



ORIGINAL RESEARCH PAPER

Orthodontology

FACTORS THAT AFFECT THE CLINICAL SUCCESS OF INTERRADICULAR MINISCREWS USED AS TEMPORARY ANCHORAGE DEVICES IN ORTHODONTIC TREATMENTS.

KEY WORDS: Orthodontic Anchorage Procedures, Bone Screws, Prognosis.

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ABSTRACT
 Interradicular Miniscrews (MTI) are temporary anchoring devices designed to be inserted into the alveolar bone in order to improve anchorage. The aim of this study was to present the general success rates and to summarize the factors that affect treatment with these devices. A comprehensive literature review was conducted of the PUBMED, SCHOLAR GOOGLE and SCieLO databases, which were published between 2000 and 2020, in English and Spanish. Bibliographic, systematic reviews and clinical trials were evaluated. Our review suggests, according to the current literature, planning at the beginning of orthodontic treatment taking into account all the possible factors that could increase failure rates. Bibliographic, systematic reviews and clinical trials were evaluated. Our study advises, according to current bibliography, to conduct a planning at the beginning of orthodontic treatment, taking into account all the possible factors that could increase failure rates. The significant factors in the overall success rate were: oral hygiene, inflammation, post-insertion mobility, operator experience, and drilling of adjacent anatomical structures (dental roots, nerve structures, maxillary sinus).

INTRODUCTION

Orthodontic inter radicular micro screws (MTI) are devices designed to be temporarily inserted into the bone alveolar to improve anchorage^{1,2}.

Anchor preservation has always been a challenging goal during orthodontic therapies, especially when planning a treatment involves mobilizing a group of teeth simultaneously^{1,3,4}.

Orthodontic anchoring is defined as the resistance that opposes a tooth to its movement. In clinical practice there are situations where absolute anchorage is necessary, that is, high resistance to displacement^{4,5}. Whenever a force is applied to achieve a dentary movement, movements are going to be generated in the opposite direction that is sometimes unwanted and difficult to neutralize², being able to generate the mobilization of dental parts that we don't want them to move⁴. That's why the area that doesn't need to be mobilized should have a larger mass or be fixed in such a way that it behaves like an anchor area. To get a good anchor you need a by-apparatus that compensates for the reaction forces. The use of MTI as an anchor opens a door so far nonexistent, gives us the possibility of nullifying secondary movements and dispense with patient collaboration². This has led to ITM due to their easy insertion, extraction, and low cost, they have gained enormous popularity⁶⁻⁸.

MTI is a non-Osseo integrated element designed for temporary use⁸⁻¹⁰. In terms of their dimensions, they can vary depending on their diameter in a range of 1 to 2 mm and depending on their length in a range of 6 to 17 mm^{11,12,13}.

However, the use of an MTI does not guarantee clinical success. Its stability is essential before it can be used as an

anchoring device⁶. Therefore, the objective of this bibliographic review was to present the general rates of success and summarize the possible factors that may affect them.

MATERIAL AND METHODS

An electronic search was carried out in Pubmed, Schoolar Google, and SCieLO, using the key words: Orthodontic Anchorage Procedure, Bone Screws, and Prognosis. Articles in English and Spanish, published between 2000 and 2020, were selected. Bibliographic and systematic reviews and clinical trials were evaluated. The selection of the articles was carried out through the reading of abstracts, discarding the redundant ones, and subsequent reading of the complete texts, thus selecting the definitive articles.

REVIEW OF CURRENT BIBLIOGRAPHY

There are many anatomical structures in proximity to the common sites of insertion of these devices (such as inferior dental nerve, maxillary sinus, periodontal ligament, among others)⁶, which, if affected, can produce noxas, reducing the rates of success.

An example of this is trauma to the periodontal ligament or the tooth root itself, which can lead to loss of pulp vitality, osteosclerosis, and dental ankylosis¹⁴.

Overall success rates range from 61 to 100%^{1,12,15-20}. Several authors have described that clinical success can be affected by many factors, some related to the characteristics of MTI (diameter and length), others related to the host (insertion site, age, sex, hygiene), and factors related to the operator (clinical experience)^{6,9,12,18,20-24}. The possible factors that may affect this type of treatment will be summarized below (Tables 1, 2, and 3).

Table 1. Host factors that can affect the clinical success of using MTI in orthodontic treatments. Each factor studied is represented by a color, those authors who have dotted the bottom of the cell are those who propose that rates. the factor studied does not significantly affect success

FACTORS AFFECTING THE SUCCESS RATE IN THE INSERTION OF MTI: - GUEST FACTORS:

Factor	Authors et al. for which the factor affects significantly	Year	Description	Authors et al. for which the factor does not affect significantly	Year	Description
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Age	Chen YJ ²⁵	2007	Adolescents were more likely to lose MTI because the cortical bone was thinner and the bone density was lower.	Miyawaki S ²⁶	2003	The loss of MTIs was not associated with age.
	Dalessandri D ²⁷	2014		Park H S ¹²	2006	
	Hong SB ²³	2016		Motoyoshi M ¹⁵	2006	
				Kuroda S ¹⁶	2007	
				Moon CH ¹⁷	2008	
				Wu T Y ¹⁸	2009	
				Lim H J ²⁰	2011	
				Papageorgiou SN ²⁸	2012	
Sex			For none of the authors studied, the sex of the patient affected significantly; therefore, it was not related to the clinical success of MTIs.	Park H S ¹²	2006	They found no statistically significant differences between the success rates of inserted MTIs in men and women.
				Motoyoshi M ¹⁵	2006	
				Kuroda S ¹⁶	2007	
				Moon CH ¹⁷	2008	
				Wu T Y ¹⁸	2009	
				Lim H J ²⁰	2011	
				Papageorgiou SN ²⁸	2012	
				Dalessandri D ²⁷	2014	
Insertion side (right / left)	Park H S ¹²	2006	Higher success rates when inserting on the left side. One possible explanation was that there is better hygiene control on the left side in right-handed patients, who represent the majority of the world population.	Motoyoshi M ¹⁵	2006	Regardless of the insertion site, there were no significant differences in the success rate.
	Wu T Y ¹⁸	2009		Moon CH ¹⁸	2008	
				Papageorgiou SN ²⁷	2012	
				Tepedino M ¹	2018	
				Azeem M ²⁹	2019	
Insertion in maxilla / mandible	Park H S ¹²	2006	MTIs inserted in the maxilla had higher success rates than those inserted in the mandible.	Miyawaki S ²⁶	2003	MTI insertion site, not related to the success rate.
	Papageorgiou SN ²⁸	2012		Motoyoshi M ¹⁵	2006	
	Dalessandri D ²⁷	2014		Moon CH ¹⁷	2008	
	Hong SB ²³	2016		Wu T Y ¹⁸	2009	
				Lim H J ²⁰	2011	
Hygiene	Molina A ²	2004	Good oral hygiene around the MTI implantation site prevents inflammation of the surrounding soft tissues. They recommend the use of 0.12% chlorhexidine gel in case of peri-implant irritation	Azeem M ²⁹	2019	Oral hygiene did not statistically affect the success rate of MTIs.
	Park H S ¹²	2006				
	Wu T Y ¹⁸	2009				
	Dalessandri D ²⁷	2014				
	Fernández L ¹³	2017				

FACTORS INHERENT TO MTI

Table 2. Factors inherent to MTI that can affect clinical success in orthodontic treatments. Those authors who have dotted the bottom of the cell are those who propose that the studied factor does not significantly affect the success rates.

Factor	Authors et al. for which the factor affects significantly	Year	Description	Authors et al. for which the factor does not affect significantly	Year	Description
MT diameter and length	Miyawaki S ²⁵	2003	Unlike length, MTI diameter 1.0mm was associated with lower success rates.	Miyawaki S ²⁶	2003	The length did not affect the success rate.
	Gutiérrez L P ⁹	2014	Conical MTI should be used, with a diameter not less than 1mm.	Park H S ¹²	2006	The diameter and length of MTI had no impact on success rates
	Hong SB ²³	2016	Significantly higher success rates for MTI with a length ≥ 8mm and a diameter > 1.4mm.	Kuroda S ¹⁶	2007	
				Wu T Y ¹⁸	2009	Small and short MTI had lower survival rates, although it was not significant; likewise, they recommend the use of MTI with diameters 1.4mm in the maxilla and > 1.4mm in the mandible.
				Lim H J ²⁰	2011	
			Dalessandri D ²⁷	2014	There are no differences in success rates when MTI with lengths ≥ 8mm and with diameters > 1.3mm are used.	

SURGICAL FACTORS:

Table 3. Surgical factors that can affect the clinical success of using MTI in orthodontic treatments. Each factor studied is represented by a color, those authors who have dotted the bottom of the cell are those who propose that the factor studied does not significantly affect success rates.

Factor	Authors et al. for which the factor affects significantly	Year	Description	Authors et al. for which the factor does not affect significantly	Year	Description
Insertion into keratinized mucosa	Wu T Y ¹⁸	2009	ITNs inserted into mobile mucosa could be at greater risk of suffering from food impact, which could trigger an inflammatory process and consequently loosening of the MTI.	Lim H J ²⁰	2011	. There is no difference in the success rate of MTI inserted into keratinized vs. non-keratinized tissues.
	Fernández L ¹³	2017		Dalessandri D ²⁷	2014	
	Tepedino M ³⁰	2017				
Inflammation	Miyawaki S ²⁶	2003	The inflammatory process (irritation and / or superinfection) of the peri-implant tissue was associated with a lower success rate.	Azeem M ²⁹	2019	Inflammation did not affect the success rate.
	Molina A ²	2004				
	Park H S ¹²	2006				
	Dalessandri D ²⁷	2014				
Post-insertion mobility	Miyawaki S ²⁶	2003	If an MTI exhibits post-insertion mobility, the success rate will decrease.			
	Park H S ¹²	2006				
	Gutiérrez L P ⁹	2014				
Operator experience	Wu T Y ¹⁸	2009	The greater the clinical experience in inserting MTI, the higher the success rates.			
	Lim H J ²⁰	2011				
	Gutiérrez L P ⁹	2014				
	Fernández L ¹³	2017				
Time to perform the orthodontic load	Molina A ²	2004	It is necessary to wait 2/3 weeks after the insertion of the MTI to perform the orthodontic loads.	Dalessandri D ²⁷	2014	Regardless of when the orthodontic load is applied, either early or late, there will be no impact on the success rate.
Root contact or perforation of contiguous anatomical sites (maxillary sinus, nerve structures)	Molina A ²	2004	The contact with the root or the perforation of anatomical sites due to the insertion of MTI will negatively affect clinical success.			
	Peters F H ¹⁴	2013				
	Fernández L ¹³	2017				
	Mohammed H ²²	2018				

Our review suggests that to have higher rates of clinical success, an evaluation should be carried out during the initial planning phase of orthodontic treatment, carrying out a preliminary assessment of the feasibility of insertion of these devices, taking into account all these factors presented.

CONCLUSIONS

MTI are devices used in orthodontic treatments, where the anchorage must be predictable and consistent. Overall success rates range from 61 to 100%, these can be affected by several factors. For most of the studies presented, the factors that did not imply clinical success were: age, gender, insertion side, length, and diameter of the ITN. While the factors that influenced the success rate were, oral hygiene, inflammation, post-insertion mobility, operator experience, and perforation of adjacent anatomical structures (tooth roots, nerve structures, and maxillary sinus).

Other factors require a more exhaustive study to determine their implication in clinical success; these were insertion in the maxilla/mandible, keratinization of the insertion site, and the moment in which is exerted the orthodontic load. Our review suggests planning at the beginning of orthodontic treatment taking into account all possible factors that could increase failure rates in MTI use.

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