

# SUCCESS RATE OF DIFFERENT INSERTION SITES AND LENGTHS OF MINI SCREWS IN ORTHODONTIC PATIENTS

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## ABSTRACT

**Objective:** To determine the success rate of different insertion sites and lengths of miniscrews in orthodontic patients.

**Materials and methods:** A cross-sectional study conducted at the orthodontics department of Khyber college of dentistry from July 2017 to October 2017. A total of 105 titanium mini screws of different lengths 6mm, 7mm, 8mm and 10mm were inserted in different sites of maxilla and mandible in 60 orthodontic patients. All miniscrews were self-drilling. The stability was checked at the time of insertion and rechecked after the application of orthodontic load for three months. Potential confounding variables like gender, miniscrews length and insertion site were evaluated. Chi-square tests were applied to determine the influence of each factor on the stability of miniscrews in each patient using SPSS version 20.

**Results:** The overall success rate for miniscrews was 78 percent for three months. The success rate in males (n=42) was 76 percent and in females (n=63) was 79 percent. No significant differences were found for gender (p value= 0.548) and insertion site of miniscrews (p-value 0.93). Anterior maxilla (n=14) showed most stable results (85 percent). The only factor having a significant effect on miniscrews stability was its length (p-value 0.050). The stability increases with increase in length that is 10 mm (n=12) were the most stable length (100 percent), and 6mm (n=19) was the least stable (52 percent).

**Conclusion:** Miniscrews insertion sites have no significant influence on stability, but careful selection should be made to avoid trauma to adjacent vital structures. A longer mini screw has greater stability and is a statistically significant factor and is recommended to achieve higher mechanical retention to fulfil anchorage demands for an orthodontic appliance.

**Keywords:** Mini screws, Orthodontics, Insertion sites

## INTRODUCTION

One of the most challenging tasks for orthodontists is to build up anchorage for dental and skeletal malocclusion.<sup>1</sup> Unwanted reactionary forces act on the anchorage segments making unwanted movements

of these segments. The best solution to overcome such clinical problems is the use of mini screws or temporary anchorage device. Tads have been introduced in the form of titanium mini screws that has widened the horizon of biomechanics in the field of orthodontics and dentofacial orthopaedics. Miniscrews are used to provide skeletal/absolute anchorage.<sup>2</sup>

These devices are inserted into jaw bones on the mucogingival junction in temporarily to fulfil the

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requirement of skeletal anchorage without Osseointegration. The main purpose is to provide a reliable and stable anchorage system for an orthodontic appliance<sup>3</sup>. They have an advantage of being used in non-complaint patients who refuse to use intra oral elastics and or extraoral headgears which were used as anchorage tools. In addition to this, they are user-friendly having numerous benefits like easy placement and removal, small size, immediate loading and low cost.<sup>4</sup> They offer various clinical applications like molar uprighting, molar protraction, correction of open bite, mild asymmetry and other dentofacial deformities.<sup>5</sup>

Evidence shows that various difficult tooth movement has been made possible clinically using mini screws for anchorage control. The success can be achieved only if the mini screws are stable in bone throughout the treatment. There are several factors affecting the mini screws stability within the bone, like shape and size of mini screws, placement site in the jaw bone, insertion technique bone contact, bone quality, thickness and operator experience. If the mini screws become immobile and non-retentive, both before and after applying orthodontic load. It can lead to mini screw instability and failure of the anchorage system<sup>5,6</sup>

## OBJECTIVE

This study aims to determine whether mini screws with different insertion sites and lengths used in our setup inserted into different sites in jaw bones in our population have any effect on the stability of the mini screw among males and females both before and after applying orthodontic load.

## MATERIALS AND METHODS

A cross-sectional study conducted at the department of orthodontics in Khyber College of Dentistry, Peshawar from July 2017 to October 2017. Approval of the hospital committee was taken. A total of 105 tapered titanium mini screws of same size/diameter (1.3 mm) and various lengths (6mm, 7mm, 8mm and 10mm) inserted in 60 patients (42 mini screws placed in males and 63 placed in females with mean age  $\pm$  SD =  $22.0 \pm 6.8$  years) were included in this study. Patients with following records were included in the study. 1) Insertion date of the mini screw, mini screw loading, 2) Type, length, and diameter of mini screw. 3) Location of mini screw. Smokers and patients with

systemic medical conditions or those on long-term medications were excluded.

To determine the association between different factors affecting the success of mini screws stability. The variables were divided into two categories: patient-related, and miniscrew related factors. Patient-related factors included gender of the patient. Miniscrew related factors included miniscrews with different lengths (6mm, 7mm, and 10mm) and site of placement of miniscrews i-e anterior and posterior (buccal and palatal) maxilla and anterior and posterior mandible.

For this study, detailed patient information was obtained from lateral cephalogram films, panoramic radiographs and photographs. Informed consent of the patients was obtained. The mini screw was inserted directly into the bone with a hand-driven screwdriver without predrilling. The patients were instructed to rinse with 0.2% chlorhexidine mouthwash preoperatively and use it for two weeks postoperatively with other oral hygiene maintenance instructions. The mini screw of variable lengths was inserted into following sites. Type A: miniscrews of length 7mm or 8mm were inserted into maxillary buccal region (mostly between second premolar and 1st molar) and anterior maxilla (between central incisors), Type B: miniscrews of length 6mm were anchored to mandibular buccal region (between second premolar and 1st molar, and distal to canine), anterior mandible (between incisors). Type C: miniscrews of length 10mm were inserted into the palatal side, 10 mm lateral to the midpalatal suture between first molar and 2<sup>nd</sup> premolar.

Two criteria marked the success of miniscrews: No inflammation of the mucosa around the miniscrew head and no signs of clinical mobility. An extremely unstable mini screw that cannot be used as a source of anchorage was considered failed. The clinical stability of all the miniscrews was repeatedly observed for three months.

## RESULTS

The overall success rate was 78.09 percent for all miniscrews for three months of orthodontic treatment (n=105). The success rates for initial stability were observed concerning the following potential confounding factors, i-e gender, miniscrews length, and site of placement of miniscrews.

The success rates were comparable in females (n=63, 79%) and males (n=42, 76%). However, the difference was statistically non-significant (p value=0.548)(Table 1). However, the number of failed miniscrews increased in females after one month, and after 3rd month the count was greater in males. Success rates of Miniscrews implanted in the maxilla (n=74, 83%) was higher than mandible (n=21, 57%). Moreover, the success rate in anterior mandible was greater (n=7, 85%) than posterior mandible (n=14, 42%) which showed that the posterior mandible was least stable among all sites. The success rates in anterior maxilla was greater (n=14, 85%) than posterior maxilla (n=70, 82%). But the results were

statistically non-significant (p value=0.93). Among sites, posterior mandible remained the most unstable region for miniscrews after three months in contrast to anterior maxilla which showed most stable miniscrews count after three months (Table 2). The success rate of miniscrews in terms of length was least with 6mm (n=19, 52%), higher with 7 mm (n=66, 81%), and 8 mm (n=8, 87%) and highest with 10 mm (n=12,100%). The results were statistically significant (p-value =0.050). Among lengths, 6mm miniscrews failed mostly. However, the stability rate increased with increasing lengths of miniscrews. That means 10 mm miniscrews remained most stable after three months.

**Table-1: stability of miniscrew in both genders stratified by duration of use**

chisquare value= 2.12, df = 3 , P=.548

Gender	remains stable		unstable after 1 month		unstable after 2 months		unstable after 3 months	
	Count	%	Count	%	Count	%	Count	%
Male (n=42)	32	76.19	3	7.14	2	4.76	5	11.90
Female (n=63)	50	79.36	5	7.93	5	7.93	3	4.76
Total (n=105)	82	78.09	8	9.75	7	8.53	8	9.75

**Table-2: stability of miniscrew in both genders stratified by length/screw type**

chi-square value= 16.925, df = 9 , P=.050

mini screw length		remain stable		after one month		after two months		after three months	
		Count	Column N %	Count	Column N %	Count	Column N %	Count	Column N %
6mm	(n=19)	10	52.63	2	10.52	3	15.78	4	21.05
7mm	(n=66)	54	81.81	4	6.06	4	6.06	4	6.06
8mm	(n=8)	7	87.00	1	12.5	0	.0	0	.0
10mm	(n=12)	12	100	0	.0	0	.0	0	.0

**Table-3: stability of miniscrew in both genders stratified by site of placement**

chi-square value= 14.916, df = 9 , P=.93

site	remain stable		after one month		after two months		after three months	
	Count	Column N %	Count	Column N %	Count	Column N %	Count	Column N %
post.maxilla (n=70)	58	82.85	5	7.14	3	4.2	4	5.71
ant.maxilla (n=14)	12	85.71	1	7.14	1	7.14	0	.0
post.mandible (n=14)	6	42.85	2	14.28	3	21.42	3	21.42
anterior.mandible (n=7)	6	85.71	0	.0	0	.0	1	14.28

## DISCUSSION

This study evaluated factors like gender, miniscrews length/type and site of its placement to check whether factors like these have any effect on the stability of miniscrews used as temporary anchorage devices in orthodontic treatment. Temporary anchorage devices are used in orthodontic treatment as an anchorage source to make difficult tooth movements possible in extreme situation where anchorage requirement is critical. To carry out such movements the stability of miniscrews is of chief concern.

In this study, the miniscrews stability was checked for three months of treatment. In this period the overall success of miniscrews implanted in the maxilla was 83 percent and mandible 57 percent. This shows that maxilla has higher stability compared to the mandible. Moreover, the success rate in anterior mandible was 85 percent, and posterior mandible was 42 percent. The stability rates of miniscrews in anterior maxilla was 85 percent and in posterior maxilla was 82 percent, so anterior maxilla remained the most stable site after insertion up to 3 months of orthodontic force application. However, the results were statistically non-significant. The different sites of insertion had no significant difference in success rates in our study, and this is similar to the results by Chen et al. in 2007 and 2008<sup>7,17</sup> and other researchers<sup>1,5</sup> who showed that insertion site (maxilla or mandible, left or right side, anterior or posterior) presented no statistically significant association on stability of miniscrews. However, this is in contrast to the study by Tseng et al.<sup>15</sup> Who found that the location for insertion of miniscrews was the statistically significant factor to influence miniscrews stability. He concluded that anterior maxilla was the most stable site.

The success rates were comparable among genders, as in females it was 79 percent, and males were 76 percent. However, the difference was statistically non-significant. This study is similar to the work done by Hoi-JeongLim<sup>1</sup> whose studies showed that gender values were comparable in both genders, but age and gender had no significant effect on the success rates of miniscrews

Among all factors evaluated for stability of miniscrew in our study only length of miniscrew was found to be statistically significant. The success rate of miniscrews regarding length was for 52 percent

for 6 mm, 81 percent for 7 mm, 87 percent for 8 mm and 100 percent for 10 mm. The results were statically significant and similar to the work done by Miyawakiet al<sup>5</sup>; Cheng et al.<sup>16</sup>; and Kuroda et al.<sup>8</sup> In our study the success rates of miniscrews increased with increase in length of miniscrews i-e 10 mm implants had greater stability followed by 7 or 8 mm miniscrews, and the stability was least with miniscrews of 6mm length, the results were coincident with the study by Tseng et al. who found that as success rate increases with length, it was the highest for miniscrews with greater lengths like 12mm and 14 mm.<sup>15</sup> The possible reason behind this could be that the surface contact area between bone and miniscrew is increased with increasing lengths of miniscrews. The mechanical retention of the miniscrew depends on the contact between cortical bone and miniscrew threads. These findings were similar to the study of Chen et al.<sup>16</sup> in 2006 who concluded that length of miniscrew is a significant variable influencing the stability of miniscrews in jaw bones. The 10 mm miniscrews were inserted on palatal side. According to Schatzle et al. that the palatal implants and mini plates show greater success rates.<sup>12</sup>

One common factor responsible for the success of primary stability of miniscrews is the insertion torque of the miniscrew. Since no predrilling was done before insertion of the miniscrews, as all the miniscrews used were self-drilling. Therefore the miniscrews were placed under rotatory pressure during insertion into the cortical bone. The greater the insertion torque while insertion of miniscrew, the greater is the damage to the bone and greater chances of failure of miniscrews.<sup>9-11</sup> Clinicians with higher expertise can deliver adequate insertion torque, avoid root trauma and maintains the primary retention of the miniscrews. This was concluded by Kuroda et al. in (2007)<sup>8</sup>. A mini screw must remain stable under orthodontic forces. Further research should be done to determine the effect of other potential confounding factors on the stability of miniscrews.<sup>12</sup> Park et al.<sup>13</sup> and Wuet al.<sup>14</sup> stated that miniscrews inserted on right side fails most compared to the left side of the patient as the left side of the patient is an easy location for insertion for most operators.

## CONCLUSION

1. The overall success rate for miniscrews after three months was 78 percent.

2. The success rates for miniscrews was not significant among genders and placement site, but care must be taken to avoid damage to the roots and other vital structures around the insertion site of miniscrews. The anterior maxilla was considered the most stable.

3. The success rate of stability was statistically significant with the increasing lengths of miniscrews. The longer miniscrews must be used to gain greater stability and mechanical retention of miniscrews to meet desired anchorage demands in an orthodontic appliance.

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