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ORIGINAL ARTICLE

# Comparing the Clinical Success Rate of Self-Drilling and Self-Tapping Mini-screws in the Retraction of Maxillary Anterior Teeth

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**Abstract**

**Objective:** To compare the success of self-drilling and self-tapping methods in the retraction of maxillary anterior teeth. **Material and Methods:** The study was conducted in 57 subjects with Cl II malocclusion who needed to be treated with extraction of four maxillary teeth. The self-tapping method was used on the left side and the self-drilling method was used on the right side. Then, the pain rate of each method was recorded by the numerical rating scale (NRS). Statistical analysis was done by t-test and Chi-square test. The significance level in this study was considered at p-value<0.05. **Results:** Considering the clinical mobility as the failure, the success of treatment was equal in both methods and was 93%. The inflammation around the mini-screws was 8.8%. A significant relationship was found between the variables inflammation and success (p<0.05). The mean pain was 2.47, but there was no significant difference between the two methods in terms of pain score (p>0.05). There was a significant difference between the groups (p=0.03). The pain was significantly higher in the female. **Conclusion:** There is no difference between self-drilling and self-tapping methods in terms of success. Comparison of the pain between two genders, according to the replantation method, showed a significant difference in pain sensation between two genders. The pain sensation mean in female group was greater than male group.

**Keywords:** Orthodontic Anchorage Procedures; Dental Implants; Osseointegration.

**Introduction**

Applying effective force to the teeth in the orthodontic treatment requires a proper suppository called anchorage, which is defined as resistance to unwanted dental movements [1-3]. Anchorages have different types, including extra-oral anchorages, such as headgear, face mask; intraoral, such as palatal arch, lingual arch, lumbar bump and mandibular teeth and skeletal anchorages such as Mini-screws and mini-plates [3].

The skeletal anchorages help to have a controlled anchorage without the need for the patient's cooperation [4]. In some cases, the maximum anchorage is needed for treatment [5]. Mini-screws are known as an excellent alternative to extra oral anchorages [6]. Today, mini-screws are widely used to provide anchorage for orthodontic treatment [7]. Osseo-integration implants were considered as a reliable source for providing anchorage for orthodontic treatment [8]. However, their large size, and more importantly, the ability to create osseointegration, limited their use in these therapies. Therefore, the use of mini-screws has been developed to provide suitable anchorage for orthodontic treatment in order to solve this problem [9,10].

Non-osseointegrated mini-screws are known as temporary anchorage devices (TADs). This term refers to implants that are inserted into the bone to provide skeletal anchorage and are reintroduced upon the termination of treatment [11]. Their advantages are the possibility of immediate load and cost-effectiveness in addition to the appropriate size, minimum anatomical limitations, minor surgery, easy replantation and removal, increased comfort and no need for patient collaboration [12-16]. It should be noted that the use of mini-screws does not always guarantee the success of the treatment and can have mobility and be removed from the site before or during the complete treatment [17,18]. According to the literature, the percentage success of the mini-screws is less than osseo-integrated implants (85-80%) [19-22].

As mentioned, the osseointegration plays a minor role in mini-screws. It is also important to maintain mechanical stability in orthodontic forces [23,24]. The mechanical stability in the mini-screws is defined in two primary and secondary stability forms, which have the greatest probability of failure in the mini-screws based on clinical findings due to impairment in the initial stability or at the very beginning of the onset of force [25-27]. Mini-screws can be placed in self-drilling and manually or by self-tapping on the bone [28,29].

Theoretically, several texts have highlighted the advantages of the self-drilling method, which can be referred to as the need for less time to accommodate and the need for a pilot hole, the latter that reduces the risk of damage to the nerves, collisions with the teeth root, fracture of drill tip and necrosis caused by heat. On the other hand, studies have shown that there is a lack of superiority in terms of the clinical success of self-drilling methods in comparison with the self-tapping method and suggest that cortical bone damage is greater in self-drilling [29].

Based on literature reviews, most studies have been conducted on the initial stability of these two methods and less has been considered for clinical success. Since the ultimate goal of studies is a clinical success, the present study aimed to examine this issue given the controversial information

available in these two methods, which could be judged clinically in each case. In this study, the success rate of the mini-screws used in self-tapping and self-drilling methods in class II patients were evaluated.

## Material and Methods

### Study Design and Sample

This study was performed as a clinical trial and in vivo. Initially, individuals with Class II malocclusion included in the study which required the extraction of four teeth and the retraction of the anterior maxillary teeth in their treatment. After acquiring this competence, patients should not have any metabolic bone disease and should not take medications that affect bone and orthodontic treatment, as well as not being in the period of mixed dentition [29].

A total of fifty-seven patients were entered to study and patients should be over 15 years old in order to include in the study. Patients were initially treated for initial preparation and they were treated with mini-screws after the extraction of the teeth. Initially, the informed consent form was given to the patients and, while recording the demographic information, the necessary information about the treatment was given to them. They were asked to pay attention to the pain caused by each method during the replantation of the mini-screws.

### Clinical Procedures

Initially, the vestibular area was anesthetized by 2% Lidocaine solution with 1: 100000 epinephrine. Self-tapping screws were placed on the left and self-drilling were placed on the right. Replantation priority was randomized for each patient. Jeil screws (Jeil Medical Corporation, Seoul, Republic of Korea) were applied for this study, with a diameter of 1.4 mm and a length of 8 mm and made of titanium alloys.

The screws were placed between the second premolar teeth and the first molar. First, the mucogingival line was detected and then tapped by orthodontist gauge with a 90-degree angle to the maxillary alveolar bone [29,30]. The main research group consisted of two sides of individuals in the study, each side using a method for placing the mini-screw (self-tapping on the left and self-drilling on the right). All mini-screws were fitted with an experienced orthodontist to minimize operator-related errors (Kappa intra-examiner = 0.76).

In the self-tapping method, screws are placed by Jeil screw driver. In the self-drilling method, a pilot drill was started with a 10th milling tool (during this process, the area should be cooled down by normal saline to prevent bone damage), and then were inserted with the same screw driver [29] (Figure 1). Then, the patients were asked to choose a pain scale from 0 to 10, which is referred to as the numerical rating scale (NRS), to select a number for each side for their pain and to register in the relevant form. Finally, the mobility of screws was checked by the dentist's pans. At the first session, mini-screws were not subjected to force according to some new studies, and patients were discharged [25,28]. The next challenge was at least two weeks after replantation, and it could

take a month. In the second session, the surrounding tissues of screws was examined for redness, inflammation, hyperplasia, and bleeding [29,31]. Then, the mobility was checked by a screw driver and the slightest move was considered as mobility, which was recorded as a failure in treatment. The mini-screws with mobility were snapped [22,29,31]. Continued further follow up in the event of inflammation and lack of mobility. The ortho technology is used to apply force [29]. The amount of force was 150-200g per side, measured by the orthodontic gauge (Figure 2).

**Figure 1. Preparation for conducting self-drilling method.**

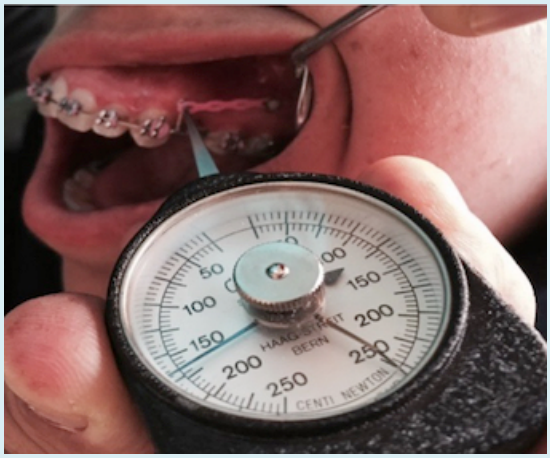


**Figure 2. Measurement of force by the orthodontic gauge.**

Subsequently, patients were referred to the clinic once a month for 6 months for follow up and mobility check and the information were recorded. At the end, 6 months of treatment were evaluated.

Hence, NRS was selected given the limited differences between these scales. A part of the data was collected by a questionnaire provided to the patients for the registration of NRS, and the rest of the data were collected by the experienced orthodontist or mobility and inflammation.

Data Analysis

The obtained data were analyzed using IBM SPSS Statistics for Windows Software, version 17 (IBM Corp., Armonk, NY, USA). Statistical analysis was done by t-test and Chi-square test. The significance level was considered at $p\text{-value}<0.05$.

Ethical Aspects

This research project was approved by the Ethics Research Committee of the University of Medical Sciences and all procedures followed were in accordance with the Helsinki Declaration.

**Results**

The mean age was 25.7 ± 4.4 and the minimum and maximum data were 17 and 36 years, respectively. There was a predominance of female patients (86%). Mobility percentage was generally 7% while pain variable was 2.47 ± 1.6 (minimum 0 and maximum 7) (Table 1).

**Table 1. Distribution of the sample according to demographic and clinical data.**

| Variables | Frequency | |
|---|---|---|
| | N | % |
| Age (Mean ± SD) | 25.7 ± 4.4 | |
| Sex | | |
| Male | 8 | 14.0 |
| Female | 49 | 86.0 |
| Inflammation | 5 | 8.8 |
| Mobility | 4 | 7.0 |
| Pain (Mean ± SD) | 2.47 ± 1.6 | |

The self-tapping mean value for pain was 2.35 and the mean value for self-drilling screws was 2.6. Mobility was exactly the same in both groups and there was no difference. Considering the clinical mobility as the failure, the success of treatment was equal in both methods and was 93%. The inflammation around the mini-screws was 8.8%. No significant difference was observed between the methods ($p>0.05$) (Table 2).

**Table 2. Comparison of clinical indices in two mini-screw types.**

| Variables | Mini-Screw Type | | |
|---|---|---|---|
| | Self-Tapping | Self-Drilling | **p-value** |
| Pain (Mean) | 2.35 | 2.6 | >0.05 |
| Inflammation | 9.0% | 8.8% | >0.05 |
| Mobility | 7.0% | 7.0% | >0.05 |

A significant relationship was found between the variables inflammation and success ($p<0.05$). The t-test was used to compare the pain between two genders according to the replantation method and there was a significant difference in pain sensation between two genders ($p=0.03$). The pain sensation mean was 2.6 in female group and 1.3 in the male group.

## Discussion

The success rate of mini-screws depends on many factors, but according to studies, it varies from 0 to 100%. However, most studies have noted the minimum factors for the failure of treatment (displacement and mobility) of over 80% [2,18,22,31]. In this study, the failure rate was similar to previous studies, which was 7% and a success rate of 93% was observed. The failure criteria were clinical mobility and mini-screws breaking. In the current study, there was no failure of mini-screw breaking and it was just mobility. In a systematic review, these factors are divided into six categories [2], which include implant, patient variables, implantation process, type of orthodontic treatment and the applied force, and factors relating to the maintenance of the mini-screws. The lengths [19,22], diameter [26], design engineering [15,24], surface features [16,30], and alloys can be mentioned as the factors related to the mini-screws. The age, mental admission, mandibular plane angle, and metabolic diseases [29] can be pointed out as the factors related to the patient.

The replantation location can vary depending on: anterior or posterior of arches [20,22]; the cortical bone density, type of that area soft tissue (attached gingiva or alveolar mucosa), the side of

action (buccal, lingual, left or right) [21] and the conditions of the underlying roots. Replantation variables include the surgical technique flapless or with flap [26], self-drilling or self-tapping, direction and angle of replantation, and the amount of replantation torque [6,28]. The variables related to orthodontics include the onset time of applying force, duration of applying force, and the amount of force of orthodontic treatment. In the case of mini-screw maintenance, mobility control [31], inflammation around the mini-screw [26] and patient's health are among the most important factors.

In the present study, the 6-month success rate of both methods was equal and was 93%. Some authors biomechanically and histologically compared both methods using mini-screws with a different design for each method on dogs. The screws were subjected to a force of 200 g for 9 weeks. Any mobility was considered as a failure like our study. After the completion of the course, the success of the self-drilling and self-tapping groups was 86% and 93% respectively, and according to a sample size of 28 for each group, the results cannot be regarded as highly valid and reliable. Since physiologically and structurally, the bone and body of the dog are different from humans, the important factors in the low success rate of both groups, especially in the case of self-drilling can be pointed to a high gap between screws because in previous studies and in many new studies, at least two weeks have been recommended to repair the wound area [25,29]. During histological studies, it was observed that the bone tissue was better involved around the self-tapping screws and a less fibrous connective tissue was formed.

The reason for the high failure rate in this study is the small sample size, which causes the failure cases to affect the result. Moreover, the applied mini-screws were not from a reputable company and a local laboratory has been used to construct them. They did not have a good quality. Regarding the fact that the mini-screws with the inflamed gingiva were still had anchorage ability; they should not be considered as failures. Another factor causing a high failure rate in this study was the age range of the patients. One of the most important factors in age is the time of applying force because one study that examined mini-screws in adolescent patients concluded that this age group should spend a 3-month period without force and then can be subjected to force [31]. The success of the groups according to the time of force was 92% and 63%, respectively [31].

In a previous study, the breakdown was more internal [16]. Therefore, it can be concluded that the reason for this can be the morphology of the screws and their implantation process that certainly not to indicate the stability and superiority of one another. Self-tapping mini-screws apply more force into the surrounding bone due to the need for maximum implantation torque and compress it more. Due to their successful success, this indicates that their micro-injuries are within the limits of the physiological tolerance of bone tissue. Then, CBCT radiography was performed from all patients and the root contact was investigated. In their study [16], the percentage of success in both methods was high and equal (97%) as the current study. The authors stated that mobility was significantly higher in the self-tapping group with root contact than the self-drilling group [16].

This study did not allow CBCT radiography to be considered since it was costly. For this reason, the most important cause of failure was related to inflammation around the mini-screws while other studies directly identify root contact as one of the most important factors in mobility or indirectly considered root proximity as a failure factor. In this study, the subjects were divided into two groups and two implantation methods were used for both groups. However, it was better to do a split-mouth study on each side each person used a mini-screw according to previous studies to minimize the probability of interpersonal differences. Moreover, since these different implantation methods are used for their own mini-screws, self-tapping screws should not be used for self-drilling methods.

It cannot be certainly said that whether inflammation around the mini-screw can be a failure factor or not? Because there is no study just about this case. In most studies, this item is studied along with existing variables [21,25,26,32]. Whether to accurately determine the effect of inflammation or its cause require to prove other variables with para-clinical tools, high precision during the work and subsequent examinations of the patient to determine whether the cause is due to non-compliance with the health, type of implantation or factors such as the type of force and even root contact mentioned in the previous discussion.

The main cause of the failure in this study was the mobility of screws, but the cause of the inflammation was unknown because other factors that could affect it were not controlled. Some studies identified only a relationship between failure and mobility with inflammation [25,26,32]. A higher failure rate was shown in the group that was subjected to force during the first three weeks of implantation [25]. This can also be a factor in the reaction type of bone and soft tissue and inflammation type. However, a lag force was applied in this study and this factor was eliminated. Also, they examined the relationship between root contact and inflammation in an animal study. It was argued that one of the causes of soft tissue inflammation could be screw in periodontal tissue, and the root surface can be mended in case of mild injury [25]. One of the most important factors that are mentioned is the sufficient attached gingiva around mini-screws while non-keratinized tissue around screws causes' inflammation and treatment failure [32]. Meanwhile, the application of lag force is mentioned as an important factor in reducing failure.

Since pain is one of the factors that relate to the patient's comfort and acceptance of treatment, we tried to address this problem. In one of the previous studies, only complaints by the patient were fear after the implantation. They stated that 40-50% of the patients expressed pain after the implantation and there was no mention of gender or cause or other factors. In this study, sex had a role in pain sensation, but there was no difference in the pain associated with implantation type.

## Conclusion

There is no difference between the self-drilling and self-tapping methods in the maxilla and the selection of each method is up to the dentist. However, it is better to advice patients to fully observe the health to control surrounding soft tissues for the possible inflammation. In the case of

inflammation, it is not necessary to bring the screws out in the absence of mobility. In addition, the pain caused by this process is low despite the numbness. According to various studies, it is recommended to spend 2 till 4 weeks between applying force and implantation.

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**Conflict of Interest:** The authors declare no conflicts of interest.

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