (0.6)	1.00 (0.73)	0.92
Mean	1.00(1.03)	1.00(1.12)	0.76

**Table 2.** Prevalence of root resorption grades in groups.

	<b>Grade</b>									
	<b>0</b>		<b>1</b>		<b>2</b>		<b>3</b>		<b>4</b>	
	Prevalence*	%	Prevalence	%	Prevalence	%	Prevalence	%	Prevalence	%
Group 1	24/120	20	84/120	70	12/120	10	0/120	0.00	0/120	0.00
Group 2	25/120	20.8	87/120	72.5	8/120	6.66	0/120	0.00	0/120	0.00

\*Number of resorped roots/number of examined roots.

**Table 3.** Prevalence of root resorption in incisors and dental arches.

Teeth	Group 1 (n - 15)		Group 2 (n - 15)	
	Prev*	%	Prev	%
12, 22	27/120	22.5	26/120	21.6
11, 21	29/120	24.2	30/120	25.0
32, 42	17/120	14.2	15/120	12.5
31, 41	23/120	19.1	24/120	20
Max arch	56/120	46.6	56/120	46.6
Mand arch	40/120	33.3	39/120	32.5
Total	96/120	79.9	95/120	79.1

\*Number of resorped roots/number of examined roots.

Prev, prevalence; Max, maxilla; Mand, mandible 12, Maxillary right lateral incisor; 11, maxillary right central incisor; 21, maxillary left central incisor; 22, maxillary left lateral incisor; 42, mandibular right lateral incisor; 41, mandibular right central incisor; 31, mandibular left central incisor; 32, mandibular left lateral incisor.

## DISCUSSION

The selection of periapical paralleling technique in evaluating the degree of apical root resorption in this study was based on the fact that it provides the most appropriate information with the lowest irradiation to the patient when used for teeth that are most likely to exhibit blunting of roots "maxillary and mandibular incisors"<sup>39</sup>. It also provides less distortion and superimposition errors compared with orthopantomogram or the lateral head film and up to 4 films enable absorption of lower doses by radiosensitive tissue of the head and neck.

The most sensitive teeth to root resorption are the maxillary and mandibular incisors<sup>9,20,40,41,42</sup>. It is believed that if there is no apical root resorption seen in the incisors, then significant apical resorption in the other teeth is less likely to occur<sup>16,42,43</sup>. So, the aim of this study was to focus on the amount of root resorption in these teeth.

In this study, the amount of resorption was predominantly small. This may be explained by the young age of the patients (10 years and 3 months). Where, there is a higher susceptibility to root resorption seen in the adults<sup>14</sup>. All tissues involved in the root resorption process have changes with the age. The periodontal membrane becomes less vascular, aplastic and narrow, the bone more dense, avascular, and aplastic, and the cementum wider. These changes are reflected by higher susceptibility to root resorption in the adults. Only few studies showed no relationship between the apical root resorption and age of the patient<sup>9,20</sup>. Also the short duration of treatment may be a factor (9.8 months in Herbst and 11.7 months in TBBJS). Most studies reported that the severity of root resorption is directly related to treatment duration<sup>11,12,44,45</sup>. One study<sup>45</sup> reported that the amount of root loss during treatment is 0.9mm / year. Other study<sup>44</sup> reported that 40 %,70 %,80 % and 100 % of patients in treatment demonstrated some root resorption after 1,2,3, and 7 years of active treatment respectively. Only a few studies did not support this finding<sup>46,47</sup>.

There was no significant difference in apical root resorption between the two appliance systems. This was in conflict with only one study which compared root resorption resulting from fixed and removable appliances<sup>3</sup>, concluding that the use of fixed appliance is more detrimental to the roots. Where normal function of the teeth is disturbed by the splinting effect of orthodontic fixed appliances over a long period. The pause in treatment with intermittent forces of the removable appliances allows the resorped cementum to heal and prevent further resorption. On the other hand another studies<sup>3,48</sup> found that the intermittent forces have been linked in their detrimental effects to jiggling forces which are more harmful to the roots. However, in this study the treatment period was not long. Also, there were not any fixed appliances used directly on the incisors with Herbst appliance.

As in other studies<sup>8,47,49,50</sup>, there was greater root resorption in the maxillary teeth in the two groups than in the mandibular teeth. Where root resorption is directly related to the distance moved by the roots<sup>11,21,22,48,51</sup>. The extent of movement in these teeth is usually greater than in other teeth because of malocclusion function and esthetics. The root structures



and relationship to bone and periodontal membrane tend to transfer the forces mainly to the apex<sup>52</sup>. Therefore it is not surprising to detect greater apical root resorption in these teeth. In this study there was a greater resorption in the upper central incisors than the lateral incisors. This finding was also reported in other literatures<sup>5,53,54,55</sup> which is in a decreasing order, maxillary central, maxillary lateral, mandibular central, and mandibular lateral incisors. On the other hand, other studies found that, the most frequently affected teeth are maxillary laterals, maxillary centrals then mandibular incisors. The results of our study can be attributed to the age of our sample (mean age: 10 years and 3 months), where the roots of the upper lateral incisors were not completely formed by this age, the maxillary lateral incisors are the last incisors to complete root formation at 11 years of age<sup>3,56</sup>. The teeth with incompletely formed roots have greater resistance to resorption than teeth with completely formed roots<sup>57</sup>.

### **CONCLUSIONS**

Both Herbst appliances and TBBJS caused apical root resorption. However, the amounts of root resorption were predominantly small with no significant difference between the two appliances.

The prevalence of resorption for each incisor group in decreasing order was maxillary central incisors, maxillary lateral incisors, mandibular central incisors, and mandibular lateral incisors.

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