

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?

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PITHON, M. M.; DOS SANTO, R. L.; ARAÚJO, M. T. S. & MAIA, L. C. Orthodontic mini-implants: are they a good anchorage resource for cases of retraction after extraction? *Int. J. Odontostomat.*, 6(3):369-374, 2012.

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).

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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”.

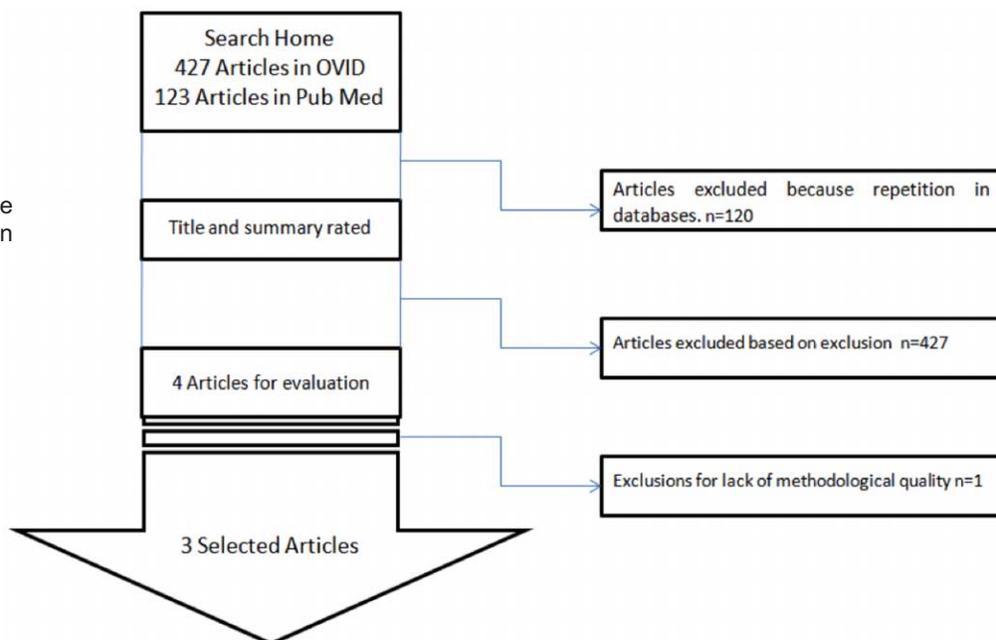
After the initial search in the databases, a pre-selection was made by reading the titles and abstracts. After listing the articles of interest, the inclusion and exclusion criteria were applied (Table I). After this, a classification table was used, which ranked the articles in accordance with the scores 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 I. Inclusion and exclusion criteria used.

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

Fig. 1. Flow sheet of the articles during selection process.



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-orally, 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

Table II. Ranking of articles in accordance with the methodological characteristics presented.

Author	Sample size Adequate	Randomization	No sample lost	Adequate statistic provided	Blinding in measurements	No confounding factors	Prospective	Selection descriptive	Valid measurement methods	Judged Quality Standard	Note *
Kokitsawat <i>et al.</i> (2008)	0	1	1	1	0	1	1	0	0	0	5
Upadhyay <i>et al.</i> (2008b)	1	0	1	1	0	1	1	1	1	1	8
Upadhyay <i>et al.</i> (2008b)	1	1	0	1	1	1	1	1	1	1	9
Yao <i>et al.</i> (2008)	1	0	0	1	0	0	0	1	1	0	4

Table III. Selected articles and their main data.

Author	Type of study	Sample	Extruded teeth	Type of Mini-implants	Number of Mini-implants	Characteristics of Mini-implants	Location where anchorage was at the teeth	Method used to retract the teeth	Force used	Duration of force application	Method to evaluate the loss	Rate (loss of anchorage/movement achieved), Conclusions
Kokitsawat <i>et al.</i> , 2008.	Clinical Trial, Journal Article	13	Maxillary first premolar	Self-drilling	2	1.4 mm in diameter and 8 mm in length	Maxillary zygomatic	Nickel-titanium closed coil springs	300 g	5.23 months	Study models	During the study period the right and left upper first molar moved mesially 0.7±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 reinforcement for en-masse retraction and intrusion of maxillary anterior teeth. No anchorage loss was seen in either the horizontal or the vertical direction in G1 when compared with G2.
Upadhyay <i>et al.</i> , 2008b	Comparative study, Journal article, Randomized Controlled Trial	30	Maxillary first premolar	Self-drilling	2	1.3 mm in diameter and 8 mm in length	Between the maxillary second premolar and first molar	Nickel-titanium coil spring	150 g	9.2 months	Evaluated cephalometrically	Mini-implant provided absolute anchorage to a low grater 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
Upadhyay <i>et al.</i> , 2008a	Comparative study, Journal article, Randomized Controlled Trial	40	Maxillary first premolar	Self-drilling	2	1.3 mm in diameter and 8 mm in length	Between the maxillary second premolar and first molar	Nickel-titanium coil spring	150 g	--	Evaluated cephalometrically	During the space-closure phase, the molars were still stable in the Onpliant and Orthosystem groups, whereas the anchorage loss (means 1.6 and 1.0 mm, respectively, p=0.01). Thus, the Onpliant 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 Onpliant. Conclusions: If maximum anchorage is required, the Orthosystem implant is the system of choice.
Feldmann & Bondemark (2008)	Randomized Controlled Trial	120	Maxillary first premolar	Self-drilling	1	3.3 mm in diameter and 4 mm in length	Palate	Nickel-titanium coil spring	--	--	Evaluated cephalometrically	by the authors was that mini-implants had a success rate of 93%; that is, these mini-implants remained stable at this percentage. As there was no loss of anchorage in the group in which mini-implants were used, the changes in the face and mandibular plane were more notable.

The other article published by the authors Upadhyay *et al.* (2008b) in December 2008, presented the same proposal as the previous one, but the difference between the articles was due to methodological changes, such as non-randomization, non-blinded assessments and a different sample consecutively. The proposal of the study was the same; that is to compare traditional methods of anchorage with mini-implants in the retraction of anterior teeth after pre-molar extraction. The results found in the study showed the effectiveness of mini-implants during retraction without loss of anchorage.

From a methodological point of view, this article

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,

such as the use of non-stable points in the plaster models. It is important to remember that as regards the classification of this study for inclusion in the present study, the article obtained the minimum scores required, so that when analyzing the results presented in it in comparison with those of the other articles, it remains in second place.

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 pre-molars.

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RESUMEN: El objetivo fue buscar en la literatura evidencia científica que los mini-implantes ortodóncicos proporcionan un anclaje absoluto durante la retracción de los dientes anteriores superiores después de la extracción de los premolares. La búsqueda se realizó dos bases de datos: Ovid y PubMed. Fueron utilizadas las palabras clave "mini tornillo", "mini-implantes", "procedimiento de anclaje ortodóncico", "pérdida de anclaje", "movimiento de los dientes" y "cierre ortodóncico de los espacios ". Después de la búsqueda inicial, los artículos repetidos en las bases de datos fueron excluidos, y la selección se basó en los criterios de inclusión y exclusión, usando una tabla desarrollado para este propósito. De los 550 artículos inicialmente enumerados, 4 resultaron ser potencialmente elegibles, y se terminó con la selección de 3 artículos luego de aplicar los criterios de inclusión y exclusión. De acuerdo con la calidad requerida, sólo 3 artículos alcanzaron una puntuación lo suficientemente alta como para ser evaluados. Dos de estos artículos mostraron un anclaje absoluto proporcionado por los mini-implantes, y el otro demostró una ligera pérdida de anclaje. Existen fuertes evidencias científicas que los mini-implantes ortodóncicos proporcionan un anclaje absoluto durante la retracción de los dientes maxilares.

PALABRAS CLAVE: minitornillos, mini-implante, anclaje.

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