Orthodontic Mini-implants: Are They a Good Anchorage Resource for Cases of Retraction After Extraction?

Mini-implantes en Ortodoncia: ¿Son un Buen Recurso de Anclaje para los Casos de Retracción Después de la Extracción Dentaria?

Matheus Melo Pithon; Rogério Lacerda dos Santos; Mônica Tirre de Souza Araújo & Lucianne Cople Maia

ABSTRACT: The aim was to seek scientific evidence in the literature that orthodontic mini-implants provide absolute anchorage during the retraction of maxillary anterior teeth after pre-molar extractions. A search was undertaken in the two databases Ovid and Pub Med. The key words “miniscrew”, “mini-implants”, “orthodontic anchorage procedure”, “Anchorage loss”, “tooth movement” and “orthodontic space closure” were used. After the initial search, repeated articles in the databases were excluded, then selection was based on the inclusion and exclusion criteria, using a table developed for this purpose. Of the 550 articles initially listed, 4 were found to be potentially eligible, ending with 3 being selected after applying the inclusion and exclusion criteria. According to the quality required, only 3 of these articles attained a high enough score to be evaluated. Two of these articles showed absolute anchorage provided by mini-implants, and the other demonstrated slight loss of anchorage. There are strong scientific evidences that orthodontic mini-implants provide absolute anchorage during the retraction of maxillary teeth.

KEY WORDS: miniscrew, mini-implant, anchorage.

INTRODUCTION

During orthodontic treatment, precise diagnosis and correct formulation of the treatment plan afterwards are highly difficult and complex procedures. When defining the treatment plan, a significant percentage of malocclusions, such as discrepancies between the size of teeth and maxilla, and discrepancies between the bony bases normally result in a therapy involving extractions (Ricketts, 1976; Noroozi, 2000).

Closing the spaces left by the extractions must be performed in a planned and adequate manner (Shpack et al., 2008). For this purpose, according to orthodontic planning, the teeth will be partially or completely retracted. This decision depends on the requirements of the case and the type of anchorage that will be used (Burstone, 1982).

Orthodontic anchorage has been a reason for concern to orthodontists since the beginning of the specialty. Successful orthodontic therapy, to a large extent, depends on the judicious planning of anchorage, and it is no exaggeration to affirm that this factor is one of the determinants of success or failure of many treatments.

At present, mini-implants have been used to improve situations that need anchorage (Kanomi, 1997; Melsen & Costa, 2000; Melsen, 2005; Nojima et al., 2006). The reason for using them is the versatility of their positioning, and their easy removal and low cost (Araújo et al., 2006; Nascimento et al., 2006; Nojima et al.).

In certain clinical situations, in which the extra-oral appliance would be indicated as an aid to anchorage, mini-implants have been successfully used instead (Kuroda et al., 2007; Sugawara et al., 2008). This fact is relevant because one of the major problems during orthodontic treatment with extra-oral appliances is the patient’s lack of cooperation (Park et al., 2006).
Although there is consensus among clinicians about the good role played by mini-implants, a detailed analysis of published scientific studies is pertinent. Starting from this premise, the aim of this study was to seek evidences in the international literature about the effectiveness of using orthodontic mini-implants as an anchorage resource in cases of closing spaces after pre-molar extraction, by performing a systematic review.

**MATERIAL AND METHOD**

The search for articles was carried out using the Ovid and Pub Med databases. The search comprised articles published in the period from January 1997 to March 2009, in all the languages found. The key words used were: “miniscrew”, “mini-implants”, “orthodontic anchorage procedure”, “Anchorage loss”, “tooth movement” and “orthodontic space closure”.

After the initial search in the databases, a pre-selection was made by reading the titles and abstracts. After listing the articles of interest, the inclusion and exclusion criteria were applied (Table I). After this, a classification table was used, which ranked the articles in accordance with the scores received due to the methodological characteristics shown in Table II. The classification followed the ten requirements shown in the table. The article that obtained from 1 to 2 items was ranked as bad, from 3 to 4 as average, from 5 to 6 as good, 7 to 8 as very good and from 9 to 10 as excellent. That is to say, if the article fulfilled the requirement in question, it scored 1, if not, it scored 0 and at the end the requirements were added up and the article was fit into a classification.

It should be pointed out that the search for articles was performed by two examiners. After individual selection, the examiners met to solve problems of divergence that might have occurred during individual selection. Articles in which the data required for good understanding were not explicit, the authors were contacted.

<table>
<thead>
<tr>
<th>Inclusion Criteria</th>
<th>Exclusion Criteria</th>
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<tr>
<td><em>in vivo</em> experimental studies (humans)</td>
<td>Experimental studies in animals</td>
</tr>
<tr>
<td>Healthy individuals</td>
<td>Literature reviews</td>
</tr>
<tr>
<td>Cases of tooth biprotrusion in which the treatment proposal was pre-molar extraction</td>
<td>Clinical cases</td>
</tr>
<tr>
<td>The orthodontic mini-implant anchorage resource was used</td>
<td>Editorial letters</td>
</tr>
<tr>
<td>Randomized and clinical experimental studies</td>
<td><em>in vitro</em> studies</td>
</tr>
</tbody>
</table>

Table I. Inclusion and exclusion criteria used.
RESULTS

After searching the Ovid and Pub Med databases, a total of 550 articles were found. Initially, a total number of 120 articles repeated in the two databases were excluded. After this first elimination, the titles and abstracts of the selected articles were read, and after this reading, a total of 427 articles were excluded, based on the exclusion criteria (Table I).

At the end, 4 articles were selected and only 3 (Upadhyay et al., 2008a, 2008b) attained a sufficiently high score to be included in the sample (Table II). These 3 articles were read in full and discussed (Table III). The article by Upadhyay et al. (2008a, 2008b) scored 9 and the one by Kokitsawat et al. (2008) scored 5 points.

DISCUSSION

Orthodontic anchorage has always been a widely discussed subject in the orthodontic literature. Whether or not anchorage is lost is directly related to the success or failure of orthodontic cases. Since the beginning of orthodontics as a science, concern about anchorage has tormented orthodontists. Several devices were idealized and used for this purpose. Nevertheless, up until the mid 1990s, only extra-oral appliances were capable of anchoring teeth with few undesirable effects. However, as these devices are placed extra-oraly, as the name itself indicates, it makes them anti-esthetic and thus, unacceptable to use in a society that places a high value on esthetics.

Starting with this presupposition, the aim of this study was to systematically review the articles available in the international literature, assessing the performance of mini-implant devices when used as a resource for anchorage in cases of tooth retraction after maxillary pre-molar extraction.

For this purpose Ovid and Pub Med, the two main scientific databases were searched. The search took place from January 1997 to January 2009. The date chosen for starting the research was because this was the year when the first article on mini-implants for orthodontic purposes was published (Kanomi).

The study began with 550 articles, but when reviewing those that had been found in the two databases, applying the inclusion and exclusion criteria and quality chart, only three articles of interest remained.

The three articles selected were published in 2008, and two of these articles were written by the same authors using different samples. This information was obtained when the authors were contacted.

The first article in order of publication was by Upadhyay et al. (2008a) published in July 2008. The aim of this article was to assess the effectiveness of mini-implants as an anchorage resource during retraction of anterior teeth. Cephalometric measurements, in which there were stable anatomic points, were used. The results found in the study showed absolute anchorage provided by mini-implants, whereas the traditional methods demonstrated loss of anchorage. Another datum provided...
During the study period the right and left upper first molars moved mesially 0.70 ± 0.46 mm (range 0.01 -2.3 mm) and 0.76 ± 0.47 mm (range 0.1 -2.61 mm) respectively, although no force was applied to them. Miniscrews provide satisfactory anchorage for retraction of the upper anterior segment, but do not remain absolutely stationary under orthodontic loads. Because of coincidental mesial movement of the upper molars, there must be sufficient clearance mesial to the molars to avoid the molars roots contacting the miniscrews. Mini-implant are efficient for intraoral anchorage enforcement for en masse retraction and intrusion of maxillary anterior teeth. No anchorage loss was seen either in the horizontal or vertical direction in G1 when compared with G2.

Mini-implant provided absolute anchorage to a low greater skeletal, dental, and esthetic changes in patients requiring maximum anterior retraction, when compared with other conventional methods of space closure. However, no differences in the mean retraction time were noted between the 2 groups.

### Table III. Selected articles and their main data.

<table>
<thead>
<tr>
<th>Author</th>
<th>Type of study</th>
<th>Sample</th>
<th>Extracted teeth</th>
<th>Type of mini-implants</th>
<th>Characteristics of mini-implants</th>
<th>Location was at the anchorage</th>
<th>Method used to retract the teeth</th>
<th>Force used</th>
<th>Duration of force application</th>
<th>Method to evaluate the loss</th>
<th>Rate (loss of anchorage/movement achieved)</th>
<th>Conclusions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kolltsawat et al., 2008</td>
<td>Clinical Trial, Journal Article</td>
<td>13</td>
<td>Maxillary first premolar</td>
<td>Self-drilling</td>
<td>1.4 mm in diameter and 8 mm in length</td>
<td>Maxillary zygomatic</td>
<td>Nickel-titanium closed coil springs</td>
<td>300 g</td>
<td>5.23 months</td>
<td>Study model s</td>
<td>During the study period the right and left upper first molar moved mesially 0.70 ± 0.46 mm (range 0.01 -2.3 mm) and 0.76 ± 0.47 mm (range 0.1 -2.61 mm) respectively, although no force was applied to them. Mini-implants provide satisfactory anchorage for retraction of the upper anterior segment, but do not remain absolutely stationary under orthodontic loads. Because of coincidental mesial movement of the upper molars, there must be sufficient clearance mesial to the molars to avoid the molars roots contacting the miniscrews. Mini-implant are efficient for intraoral anchorage enforcement for en masse retraction and intrusion of maxillary anterior teeth. No anchorage loss was seen either in the horizontal or vertical direction in G1 when compared with G2.</td>
<td></td>
</tr>
<tr>
<td>Upadhyay et al., 2008b</td>
<td>Comparitive study, Journal article, Randomized Controlled Trial</td>
<td>30</td>
<td>Maxillary first premolar</td>
<td>Self-drilling</td>
<td>1.3 mm in diameter and 8 mm in length</td>
<td>Between the maxillary second premolar and first molar</td>
<td>Nickel-titanium coil spring</td>
<td>150 g</td>
<td>9.2 months</td>
<td>Evaluated cephalometrically</td>
<td>Mini-implant provided absolute anchorage to a low greater skeletal, dental, and esthetic changes in patients requiring maximum anterior retraction, when compared with other conventional methods of space closure. However, no differences in the mean retraction time were noted between the 2 groups.</td>
<td></td>
</tr>
<tr>
<td>Upadhyay et al., 2008a</td>
<td>Comparitive study, Journal article, Randomized Controlled Trial</td>
<td>40</td>
<td>Maxillary first premolar</td>
<td>Self-drilling</td>
<td>1.3 mm in diameter and 8 mm in length</td>
<td>Between the maxillary second premolar and first molar</td>
<td>Nickel-titanium coil spring</td>
<td>150 g</td>
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<td>Mini-implant provided absolute anchorage to a low greater skeletal, dental, and esthetic changes in patients requiring maximum anterior retraction, when compared with other conventional methods of space closure. However, no differences in the mean retraction time were noted between the 2 groups.</td>
<td></td>
</tr>
<tr>
<td>Feldmann &amp; Bondemark (2008)</td>
<td>Randomized Controlled Trial</td>
<td>120</td>
<td>Maxillary first premolar</td>
<td>Self-drilling</td>
<td>3.3 mm in diameter and 4 mm in length</td>
<td>Between the maxillary second premolar and first molar</td>
<td>Nickel-titanium coil spring</td>
<td>--</td>
<td>--</td>
<td>Evaluated cephalometrically</td>
<td>During the space-closure phase, the molars were still stable in the Onplant and Orthosystem groups, whereas the headgear and transpalatal bar groups had anchorage loss (means 1.6 and 1.0 mm, respectively, p&lt;0.01). Thus, the Onplant and the Orthosystem implant groups had significantly higher success rates for anchorage than did the headgear and transpalatal bar groups. Compared with the Orthosystem implant, there were more technical problems with the Onplant. Conclusions: If maximum anchorage is required, the Orthosystem implant is the system of choice.</td>
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From a methodological point of view, this article published by the authors would have a success rate of slightly below 50%. This leads to the conclusion that mini-implants would not be a good anchorage resource for cases of retraction after extraction. However, the other articles published by the authors would have a success rate of slightly above 50%. This leads to the conclusion that mini-implants would be a good anchorage resource for cases of retraction after extraction.
was ranked with a lower score than the previous one, and hypothetically, if the results found were different, one would give greater weight to the results provided by the article published in July.

In short, in their two articles, Upadhyay et al. (2008a, 2008b) concluded that mini-implants were shown to be an efficient mechanism of anchorage during the movements of retraction and intrusion of maxillary anterior teeth, with no loss of anchorage both in the horizontal and vertical directions, when compared with the traditional methods. The authors emphasized the need to perform a study with a larger sample.

Kokitsawat et al., also endeavoring to also assess the effectiveness of mini-implants, conducted a study in which the analysis was performed in plaster models. The results found by these authors were in disagreement with those of Upadhyay et al. (2008a, 2008b). According to Kokitsawat et al., there was a loss of anchorage when these devices were used. These results may have been found due to some methodological failures while the study was conducted.

By assessing the articles selected it can be affirmed that there are strong scientific evidences that orthodontic mini-implants provide absolute anchorage during retraction of maxillary teeth.

### CONCLUSION

After having performed this systematic review, it could be concluded that there are strong evidences that orthodontic mini-implants are an effective means of anchorage, and prevent undesirable movements of mesialization of the posterior teeth to the post-extraction space of maxillary premolars.

### REFERENCES


