Periotest Evaluation of Stability after Insertion of Temporary Anchorage Device

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Abstract

Introduction: Skeletal anchorage devices was developed for absolute anchorage during orthodontic treatment. Because of immediate loading on orthodontic miniscrews, early stability became a essential requirement for loading forces on miniscrews.

Objective: The aim of this study was to evaluate the early stability of the miniscrews after two weeks of insertion and the effect of the length and the side of insertion of the miniscrews on its stability using Periotest device.

Material and Method: Thirty- three orthodontic patients in a collage clinic were recruited who required bilateral miniscrews for orthodontic anchorage. Under local anesthesia, each patient received two miniscrews in the maxillary buccal area (one side 1.6x8mm and the other side 1.6x10mm). after two week early stability measured using Periotest device.

Results: There was no significant different in stability of miniscrew between right and lift sides and between short and long miniscrews.

Conclusion: length of miniscrew and side of insertion do not affect the early stability of miniscrew.

Keywords: *Periotest ; stability ; Insertion ; Temporary Anchorage Device*

Introduction

Preparation of the anchorage is a extremely important part in the orthodontic treatment. The success of orthodontic treatment generally relied on the anchorage protocol planned for particular cases. Planning for anchorage and preparation before tooth movement is necessary to avoid inappropriate tooth movements and not to interfere with the orthodontic result [(19)]. Absolute anchorage is defined as no movements of the anchorage segment as a result of the reaction forces applied to move the teeth [(7)]. The success rates are reported to be 80-90%, which is to some extent inferior than that of miniplate and palatal screw [(15)] . Miniscrews can simply be placed and removed with a uncomplicated procedure, can be loaded instantly, are commercially accessible in a number of sizes (width and lengths), and are relatively cost-effective [(4)].

Because of immediate loading on orthodontic miniscrews, early stability became a essential requirement for loading forces on miniscrews [(12)]. It is considered as clinical condition of immobility of miniscrew and ability to resist loads in different directions [(10)].

The early stability of miniscrews is mostly held by mechanical retention between bone and miniscrew surface [(18)].

Early stability is controlled by factors such as overloading, bone density, cortical bone thickness , design of screw and root proximity [(6,1)]. The Periotest measurements after implant placement are helpful in the assessment of early stability. Periotest® M is an electronic instrument comprised of a hand piece containing a metal slug that is accelerated towards a tooth/implant by an electro-magnet, the tapping rod strikes 16 times in 4

seconds. The contact duration of the slug on the tooth/implant is measured by an accelerometer. The software in the instrument is designed to relate contact time as a function of tooth mobility. The result is displayed digitally as Periotest® values (PTVs). The Periotest® values (PTVs), ranging from -8 to +50 [9].

Materials and Methods

Patient selection:

A total of Thirty-three patients undergoing orthodontic treatment who required miniscrew placement between second premolar and first molar teeth in the buccal side of dental arches bilaterally as part of their treatment plan at the Department of Orthodontics, College of Dentistry, University of Baghdad were recruited as study participants. Age range of the participants where between 18 and 28 years and all the participants were healthy, with no significant medical findings, or special needs. The study was reviewed and approved by the ethical committee of the University of Baghdad College of Dentistry.

Miniscrew installation protocol:

The miniscrews used in this study were a self-drilling, 1.6 mm in diameter, made of Titanium alloy (Hubit Company, Gyeonggi-do, South Korea). In one side an 8mm miniscrew was inserted and in the other side a 10mm miniscrew was used. The surgical procedure involved the following:

1. From the pretreatment OPG, the site of insertion was determined in order to reduce radiation exposure. It was located interdentally in the buccal side of the posterior segment of the maxilla between the upper second premolar and first molar.

2. Infiltration local anesthesia approximately 0.45 mL (a quarter of acarpool) of 2% lidocaine with 1:100,000 epinephrine, was administrated into the alveolar mucosa above the miniscrew insertion site, in order to provides an adequate degree of anesthesia, while still permitting the patient feedback in case the miniscrew make contact with the periodontal ligament [5].

3.Miniscrews (8mm and 10mm length) were randomly assigned to right and left sides.

4. Miniscrews were inserted manually by a screw driver through the attached gingiva at an angle between 30 and 60 degrees. No mucoperiosteal flap was raised and no pilot hole was made **(Figure 1&2).**

5. A periapical x-ray was taken to confirm miniscrew position.

6.Post-operative care instructions were explained to the patient and given in a written sheet. Post-operative care instruction included:

1. Gently brush mini-screw and use of soft bristle tooth brush.
2. Don't touch mini-screw with the tongue or finger.
3. Avoid eating hart food during first two day of insertion.
4. Don't tap mini-screw head with toothbrush.

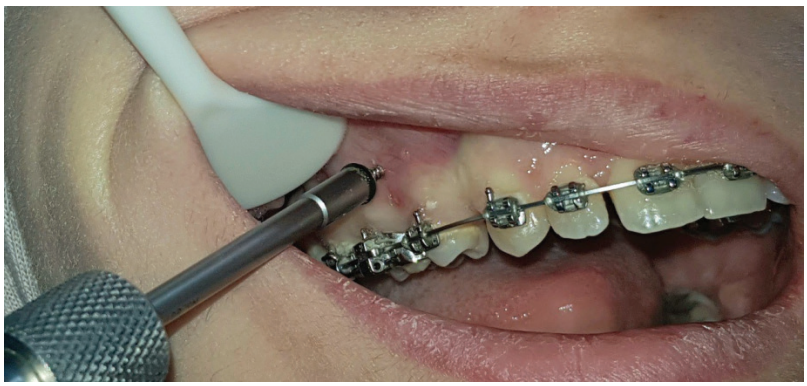

Figure 1: Miniscrew insertion.

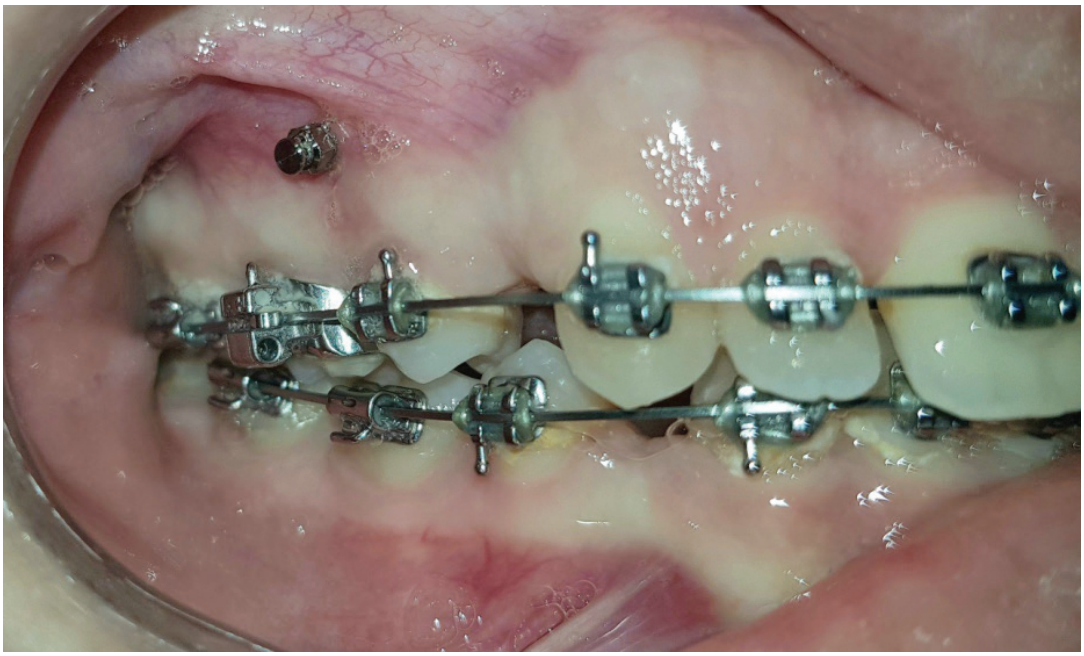

Figure 2: After miniscrew insertion

Stability measurement

After two week of miniscrew placement, early stability was measured using Periotest® M **(Figure 3).** Measuring procedure achieved by holding the Periotest® M at right angle to the center toward the miniscrew head to be examined, the maximum deviation angle from the ortho-radial direction of percussion is 45 degree. In addition, the rod of Periotest® M and the test surface of miniscrew superstructure must maintain 0.6-2.5 mm distance according the **(Periotest® M operating instructions)**, measurements were taken by placing the Periotest parallel and gingivobaccally to occlusal plane to head of miniscrew. Two repeated measurements were obtained for each implant and the mean of these two readings was taken. An audible sound will be emitted and the damping capacity was measured as a Periotest® M value (PTV), this value can range from -8 to +50, the lower the values represented the better the stability **(Figure 3).**

Figure 3: periotest M

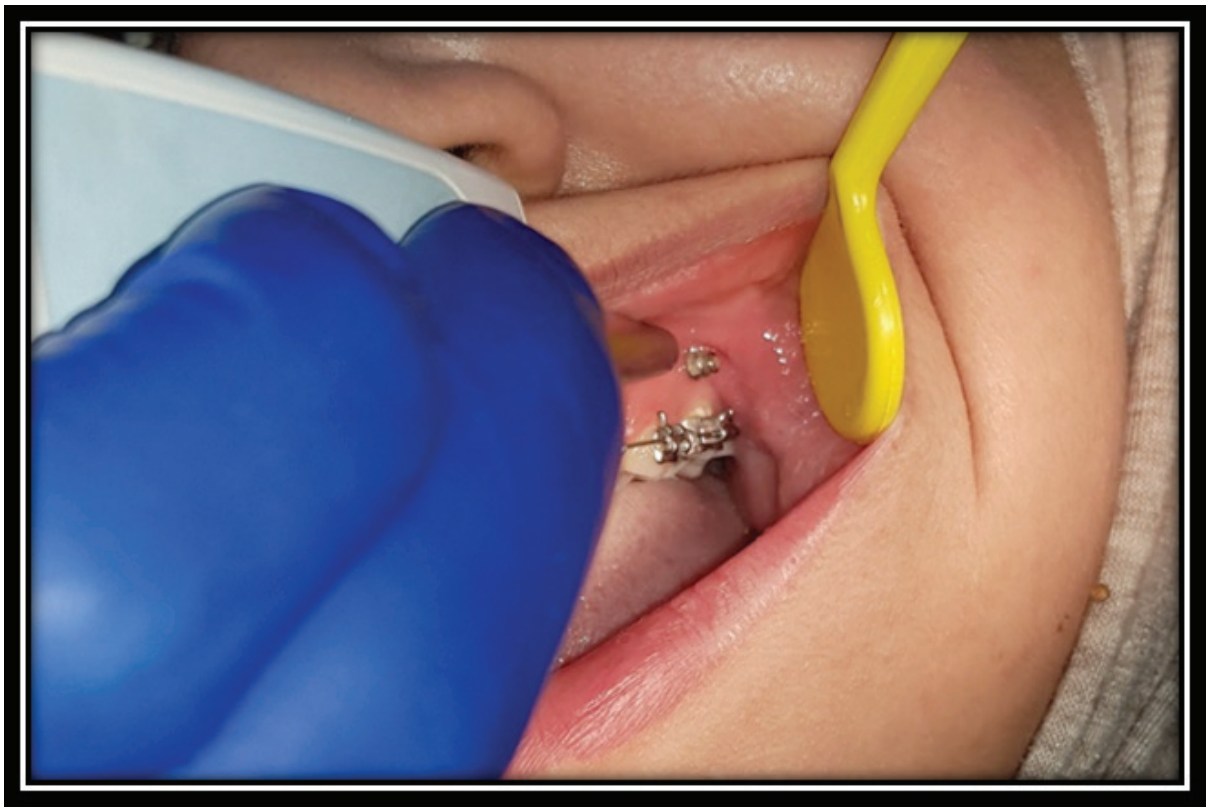

Figure 4: Early stability measurement.

Inter examiner calibration

The inter examiner calibration was done to assess the standardization of the Stability values(Periotest M values), this calibration was done by the researcher and another examiner (A.G Msc oral surgeon who work on Periotest during Msc research) at same time on 20 TAD (10 patients) and non-significant differences were found between two readings as in **Table 1.**

Table 1: Intra-class Correlation Coefficient

	Intra-class Correlation	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.998a	.995	.999	944.626	19	19	.000
Average Measures	.999c	.997	1.000	944.626	19	19	.000

Results

A total of thirty-three patients were included in the study. Their average age was 22.9years (range 18–28 years).In total, seventeen of them were females and sixteen were males. Mean, median, and standard deviation values of miniscrew stability are shown in **table 2**.

Side difference:

Wilcoxon signed rank test was used to compare between right and left sides and there was no significant difference between the two sides in stability after two weeks of miniscrew insertion as shown in **table 2**.

Table 2: Side difference of miniscrew stability.

Side	Descriptive statistics				Comparison	
	N	Median	Mean	S.D.	WSR test	p-value
Right	33	4.6	4.612	1.113	-0.599	0.549
Left	33	4.6	4.745	0.980		

Discussion

One of the most techniques to assess the stability of implant objectively and noninvasively is the Periotest Mentor. PTVs evaluates the miniscrew mobility indirectly to predict the early stability of implantation, the amount of osseointegration, and the prognosis of the implant [(8)].

Insertion of miniscrews with the self-drilling technique used, as proposed by the manufacturers, to leave out a hole of pilot drilling since the size of pilot hole and its depth have been found to control the early stability of mini-implants [(3)].

The results of this study showed that miniscrew length had no significant effect on early stability of miniscrew that agrees with [(6)] who compared the success rate of each miniscrew anchor in 51 patients with 151 miniscrew anchors. He used three types of titanium screws with different lengths and diameters (length, 6 mm, diameter 1.0 mm; length, 11 mm, diameter,1.5 mm; length, 14 mm, diameter, 2.3 mm) and miniplates with 2 screws (diameter, 2.0 mm; length, 5 mm) and one of result of his study was lack of relationship between the miniscrew length with its stability if the miniscrew was longer than 5 mm.did not find that the length of the miniscrew had a significant correlation with implant stability clinically. [(2)] study stability of miniscrew experimentally. He also found that the miniscrew length does not have significant impact on their stability when measuring insertion torque. [(16)]

However, [(14)] found that the length of the inserted screws was an important risk factor .They used 8,10,12, and 14mm miniscrews in the upper and lower jaws and left unloaded for 2 weeks. The authors findings emphasized that the miniscrews length was associated with their success rate, with higher success rates in the longer miniscrews. [(17)] suggest that the smaller diameter and shorter miniscrew had lesser survival rates than the longer miniscrews.

For side factor, the result of our study shown no significant different between right and left side. [(13)] studied 70 orthodontic patients with 140 miniscrews in the maxillary buccal bone between the first molar and second premolar the on both sides and divided them randomly into 2 groups: the first group received self-tapping miniscrew, and the second group had self-drilling miniscrews. They found that the left side with either method of placement had a higher success rate

than the right side, but the differences between both sides were not statistically significant. [11] also showed that the left side had higher rate of success and was more stable than the right side. The former two studies attributed to that hygiene on the left side of the dental arch is better by right-handed patients, who are the majority of the population. Better hygiene could decrease inflammation around the miniscrew.

Ethical Clearance: The Research Ethical Committee at scientific research by ethical approval of both MOH and MOHSER in Iraq

Conflict of Interest: None

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References

1. Alrbata, R. H., Ha, D. W., Yu, W., & Kyung, H. M. Optimal asymmetric thread for orthodontic microimplants: Laboratory and clinical evaluation. The Angle Orthodontist, (2015). 85(4):585-590.
2. Chen, Y. J., Chang, H. H., Huang, C. Y., Hung, H. C., Lai, E. H. H., & Yao, C. C. J. A retrospective analysis of the failure rate of three different orthodontic skeletal anchorage systems. Clinical oral implants research, (2007). 18(6): 768-775.
3. Gantous, A., & Phillips, J. H. The effects of varying pilot hole size on the holding power of miniscrews and microscrews. Plastic and reconstructive surgery, (1995). 95(7), 1165-1169.
4. Jasoria, G., Shamim, W., Rathore, S., Kalra, A., Manchanda, M., & Jaggi, N. Miniscrew implants as temporary anchorage devices in orthodontics: a comprehensive review. J Contemp Dent Pract, (2013). 14(5): 993-999.
5. Lamberton, J. A., Oesterle, L. J., Shellhart, W. C., Newman, S. M., Harrell, R. E., Tilliss, T., ... & Carey, C. M. Comparison of pain perception during miniscrew placement in orthodontic patients with a visual analog scale survey between compound topical and needle-injected anesthetics: A crossover, prospective, randomized clinical trial. American Journal of Orthodontics and Dentofacial Orthopedics, (2016). 149(1): 15-23.
6. Maria, O., Ana, M., & Andreu, P. Primary stability of microscrews based on their diameter, length, shape and area of insertion. an experimental study with Periotest. Progress in orthodontics, (2008). 9(2): 82-88.
7. Nanda, R. Esthetics and biomechanics in orthodontics. Seoul. (2015).
8. OH J S & KIM S G. Clinical study of the relationship between implant stability measurements using Periotest and Osstell mentor and bone quality assessment. Oral Surg Oral Med Oral Pathol Oral Radiol, (2012) 113: 35-40.
9. Oh JS., Kim SG., Lim SC., Ong JL. A comparative study of two noninvasive techniques to evaluate implant stability: Periotest and Osstell Mentor. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. (2009). 107: 513- 18.
10. Oh, J. S., & Kim, S. G. Clinical study of the relationship between implant stability measurements using Periotest and Osstell mentor and bone quality assessment. Oral surgery, oral medicine, oral pathology and oral radiology, (2012) 113(3): e35-e40.
11. Park, H. S., Jeong, S. H., & Kwon, O. W. Factors affecting the clinical success of screw implants used as orthodontic anchorage. American Journal of Orthodontics and Dentofacial Orthopedics, (2006). 130(1):18-25.
12. Son, S., Motoyoshi, M., Uchida, Y., & Shimizu, N. Comparative study of the primary stability of self-drilling and self-tapping orthodontic miniscrews. American Journal of Orthodontics and DentofacialOrthopedics, (2014). 145(4): 480-485.
13. Son, S., Motoyoshi, M., Uchida, Y., & Shimizu, N. Comparative study of the primary stability of self-drilling and self-tapping orthodontic miniscrews. American Journal of Orthodontics and Dentofacial Orthopedics, (2014). 145(4): 480-485.
14. Tseng, Y. C., Hsieh, C. H., Chen, C. H., Shen, Y. S., Huang, I. Y., & Chen, C. M. The application of mini-implants for orthodontic anchorage.

International journal of oral and maxillofacial surgery, (2006). 35(8): 704-707.

15. Tsui, W. K., Chua, H. D. P., & Cheung, L. K. Bone anchor systems for orthodontic application: a systematic review. International journal of oral and maxillofacial surgery, (2012). 41(11): 1427-1438.
16. Wilmes, B., Ottenstreuer, S., Su, Y. Y., & Drescher, D. Impact of implant design on primary stability of orthodontic mini-implants. Journal of Orofacial Orthopedics/Fortschritte der Kieferorthopädie, (2008). 69(1): 42-50.
17. Winkler, S., Morris, H. F., & Ochi, S. Implant survival to 36 months as related to length and diameter. Annals of periodontology, (2000). 5(1): 22-31.
18. Youn, J. W., Cha, J. Y., Yu, H. S., & Hwang, C. J. Biologic evaluation of a hollow-type miniscrew implant: an experimental study in beagles. American Journal of Orthodontics and Dentofacial Orthopedics, (2014). 145(5):626-637.
19. Zawawi, K. H. Acceptance of orthodontic miniscrews as temporary anchorage devices. Patient preference and adherence, (2014) 8:933.