Stability of secondarily inserted orthodontic miniscrews after failure of the primary insertion for maxillary anchorage: Maxillary buccal area vs midpalatal suture area

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Introduction: Few studies have examined the secondary insertion of orthodontic miniscrews after failure of the first insertion. We investigated both the primary and secondary success rates of miniscrews used for maxillary anchorage and compared the stability of the maxillary buccal area (MB) and the midpalatal suture area (MP). **Methods:** In total, 387 miniscrews were primarily inserted into the MB (between the second premolar and first molar); of these, 81 (20.9%) miniscrews lacked stability and were reinserted into the MB (same position or more distal position) or the MP. Additionally, 84 miniscrews were primarily inserted into the MP; 13 (15.5%) of those lacked stability and were reinserted into the MP. We calculated and compared the primary and secondary success rates in each area. Moreover, we investigated the factors affecting clinical success. **Results:** Although the success rate of the secondary insertion was significantly lower than that of the primary insertion into the MB, miniscrews inserted into the MP were stable in both primary and secondary insertions. The screw length was significantly associated with the stability of miniscrews inserted into the MB. **Conclusions:** For secondary insertions, miniscrews placed in the MP may be more stable than those inserted in the MB. (Am J Orthod Dentofacial Orthop 2018;153:54-60)

Anchorage control is one of the most important factors in orthodontic treatment. Recently, the paradigm of anchorage control has shifted toward temporary anchorage devices.[1-4] In particular, miniscrews have become a popular method for achieving maximum anchorage without compliance from the patients because miniscrews can be inserted into the bones rapidly and easily.[5]

With regard to maxillary anchorage, some previous studies have reported the use of miniscrews inserted into the molar buccal area (MB) (between the second premolar and first molar)[2,4] and the midpalatal suture area (MP)[1] to prevent mesial movement or to distalize the molars. Moreover, several studies have indicated that MP implants are more stable than MB implants, because the MP has good bone quality (high bone density and thick cortical bone).[6-10] Since there are no major nerves and blood vessels to contraindicate the placement of surgical miniscrews, the MP has been recommended as a possible placement site for miniscrews.[11] However, there are several complications related to the use of the miniscrews; for example, they can be unstable before achieving their purpose.[12-26] Therefore, it is important to understand the success and failure rates of miniscrews, the suitability of insertion sites, and the risk factors for their loss.

The risk factors associated with the instability of miniscrews can be categorized into host factors (age,[26] sex,[12] oral hygiene,[12] cortical bone thickness,[27-30] root proximity,[27,31] and the jaw receiving the insertion [maxilla or mandible][14,32]), miniscrew factors (make,[12] shape,[33] diameter,[12] and length[34] of the screws), and surgical management factors (insertion torque,[28] angle,[27] and placement site[30] of miniscrew insertion). Although

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Fig 1. Examples of palatal implants.

many factors seem to affect success and failure rates, there is little evidence to support their proposed influence. Therefore, further clinical studies are necessary to provide information that will facilitate achieving more predictable results with miniscrews.

For various reasons, some screws are lost, albeit at a low frequency, before they can achieve their purpose. When miniscrews are lost, they can be reinserted, or the treatment plan can be changed, including switching to other appliances for anchorage control.[35,36] Although many previous studies on miniscrews have analyzed their use in primary insertions, there are few follow-up studies on their secondary insertions.[12-26] We recently investigated the secondary success rate in the buccal areas in both the maxilla and the mandible; on the buccal side, secondarily inserted miniscrews showed greater instability than primarily inserted miniscrews, whereas the significantly higher failure rate of secondary insertion was not site-specific.[37] Nonetheless, in our previous study, we did not consider miniscrews that were inserted into the MP.[37]

The purposes of this retrospective study were (1) to investigate the success rates of primary and secondary insertions of orthodontic miniscrews used for maxillary anchorage, (2) to compare the stability of miniscrews inserted into the MB and the MP, and (3) to consider the risk factors associated with their instability.

MATERIAL AND METHODS

The study design was approved by the ethical committee of Tokyo Medical and Dental University (approval number D2016-029) and conformed to the tenets of the Declaration of Helsinki. All patients provided written informed consent to participate in the study.

This study included 238 consecutive patients (62 men, 176 women) aged 27.9 ± 8.4 years (mean ± standard deviation), who underwent surgery for the insertion of orthodontic miniscrews in the maxillary MB or MP for orthodontic edgewise treatment at the orthodontic department of Tokyo Medical and Dental University from July 2012 to January 2016. Of a total of 471 miniscrews, 387 were inserted into the MB, and 84 were inserted into the MP.

Thereafter, titanium miniscrews (Dualtop; Jeil Medical, Seoul, Korea) were inserted. We used miniscrews with different diameters (1.4 or 1.6 mm for the MB, 1.6 or 2.0 mm for the MP) and lengths (6.0 or 8.0 mm). Before surgery, 3-dimensional computed tomography images were obtained for all subjects, and the anatomic features (root proximity, cortical bone thickness, and maxillary sinus) were analyzed. Furthermore, we determined the miniscrew placement site and selected the diameter and length of the miniscrews required to avoid injuring the dental roots and to minimize damage to the surrounding tissues. When sufficient space for insertion of the smallest miniscrew that we used (1.4 × 6.0 mm) was observed between the maxillary second premolar and first molar, we inserted a miniscrew into the MB between these teeth. However, when the dental roots were too close to allow sufficient space for insertion of the smallest miniscrew (1.4 × 6.0 mm), we inserted 2 miniscrews into the MP (between the maxillary second premolars and second molars) and used a transpalatal or lingual arch appliance for reinforcement (Fig 1).

After anesthetic infiltration, all miniscrews were inserted by flapless surgery using the self-drilling procedure. After surgery, analgesics, antibiotics, and 0.12% chlorhexidine mouthwash were prescribed. When miniscrews were inserted into the MB, we confirmed that they did not contact the neighboring dental roots by obtaining periapical x-ray images.

If a miniscrew lacked stability, it was removed, and a new miniscrew of the same or a different size (with a change in diameter and length) was reinserted into the same or another location. For reinsertion of a miniscrew after failure of the primary insertion into the MB, there were 3 options: (1) reinsertion into the MB between the same pair of teeth 1 to 2 months after the failure of the first insertion (not entirely the same position as the first insertion, but with a change in the mesiodistal position, height, and insertion angle), (2) reinsertion