Effect of Age, Gender, Side and Jaw of Placement on the Success Rates of Orthodontic Miniscrew Implants

Abstract

Background: This study investigated the success rates of orthodontic mini screw implants and the associated clinical factors contributing to their success in bi-maxillary proclination cases.

Materials and methods: This is a single center prospective case series analytical clinical trial involving a total of 100 orthodontic mini screws inserted in 25 participants with bi-maxillary proclination. The mini screws were used for direct anchorage support and were placed in the attached gingiva between the second premolar and the first molar in all four quadrants. Participants were followed for a 6 month period. The cumulative survival rate was recorded and various clinical variables were statistically measured using Chi-squared test.

Results: The overall success rate of the mini screws was 81%. Genders, age, jaw and side of placement had no significant effect on the success rates of the mini screws with the level of significance set at (p<0.05).

Conclusion: Mini screws have high success rates as a source of anchorage reinforcement in bi-maxillary proclination cases. There is no evidence that gender, age, side of insertion or the jaw of insertion are associated with the mini screws’ success rates in this study.

Keywords: Miniscrew; Mini-implant; Failure rate; Orthodontic anchorage

Introduction

The introduction of implants to the orthodontic field served as a huge breakthrough paving the way for a wide spectrum of applicability within the scope of orthodontics [1,2]. Throughout the years, the evolution of end osseous implants inserted in various edentulous areas and palatal implants inserted in the mid palatal regions offered us alternative solutions to overcome the frequent problems encountered whilst using conventional methods of anchorage reinforcement. However, the utilization of these endosseous implants was hindered by the limited locations in which they could be inserted [3,4]. Orthodontic mini screw implants (OMIs) with their ease of applicability, simplicity and lack of compliance problems made them a reliable source of anchorage reinforcement in recent years [5].

The success rates for OMIs have been reported previously in multiple studies with a wide range of 59.2%-100% [6-10]. This wide range might be explained by the influence of different factors on the stability of OMIs including the type and dimensions of the implant, operator experience, site of insertion, age of the patient, gender, side of insertion and the implant loading time [11-13].

The aim of this single centre prospective case series analytical clinical study was to assess the success rates of self-drilling OMIs and explore the different clinical variables that might be associated with their success in bi-maxillary proclination cases.

Materials and Methods

Ethical approval was obtained from the medical research ethics committee at the national research center in Cairo, Egypt (RN16/439). Twenty-five consecutive participants (17 females, 8
males) with a mean age of 20.7 years ± 4.2 years were enrolled in this study. They were treated by an operator in a private practice located in Cairo, Egypt during 2016-2017. Inclusion criteria included subjects requiring orthodontic fixed appliances along with the extraction of the first premolar in all four quadrants with the following criteria:

- Bi-maxillary proclination cases with high orthodontic anchorage demands.
- No craniofacial anomalies.
- No significant medical history or medication that would adversely affect the development or structure of the teeth and jaws and any subsequent tooth movement including any systemic disease or bone disorders.
- No previous orthodontic or orthopaedic treatment.
- No history of bruxism or Para function.
- No past or present signs and symptoms of periodontal disease.

An informed consent was obtained from participants and parents/guardians followed by a full set of orthodontic records including study model, clinical photographs, lateral cephalograph, orthopantograph. Then, upper and lower arches were bonded with pre-adjusted fixed appliances, 0.022 x 0.028-inch slot with MBT prescription (3M Unitek).

Self-drilling titanium OMIs (MTC, Korea), 1.6 mm in diameter and 8 mm in length, were used in this study and inserted by single experienced operator. Before placement of OMIs, local anesthetic was administered and 0.2% chlorohexidine mouthwash for 30 second was prescribed. OMIs were placed in the inter-radicular region between the second premolar and the first molar in all four quadrants at the level of the attached gingiva. The placement angle was initially perpendicular to the cortical bone but then obliquely changed to 45°- 60° to the long axis of the teeth. None of the screws were replaced because of improper angulation. OMIs were immediately loaded with orthodontic force ranging from 150 to 200 cN to provide a direct anchorage support.

Subjects were followed up on a monthly basis with continuous monitoring of the status of the inserted OMIs. Criteria of a successful outcome in this study was judged upon the ability of the OMIs to provide anchorage reinforcement for more than 6 months without being lost due to excessive mobility or having to be removed prematurely due to excessive swelling, pain or any other reasons. Gender, age, side of insertion and jaw of placement were the explored clinical variables.

### Statistical Analysis

SPSS (Version 13; SPSS, Chicago, IL, USA) was used to conduct the statistical analysis. The cumulative survival of the OMIs was recorded for the planned study period. Chi-square tests were used to assess the significance of different clinical variables on the success of OMIs with significance set at (P<0.05).

### Results

All subjects enrolled in this study received OMIs and continued the follow up period with no drop outs. The overall success rate for the placed OMIs was 81% with only 19 out of 100 inserted OMIs regarded as failures during this study (Table 1). Although, the success rate of the maxillary OMIs was 6% higher than the mandibular OMIs, this difference was not statistically significant (p>0.05). Similarly, there were no statistically significant differences (p> 0.05) between the right and left sides, 76% and 86% respectively. Older participants above the age of 18 years showed a better success rate yet again without a statistically significant difference when compared to younger participants (p>0.05).

### Discussion

There is no doubt that OMIs have revolutionized orthodontic practices within the last few years. This popularity among orthodontists and patients alike was not only due to their ease of use and cutting edge superiority in anchorage reinforcement but also for their high success rates rendering their effective utilization on a constant basis. The success rates for the OMIs in this study was found to be 81% which is slightly lower than the 86.5% reported in a previous meta-analysis [11]. One possible explanation might be attributed to the inclusion of subjects with bi-maxillary proclination in this study. Altered crown and subsequently root inclination might limit the inter-radicular spaces between the teeth allowing higher chances of root proximity and thus a higher chance of failure when an inter-radicular OMI is inserted. Moreover, success rates do vary among different studies and that might be explained by the existence of different clinical variables either related to the host or the operator, these various variables could potentially influence the final outcomes.

In our study, the right side of insertion had 12 failures compared to only 7 observed failures on the left side. Whilst this difference was not statistically significant, the higher failure rates found on the right side might be explained by the fact that right-handed operators tend to have easier direct accessibility to the left insertion sites resulting in a more accurate OMI insertion in that

<table>
<thead>
<tr>
<th>Clinical variable</th>
<th>Success rate</th>
<th>Number (Successful OMIs/total)</th>
<th>P-value (Chi-square)</th>
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</thead>
<tbody>
<tr>
<td>Jaw of insertion</td>
<td></td>
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<tr>
<td>Maxilla</td>
<td>84%</td>
<td>(42/50)</td>
<td>0.444</td>
</tr>
<tr>
<td>Mandible</td>
<td>78%</td>
<td>(39/50)</td>
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<tr>
<td>Side of insertion</td>
<td></td>
<td></td>
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<tr>
<td>Right</td>
<td>76%</td>
<td>(38/50)</td>
<td>0.202</td>
</tr>
<tr>
<td>Left</td>
<td>86%</td>
<td>(43/50)</td>
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<tr>
<td>Gender</td>
<td></td>
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</tr>
<tr>
<td>Males</td>
<td>78.10%</td>
<td>(25/32)</td>
<td>0.615</td>
</tr>
<tr>
<td>Females</td>
<td>82.30%</td>
<td>(56/68)</td>
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<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 18 years</td>
<td>75%</td>
<td>(30/40)</td>
<td>0.211</td>
</tr>
<tr>
<td>&gt;18 years</td>
<td>85%</td>
<td>(51/60)</td>
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</tbody>
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side. Studies have previously reported more failures to occur on the right side [10,14,15] while others have reported an equal number of failures on both sides [16,17].

It is thought that the difference in bone quality is the reason behind younger patients exhibiting more OMI failures than older patients. A recent meta-analysis showed that patients younger than 20 years had an increased tendency to exhibit OMI failure [12]. However, investigating the success rates of OMIs by sampling the subjects into children and adolescents younger than 18 years and comparing them to adult subjects has not been adequately reported in previous prospective studies [12]. In this study, there was no significant difference in the success rate of the placed OMIs between adult patients older than 18 years and children/adolescents who are 18 years or younger. Other studies supported our findings reporting similar results with no significant difference between younger and older patients [18-20].

The jaw of insertion is considered as an important clinical parameter in the insertion of OMIs. OMIs could be inserted in different locations either in the maxilla or the mandible depending on the particular need for reinforcing anchorage. OMIs inserted in the maxilla have been reported to have a higher survivability rate compared to those inserted into the mandible in previous systematic reviews [11,20]. In this study, 8 OMIs failed in the maxilla compared to 11 failed OMIs in the mandible. This difference was not found to be statistically significant. Several studies investigating the difference in the success rate between the jaws of insertion have reached similar conclusions [21-23] while others reported even higher success rates among the maxillary OMIs when compared to the mandibular OMIs [15,16].

Gender is another clinical variable that could potentially influence the success of OMIs. There was no significant difference found between males and females in this study which was in agreement with the reports of previous systematic reviews [12,24]. In a retrospective analysis of 300 inserted OMIs, there was a significant difference between genders favoring more successful outcomes with OMIs inserted in males [25]. Another study reported higher success rates for females although the overall difference was not statistically significant [26].

This study was a single center trial putting some limitation on the generalizability of the results. The current study was also based on a follow up period of 6 months for the OMIs which might had led to a higher expression of positive results. This is however less likely as OMIs tend to fail in the first one or two months of treatment besides the fact that the predefined period was designed to be as close as possible to the time normally taken for space closure to complete.

This study adds to the existing core of knowledge about the usefulness of OMIs in clinical orthodontics with unique and particular emphasis on the success rates in subjects presenting with bi-maxillary proclination. Their high success rates support their utilization by any orthodontist thus enabling a high standard of healthcare delivery. Gender, age, jaw and side of insertion should not have a huge influence on orthodontists’ decision to use OMIs as this study found that these clinical variables might have minimal effect on the survivability of OMIs.

### Conclusion

- Orthodontic miniscrew implants provide a source for anchorage reinforcement with high success rates in bi-maxillary proclination cases.
- The side of insertion, jaw of insertion, gender and age of the patients did not significantly influence the final outcomes in this study.

### References


