

## Evaluation of periodontal condition in intruded molars using miniscrews

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### Abstract

**Introduction:** The purpose of this preliminary study was to evaluate the periodontal condition of intruded molars in various phases of treatments. **Methods:** 30 patients with at least one overerupted upper first molar were selected. Upper molar bands with brackets were cemented. Two miniscrews were placed in the mesiopalatal and mesiobuccal aspect of the aforementioned teeth. A titanium molybdenum alloy (TMA) spring was attached to the head of miniscrew in one end and ligated to the bracket in the other end to reach the predetermined force. Plaque index (PI), probing pocket depth (PPD), keratinized gingiva (KG), The distance between miniscrew (M.S) and gingival level (GL), and bleeding on probing (BOP) were recorded before loading and 1, 2, 3, 4 and 5 months post-loading. **Results:** All patients completed the study and no complications were reported. Statistically significant intrusion ( $2.1 \pm 0.9$  mm) was obtained during active treatment. Inserting miniscrews generally was presented with greater sulcus bleeding, plaque accumulation and plaque formation at follow-up visits. There was a statistically significant increase in PI, PPD and BOP indices. Furthermore, the results showed decrease in KG level and M.S to GL level. **Conclusion:** Miniscrews can provide a clinical benefit as an absolute anchorage device. However, keeping a good oral hygiene is essential to achieve ideal results, because the

presence of miniscrews, as a foreign object in mouth, and intrusion force might be harmful for periodontal tissues.

**Key words:** Intrusion, mini implant, mini-screw, over-erupted molar, soft tissue health

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### Introduction

Early loss of molars is a very common complication, which usually leads to overeruption of their antagonist. This predicament occurs more, statistically, in maxillary unopposed teeth than in mandibular (1). Craddock et al reported that up to 92% of unopposed posterior teeth might demonstrate some degree of overeruption (2). The overerupted tooth and the resulted elongated dentoalveolar process may cause some serious prognostic complications such as functional disturbances, occlusal interference and prosthetic reconstruction obstacles. There are several conventional

options such as coronal reduction, prosthetic restorations or posterior subapical osteotomy. However, these techniques are usually expensive and require general anesthesia and sometimes endodontic treatments (3).

Conventional orthodontic methods for intruding over-erupted teeth are provided by two techniques; either by intra oral anchor sites utilizing teeth and the palate (4) or from outside the mouth like headgear appliance which provides quite effective anchorage but is mostly unsafe and the results depend heavily on patient cooperation and are limited after removing the device(5,6). Furthermore, due to law of action and reaction, the consequences of treatments are mostly extrusion of the teeth that act as anchorage unit rather than posterior (7-9). To overcome these complications, interest in skeletal anchorage including dental implants (10), surgical miniplates 11 and miniscrews (12,13) has gained much attention as they are able to provide absolute anchorage (8).

There are several reports of successful molar intrusion using miniplates (4,14-20). However when it comes to comparing miniplates to miniscrews, miniscrews show several advantages such as efficient cost and more freedom in detecting insertion area. Furthermore miniplates need two separate insertions and a removal surgery (13,21).

One of the shortcomings of using miniscrews is the limitation, it causes as a foreign object in practicing oral hygiene and consequently, an increase in plaque accumulation and inflammation in surrounding tissues. Another issue is the force that miniscrews use to move the teeth which might harm soft tissues. These problems could risk the long-term success of treatment plan (21,22) and has not been observed and well documented yet. The aim of the present study was to evaluate the periodontal condition of soft tissues in intruded molars in various phases of treatments.

## Materials and Methods

Patient enrollment and clinical procedures.

This preliminary, prospective study was performed in the department of orthodontics, Mashhad University of Medical Science, school of dentistry in Iran. The ethics review board approved the study and measuring instruments were standardized and calibrated. All indices were assessed by an independent operator who was unaware of the allocated treatments .

The structure of the study and oral prescriptions were explained to the participants who had met all of the inclusion and exclusion criteria and informed consent was obtained .

The inclusion criteria were predefined as follows: patients under fifty year-old with at least one overerupted maxillary first molar, which contributed to

prosthodontic replacement of the antagonist tooth and had appropriate periodontal condition .

The exclusion criteria were any aspects of the medical history that might complicate the outcome of the study such as alcohol, drug dependency, pregnancy and lactation, poor health condition or any other medical, physical or psychological reason that might affect the surgical procedure or the subsequent prosthodontics treatment; patients with any history of head and neck radiation treatment, orthodontic treatment, parafunctional habit and active periodontal disease in the beginning of treatment. A total of 30 consecutive patients with mean age of 41.6 years (30 to 50 years) and at least one overerupted maxillary first molar were selected (Total number of 30 patients was chose based on power analysis). An Absoanchor Miniscrew Minikit (Dentos Inc, Daegu, Korea), included long and short hand drivers for insertion, a round bur (1.9-mm diameter, 21-mm length) for making an indentation in the cortex and bracket type miniscrews (1.3-mm diameter, 7-mm length) was used. Stainless steel bands with .0183.030 welded brackets (Dentaurum, Inspringen, Germany) were banded over extruded teeth. A .017 3 0.25-in titanium molybdenum alloy (TMA) spring was constructed to force delivery, which was attached to the head of miniscrew in one end and ligated to the bracket in the other end to reach the predetermined force. Two miniscrews with bracket-type head were inserted; one in the mesiobuccal aspect and another in the mesiopalatal aspect of the selected tooth. The orthodontic technique used in this study for placing miniscrews has been previously published (20).

### Clinical evaluation parameters

The clinical evaluation parameters included plaque index (PI), probing pocket depth (PPD), keratinized gingiva (KG), the distance between the miniscrew (M.S) and gingival level or gingival margin (GL), and bleeding on probing (BOP). All these parameters were evaluated clinically using a Williams SE manual probe (Hu-Friedy Co., Chicago, USA) before insertion of the miniscrews (loading time), as well as all follow-up visits by a calibrated examiner who had no information regarding the procedure of the study. Follow-up appointments were held at 1,2,3,4 and 5 months post-loading for all patients who were also blind with respect to the treatment results. Scores for the PPD index were recorded at the mesial, distal, buccal and palatal aspect of each aforementioned tooth. The PI index was calculated by dividing the number of surfaces containing plaque by the total number of available surfaces. KG and the distance of M.S-GL were measured at the mid-facial aspect of each miniscrew. KG measured the width of the keratinized gingiva (mm), while the distance of M.S-GL demonstrated the

width from the most coronal gingival margin to top of miniscrew (mm). Finally, negative value of BOP, which is only a clinical parameter, represents efficient plaque control while positive value can only demonstrate a strong relationship to progression of periodontal disease and cannot be considered as an accurate health assessment index .

**Statistical analysis**

Following data collection, statistical analysis was carried out by SPSS 12 (SPSS Inc., Chicago, IL, USA), using paired t-test and McNemar’s test.

**Results**

All patients completed the study and all of the maxillary first molars were successfully intruded in all patients according to their own clinical needs. No prosthetic complications such as screw loosening were reported. The mean intrusion value during active treatment was  $2.1 \pm 0.9$  mm (2)

*Plaque Index.* Descriptive Statistics of PI scores at baseline and each follow-up visit are shown in table 1. According to paired t-test, analyzes revealed that mean

PI scores increased significantly with each follow up visit.

*PPD Index.* Table 2 illustrates the mean PPD scores at various follow-up visits. Same pattern was observed for PPD scores; A statistically significant increase in mean PPD scores with each follow-up visits except in baseline and first and second months .

*The average distance of M.S-GL level.* The average distance of M.S-GL level at baseline and each follow-up visits are shown in table 3. Based on paired t-test the decrease in this index was not statistically significant except in baseline and fifth month (p=0.02)

*KG Index.* Table 4 illustrates the mean KG index at various follow-up visits. No statistically significant difference was seen in the results .

*BOP Index.* Finally, the results of BOP of each tooth are shown in table 5. Observing any bleeding while probing was recorded as positive and negative BOP index defines no bleeding while probing. As the results of BOP index were non parametric, McNemar’s test was used to analyze the data .

BOP scores had no statistically significant

**Table 1.** Comparison of PI index in baseline with the other intervals (n=30).

Time point Months post- loading	Mean	Std. Deviation	p-value
Baseline	0.55	0.2	
First month	0.9	0.22	0.052
Second month	0.95	0.11	0.003
Third month	1.0	0	0.009
Forth month	0.95	0.11	0.003
Fifth month	1.0	0	0.009

**Table 2.** Comparison of PPD index in baseline with the other intervals. (n=30).

Time point Months post- loading	Mean	Std. Deviation	p-value
Baseline	1.91	0.53	
First month	2.16	0.43	0.36
Second month	2.36	0.38	0.07
Third month	2.58	0.33	0.02
Forth month	2.55	0.2	0.002
Fifth month	2.61	0.28	0.007

**Table 3.** Comparison of M.S-GL level in baseline with the other intervals (n=30).

Time point Months post- loading	Mean	Std. Deviation	p-value
Baseline	1.8	0.44	
First month	1.75	0.5	0.37
Second month	1.6	0.37	0.09
Third month	1.7	0.27	0.62
Fourth month	1.55	0.27	0.08
Fifth month	1.5	0.3	0.02

**Table 4.** Comparison of KG Index in baseline with the other intervals (n=30).

Time point Months post- loading	Mean	Std. Deviation	p-value
Baseline	4	0.7	
First month	3.8	0.57	0.37
Second month	3.7	1.03	0.57
Third month	3.8	0.83	0.62
Fourth month	3.4	1.02	0.2
Fifth month	3.5	1.06	0.32

**Table 5.** Comparison of BOP in baseline with the other intervals (n=30).

Baseline			
	+BoP	-BoP	P-value
First month			
+	9	12	
-	0	9	0.12
Second month			
+	6	15	
-	3	6	0.21
Third month			
+	9	12	
-	0	9	0.12
Fourth month			
+	9	12	
-	0	9	0.12
Fifth month			
+	9	15	
-	0	6	0.06

## Discussion

The present study was carried out to evaluate the periodontal aspect of miniscrews used to intrude supra-erupted unopposed molar teeth. A whole number of 30 participants with at least one over-erupted maxillary molar was included in the research. Patients met all the inclusion criteria and completed the study successfully.

The rule of action and reaction is an important obstacle against conventional methods of intrusion. Hence, the results are usually accompanied by extrusion of the anchorage unit. The usage of temporary anchorage devices and miniscrews in orthodontics was firstly appeared in literature by Kanomi in 1997(23). Within the last few years, more refined screw designs

have been introduced and the use of absolute anchorage devices is increasingly becoming of interest in literature (4, 18, 24). It has been clearly shown that skeletal devices can intrude overerupted teeth successfully in variable ranges (15, 16). Unfortunately, studies about intruding supra-erupted molars with skeletal devices, especially miniscrews, are limited to case reports (4, 18,24) and a few animal studies (15,25) and not many studies have been published on limitations of utilizing miniscrews. Thus, studies on limitations as well as surgical and orthodontic treatment procedures are much needed .

Periodontal disease is considered as one of the most widespread dental diseases (26). Dental plaque is a microbial ecosystem and its etiological role in the initiation and progression of periodontal disease has been clearly proven by several studies (26, 27). Periodontitis and gingivitis may be the causal factor in some systemic diseases and need to be addressed seriously especially in the immunocompromised, the chronically sick and the elderly (28).

Analysis revealed that inserting miniscrews on overerupted unopposed teeth was generally presented with statistically significant greater sulcus bleeding and plaque accumulation at follow-up visits. In spite of separate positioning of miniscrew from the molar, it seemed that presence of miniscrews might be the main culprit in this case, as brushing would become more difficult and patient might not feel comfortable with the presence of a foreign object in his/her mouth. As a result, miniscrew can be a strong contributing factor in plaque accumulation. Besides, intrusion force for moving the tooth might be harmful to periodontal tissues. (29, 30) Vanarsdall (31) argued that for the health of the periodontal tissue, the tooth should be extruded rather than intruded, because bone deposition occurs with tension but not with pressure.

The mean PPD scores were on increase as a result of plaque accumulation and lack of oral hygiene. It should be noticed that the aforementioned pocket could only be a pseudo pocket caused by plaque accumulation, periodontal inflammation and gingival enlargement because gingival recession and development of a periodontal pockets are multifactorial, time-consuming processes. Likewise, bleeding on probing could be the result of mechanical trauma of healthy sites (32).

KG and the distance of M.S-GL present worsening trend, which can be due to the intrusion of the aforementioned teeth in their treatment process and apically contraction of periodontal tissues during follow-up visits .

Since our researchers could not find any related study about periodontal condition of the teeth that had been intruded using miniscrews as an absolute

anchorage device, we could not compare the results with similar studies.

Sebbar et al conducted an observational study to discover different kind of histologic reactions of peri-implant soft tissue to miniscrews. They observed both patients with orthodontic treatment those with anchorage miniscrews. Histologic analysis was performed on 28 miniscrews. There were signs of inflammation in all soft tissue samples, both a moderately or highly inflamed surface epithelium and underlying connective tissue. They concluded that there might be a greater variation in soft tissue histologic reactions in actual human biopsies rather than in samples of animal studies (33).

Healthy peri-implant tissue plays an important role as a biologic barrier to bacteria. Tissue inflammation, minor infection, and peri-implantitis can occur after miniscrew placement. Inflammation of the peri-implant soft tissue has been associated with a 30% increase in failure rate (34). Peri-implantitis is inflammation of the surrounding implant mucosa with clinically and radiographically evident loss of bony support, bleeding on probing, suppuration, epithelia infiltrations, and progressive mobility (32). The clinician should be forewarned of soft-tissue irritation if the soft tissues begin twisting around the miniscrew shaft during placement. Some clinicians advocate a 2-week soft-tissue healing period for miniscrews placed in the alveolar mucosa before orthodontic loading (31).

Mini-screw failures most often arise from inflammation of the soft tissue around the screw. When mini-screws are implanted on movable mucosa below the mucogingival junction, it is often difficult to apply elastic force because of soft tissue covering the head of the screw. Miniscrew attachments (elastic chain, coil spring) that rest on tissues will likely become covered by tissue. The soft-tissue overlaying the miniscrew is relatively thin and can be exposed with light finger pressure, typically without an incision or local anesthetic. Soft-tissue overgrowth can be minimized by placement of a healing abutment cap, a wax pellet, or an elastic separator. In addition to its antibacterial properties that minimize tissue inflammation, chlorhexidine slows down epithelialization and might reduce the likelihood of soft-tissue overgrowth (31,33,34). So, when possible, implant the mini-screw in the zone of attached gingiva above the mucogingival junction. Soft tissue impingement is less likely in this area, decreasing the possibility that the soft tissue will cover the screw or the screw will fall out, and increasing the patient's ability to maintain good oral hygiene (35) Adjacent roots, nerves, and blood vessels can be damaged during the operation, but, with careful attention, this danger can be avoided. In this situation, a

higher failure probability was reported when the mini-screw invaded the root or periodontal space (36). Therefore, many guidelines and methods have been suggested to avoid root contact, particularly surgical stents and various visual devices. Finally, select a screw with a proper collar length compatible with the thickness of the soft tissues in the area. With observation of all above notification, the patient could be successful in better oral hygiene (36).

Finally we should noticed that miniscrews are contraindicated in heavy smokers and patients with bone metabolic disorders and optimal oral hygiene is imperative to minimize miniscrew complications (36). Chlorhexidine (0.12%, 10 mL) should be used a minimum of twice daily and preferably after each meal. The cationic nature of chlorhexidine allows for its sustained effect through persistent adherence to the enamel and soft tissue, providing a prolonged bactericidal and bacteriostatic effect. Kravitz and Kusnoto advocated rinsing with chlorhexidine and waiting 30 minutes before fluoridated brushing. Additionally, the patient can be taught to use a plastic toothpick to press down the soft tissue or lift the miniscrew attachments away from the tissue periodically (37). In conclusion according to all of the notes said above, tissue inflammation and soft-tissue complications can be minimized by attention to a technical procedure, proper patient selection, and home care notification.

We suggest that long-term studies and larger sample size group are essential to verify the findings of this study. In addition, investigations on other parameters such as radiographic study on crestal bone levels would be an interesting study to design. Furthermore, designing an in vivo study to investigate the discrepancies and histologic changes in soft and hard tissues might be helpful.

### Conclusion

Within the limitation of this small size investigation, miniscrews can provide a clinical benefit as an absolute anchorage device. However, poor periodontal statues can adversely influence the prognosis. Therefore, inflammation must be under control and practicing good oral hygiene must consider as an essential step for achieving ideal results.

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