Control of maxillary dentition with 2 midpalatal orthodontic miniscrews

Yoon-Goo Kang, a Ji-Young Kim, b and Jong-Hyun Nam c
Seoul, Korea

The midpalatal area has no critical anatomic structures and has thick cortical bone. These conditions are favorable for miniscrew implantation. Also, there is no concern that damaging a dental root in this area would cause failure of the miniscrew. Although these advantages can decrease the failure rate of miniscrews, midpalatal miniscrews have not been as popular as interdental miniscrews. Because the midpalatal area is far from the teeth, the utility of midpalatal miniscrews has been considered to be limited. This article describes a new method for controlling the maxillary dentition with 2 midpalatal miniscrews. (Am J Orthod Dentofacial Orthop 2011;140:879-85)

There is little controversy regarding whether temporary anchorage devices or skeletal anchorage devices have widened and expanded the horizons of orthodontic tooth movement limitations. The possibilities of an orthodontic regimen as a tool to solve dental and skeletal problems have expanded, and orthognathic surgery can even be minimized in certain cases. 1,2

Miniscrews are the most popular and simplest type of skeletal anchorage device with a simple procedure for implantation and removal. They have a screw part that is implanted into the bone and an upper part that is projected into the oral space that can accommodate a variety of orthodontic devices, including elastics and springs. The most preferred site for miniscrew implantation is the interdental alveolar bone between the second premolar and the first molar because miniscrews are commonly used as anchorage devices to retract the anterior teeth. In addition, this site is favored because of its ample interradicular space for miniscrew placement. 3-6 However, many studies have reported that miniscrews implanted in the interradicular area can fail for a variety of reasons, including root proximity to the miniscrews. 5-7 Root contact of miniscrews is considered a main reason for their failure when placed in the interdental area.

Although many methods have been developed to prevent miniscrews from coming in contact with dental roots, and to decrease the failure rate, these procedures are either tedious or require specially designed equipment. In addition, for patients with congenitally narrow interradicular spaces, touching the roots while implanting the miniscrews is sometimes unavoidable, and additional procedures are needed.

To prevent root contact of miniscrews and decrease failure rates, nondental bearing areas, such as the retro- molar area of the mandible and the midpalatal area of the maxilla, have been reported to be good sites for miniscrew implantation. 8-12 These areas also have thick cortical bone that can reduce the failure rates of miniscrews compared with miniscrews placed in interradicular areas. 8,12,13 However, the increased success rate has come at the cost of biomechanical convenience. Other mediating devices are required because these nondental bearing sites are far from the teeth that the clinician aims to move.

Several methodologies for miniscrews implanted in the midpalatal area have been proposed, but more biomechanical considerations and methodologies are needed to fully use midpalatal miniscrews to control the maxillary dentition. 9,11 This article introduces a new method for controlling the maxillary dentition with 2 midpalatal miniscrews.

MATERIAL AND METHODS
Two miniscrews (DualTop JD, Jeil, Seoul, Korea) with a 0.215 × 0.250-in rectangular slot were used for each
Among the various sizes, 6-mm length and 1.60-mm diameter screws were used preferably. The rectangular slot can accommodate orthodontic archwires up to 0.215 x 0.250 in. The implanted mini-screws are connected to a 0.215 x 0.250-in rectangular stainless steel wire bent to fit the slots. Steel ligature ties are needed to secure the wire to the miniscrews.

Two miniscrews were implanted in the midpalatal area. The implant site was approximately 1 to 2 mm from the midpalatal suture transversely, and the antero-posterior position was determined according to the treatment objectives. However, the position of the miniscrews is not of great importance because the force is not applied directly to them but to the miniscrew-connecting wire. Even if the miniscrews are implanted in an unintended place, this can be overcome by adjusting the miniscrew-connecting wire. After a mucosal disinfection treatment and the application of local anesthetic, a mucosal incision was made with a number 15 surgical blade. The bone surface was exposed with a small periosteal elevator, and a perforation of the cortical bone was made with a drill bur mounted on a low-speed hand piece (Fig. 2, B). Cortical perforation and miniscrew implantation were performed under saline-solution irrigation. After most of the screw part implantation had been achieved, the miniscrews were turned for a half to 1 more turn to parallelize the slots (Fig. 2, C and D).

After implanting the miniscrews, a rubber impression was taken by using a light-body injection-type vinyl polysiloxane impression rubber material and a heavy-body putty vinyl polysiloxane impression rubber material. First, light-body rubber was injected over the miniscrews and surrounding mucosa with care not to capture air bubbles (Fig. 3, A). After initial polymerization of the light-body rubber, heavy-body putty was applied over the light-body putty covering more of the palatal mucosal surface (Fig. 3, B). After polymerization of the rubber material, they were removed from the oral cavity and examined carefully for any air bubbles captured in the miniscrew impressed area (Fig. 3, C). Two additional miniscrews were fitted to the miniscrew impressed area of the impression body and secured with cyanide adhesive (Fig. 3, D). These miniscrews were used as analogs for the midpalatal miniscrews. The miniscrew-impression body complex was then placed in the bottom of a hollow open cylinder, and mixed stone was poured on the complex (Fig. 3, E and F). After the stone had hardened, the stone and impression body were separated, leaving the miniscrew analogs incorporated in the stone (Fig. 3, G). This stone model and miniscrew analog complex is a precise replica of the palate and the miniscrews.

A 0.215 x 0.250-in rectangular stainless steel wire was bent to fit the 2 miniscrew slots passively (Fig. 3, H). This wire connects the 2 miniscrews tightly and enables them to withstand the moments created from an orthodontic force that might loosen the miniscrews. This is why 2 miniscrews are needed. The wire also works as a support where orthodontic forces are applied or extended and come in direct contact with the dentition to exert the orthodontic forces. By adjusting the position of the wire, the force application points can be optimized in various situations of tooth movement without needing to relocate the screw position. Clinical applications are described as follows.

For the intraoral delivery of the miniscrew connecting wire, the laboratory fabricated connecting wire is usually well fit to the intraoral real miniscrews. Mostly only minor adjustments are needed to passively place the wire. However, if major adjustments are required, it might be better to repeat the laboratory procedure with a new rubber impression than to adjust the wire directly in the intraoral space. After the connecting wire was passively fit, its terminal ends of were generally bent to obtain a suitable position and shape to admit or exert orthodontic forces. The connecting wire was then secured to the miniscrews by tight wire ligation.
To provide absolute anchorage for retraction of the 6 anterior teeth (Fig 4), a miniscrew–connecting wire can be fabricated to extend to the appropriate height according to the treatment objective (if bodily tooth movement is required, then height can be one third to two thirds of the root height) with the hooks bent distally. The 6 anterior teeth were splinted to a large tooth with a figure-8 tie ligature wire, and lingual buttons were bonded to the palatal side of the canines. Coil spring or elastomers were connected to the hooks and lingual buttons to provide a retraction force to the anterior teeth.

Distalization of the maxillary dentition was accomplished (Fig 5). Bilateral or unilateral distalization of the maxillary molars or the whole maxillary dentition can be obtained by using these biomechanics. Normally, the molars are distalized first, followed by the premolars and the anterior teeth. For bilateral distalization of the molars, a lingual arch with anterior hooks was used. A miniscrew–connecting wire was extended to the appropriate height with the distally opened hooks bent at each end. The anterior hooks of the lingual arch and the hooks of the connecting wire were connected with a coil spring or elastomers to provide a distalization force to the molars. Another method is simply to connect the connecting wire and lingual buttons bonded to the palatal side of the premolars or the canines.

For unilateral distalization of the maxillary molar, a segment wire (usually 0.032 in) was inserted in the lingual sheath and extended anteriorly with a hook at its end. The segment wire hook and the connecting wire hook were connected to a coil spring or an elastomer to exert a distalizing force on the maxillary molar.

Bilateral or unilateral mesial movement of the maxillary molar (Fig 6) is possible by using midpalatal mini-screws. The miniscrew–connecting wire was extended in the occlusal direction to the appropriate height and then extended anteriorly. For bilateral mesial movement of the molars, a transpalatal arch was placed and connected to the hook of the miniscrew–connecting wire with a coil spring or an elastomer. As an alternative, segment wires with a distally opened hook inserted in the lingual sheath of the molars can be used instead of a transpalatal arch depending on the clinical situation. For unilateral mesial movement of a molar, a segment wire with a distally opened hook was engaged in the lingual sheath of the corresponding molar. The segment wire and miniscrew–connecting wire were connected to coil springs or elastomers to deliver a mesial force to the molar.

To intrude the maxillary molars (Fig 7), the transpalatal arch was used to prevent palatal inclination of the molars. The miniscrew–connecting wire was extended shortly to place the hooks in a deep position. A deep position of the hooks ensures a long action range of the intrusion action components. These hooks and lingual sheathes of the molar bands were connected with springs or elastomers to provide an intrusive force to the molars.

Bilateral or unilateral expansion or constriction of the maxillary dentition (Fig 8) is frequently needed in daily
orthodontic practice. Burstone’s precision lingual arch brackets, 0.215 × 0.250 in, with a rectangular slot were welded to the palatal side of the first molar bands. A miniscrew connecting wire was fabricated and ligated directly to the lingual arch brackets with expansion or constriction activation. For unilateral activation, 1 arm of the miniscrew connecting wire was engaged to the lingual bracket with the other arm cut off. Loops or helixes can be added to increase the range of action and decrease the magnitude of the force.

**DISCUSSION**

Two midpalatal screws with a connecting wire system are versatile. By modifying the connecting wire, which is removable, most of the required tooth movement can be achieved without additional miniscrews or relocating them. Moreover, using 2 miniscrews and connecting them provides good stability that can endure multiple forces at various directions with increased amounts of force. Each miniscrew can resist force moment of loosening direction on the other. Therefore, it is

---

**Fig 3.** Procedures for fabricating miniscrew-connecting wire: A and B, light-body followed by heavy-body rubber impression was taken; C, impression body with 2 miniscrew impressions; D, placement of the miniscrews in the impression body (cyanide adhesive can be used to immobilize the miniscrews); E, impression body placed in the bottom of the hollow cylinder; F, pouring stone in the cylinder; G, final stone model with 2 miniscrew analogs; H, fabrication of passively fitting 0.215 × 0.250-in miniscrew-connecting wire.
possible to perform multidirectional tooth movements simultaneously, such as intrusion and distalization. According to the features of this system, we called the system a midpalatal screw connected versatile device. The midpalate is a good place for miniscrew implantation with few failures. We implanted more than 120 miniscrews in midpalatal areas from 2006 to 2009, and none failed.

This method is not recommended for patients who need simple anterior retraction requiring absolute anchorage because of the additional laboratory procedures. For those patients, conventional positioning of miniscrews between the buccal sides of the second premolar and the first molar would be simple and convenient for both the patient and the clinician. However, this method is useful for complex cases requiring molar control or the correction of 2 or more dimensional problems including the sagittal, transverse, and vertical dimensions. The midpalatal area is recommended for successful miniscrew implantation in patients with a narrow interradicular space that cannot accommodate miniscrews and in those who have experienced failure of miniscrews without an identifiable reason.

Interdental miniscrews can act as a mechanical interference that limits adjacent tooth movement. Tooth roots cannot move through miniscrews. Therefore, removal and replantation of miniscrews are required in certain cases. This aspect should be considered,

Fig 4. Retraction of the anterior teeth. Height of the miniscrew-connecting wire hooks can be modified.

Fig 5. Distalization of the maxillary molars: left, Lingual arch was used for bilateral distalization of the molars; middle, unilateral distalization of the maxillary molar; right, unilateral distalization of the maxillary molar. A lingual arch with a swivel joint was used to minimize molar rotation.

Fig 6. Mesial movement of the maxillary molars: left, Bilateral mesial movement of the molars; right, unilateral movement of the molar.
particularly when total distalization of the dentition is needed. Sites for miniscrews should be carefully selected to minimize root movement interference and the number of replantation procedures. However, the midpalatal area has no dental roots, and the limitation of tooth movement is not a matter of consideration.

Creative connecting wire designs other than the design introduced in this article can be used to obtain the required tooth movement in a range of clinical situations. Loops or helixes also can be added to control the action range and the force magnitude. For example, distalization of the molars can be achieved by directly engaging a distally activated miniscrew connecting wire to the lingual bracket welded to the palatal side of the molar bands. The loops can be added like the design of the pendulum appliance arm. The clinician’s
understanding of the biomechanical principles of tooth movement are applied to the design of the miniscrew connecting wire, and a range of tooth movements in various clinical situations can be achieved. By keeping the palate plaster model with the miniscrew analogs, the clinician can promptly fabricate several designs of miniscrew connecting wires with different tooth movement objectives. Therefore, various tooth movements are possible without the need for additional miniscrews or relocating them by only changing the design of the miniscrew connecting wire.

The most unique use of this system is unilateral expansion or constriction of the maxillary dentition. In conventional orthodontics, expansion and constriction of the dental arch is usually obtained by using a transpalatal or lingual arch. They produce good results for bilateral or unilateral expansion cases. Regardless how much the clinician deliberately controls the anchorage, unwanted expansion or constriction of the contralateral part of the dentition is generally inevitable with conventional orthodontic biomechanics. Absolute unilateral expansion or constriction of the dental arch is possible by using our method.

Occasionally, mucosal swelling occurs around the palatal miniscrews, but the miniscrews still do not fail in those circumstances. Swollen mucosa can be treated with dental laser eradication. We encountered 3 such cases in 55 patients and reached the conclusion that mucosal swelling is not a common condition and not serious. The mucosal swelling disappears when the miniscrews are removed in a month. In addition, the midpalatal area lacks critical anatomic structures, such as large blood vessels and nerves, substantially reducing the risk of damage during miniscrew implantation or removal. The incisive canal can be considered a dangerous structure. However, there is minimal risk when miniscrews are implanted distal to the first premolar because the incisive canal is mostly anterior to the first premolar.8

Sometimes, miniscrews are not placed at the same sagittal level, or the slots are not parallelized. These situations need a more complicated wire-bending procedure to fabricate the miniscrew connecting wire but do not require replantation of miniscrews.

CONCLUSIONS

Two midpalatal miniscrews with a connecting wire system is a versatile method for controlling the maxillary dentition with a low failure rate.

REFERENCES