

Maxillary molar intrusion with micro-implant anchorage (MIA)

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Background: Intrusion of the maxillary molars is difficult to accomplish using traditional methods of anchorage.

Aims: To describe methods of maxillary molar intrusion with the aid of micro-implants.

Methods: Micro-implants provide stable intra-oral anchorage and enable the maxillary molars to be intruded without the usual side effects. Three adult patients are presented showing how micro-implants can be used to intrude the maxillary molars. In the first patient micro-implants were placed in the alveolar process between the second premolar and first molar, in the second patient micro-implants were placed in the palatal alveolar process between the first and second molars, and in the third patient a micro-implant was placed in the palate paramedially. A transpalatal bar was used to prevent bucco- or linguoversion of the molars during intrusion.

Conclusions: The maxillary molars can be intruded with intra-oral anchorage derived from micro-screw implants.

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Introduction

Molar intrusion is one of the most difficult tooth movements to achieve in orthodontics. The use of conventional methods to intrude molars can lead to undesirable extrusion of the anchor teeth.^{1–4} Increasing the number of teeth in the anchorage units may minimise the undesirable side effects, but not eliminate them. Microscrew implants can be used to retract the upper anterior teeth,^{5–9} to upright tipped lower molars,^{7,8} as anchorage for lingual orthodontic treatment,^{7,9} and for intrusion of anterior teeth.¹⁰ Successful use of micro-implants has been reported by many authors,^{5–10} with success rates ranging from 83.9 per cent to 93.3 per cent.^{11–14} In most clinical situations micro-implants remain stable throughout the entire treatment period, thereby demonstrating that they can provide absolute anchorage for tooth movement. When absolute intra-oral anchorage is available clinicians can achieve the desired tooth movements efficiently and consistently.

In this report three methods of maxillary molar intrusion with the aid of the micro-implants will be described and illustrated with case reports.

Intrusion methods with micro-implant anchorage

When intruding an overerupted maxillary molar after loss of its antagonist, the intrusive force should pass through the centre of resistance of the tooth buccopalatally and mesio-distally, otherwise tipping may occur. Unwanted tipping can be prevented by using four micro-implants (two placed palatally and two placed buccally) or a transpalatal bar (Figure 1). Fewer micro-implants are required if a transpalatal bar is used to prevent bucco-lingual tipping. It is possible to intrude a molar with a single micro-implant placed high above the roots of the tooth, so that the intrusive force passes through the centre of resistance of the tooth mesio-distally (Figure 1). Several millimetres of clearance between the transpalatal bar and the palatal mucosa are needed, otherwise the bar will contact the mucosa during intrusion.

For intrusion micro-implants can be placed in the palatal or buccal alveolar bone (Figure 1). If molar intrusion is the sole purpose of treatment then a micro-implant placed palatally may be the better site.

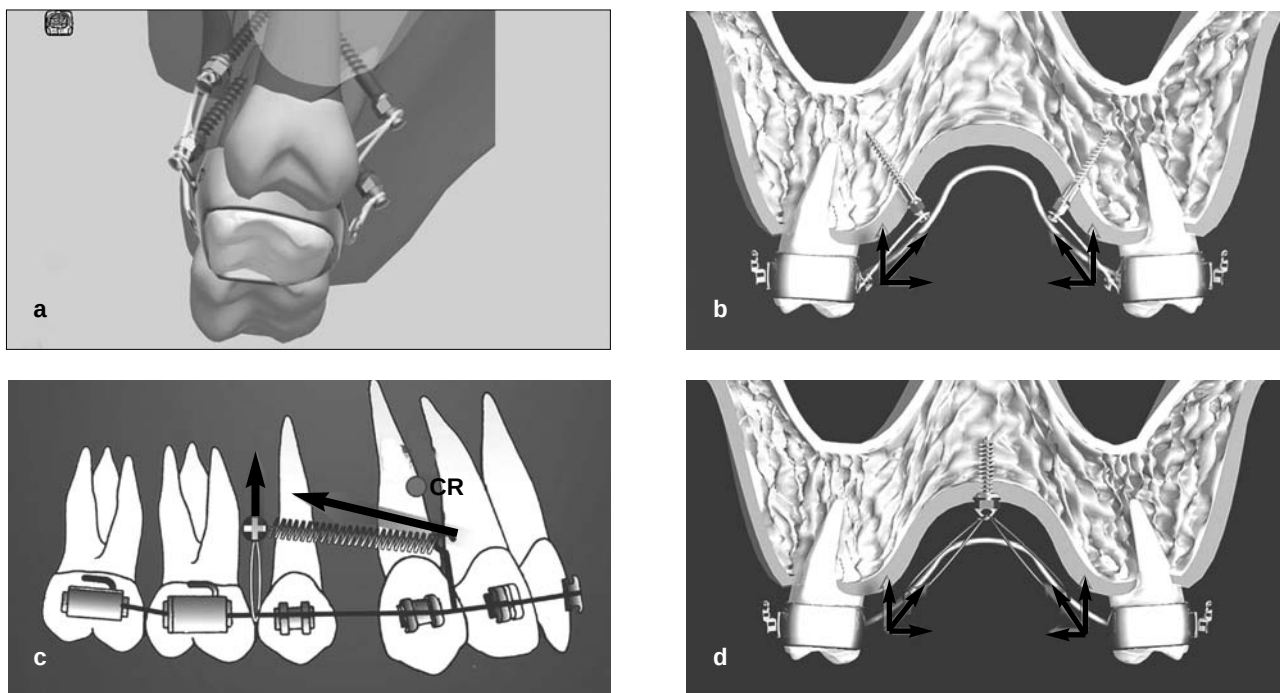


Figure 1. a: Four micro-implants used to intrude a molar. b: Palatal micro-implants and a transpalatal bar. Note the horizontal component of force. c: A single micro-implant used to intrude the posterior teeth and retract the anterior teeth. d: A single palatal micro-implant and transpalatal bar.

If, on the other hand, the molars are to be intruded and the anterior teeth retracted then buccally placed micro-implants should be used. A micro-implant in the midpalatal area can provide an effective intrusive force, but it should be combined with a rigid transpalatal bar to prevent the horizontal component of the force tipping the teeth (Figure 1). When tipping occurs the roots invariably move buccally.

Case reports

Case 1

A 24 year-old female patient presented in our clinic with an anterior openbite (Figure 2). Her temporomandibular joints had evidence of slight resorption radiographically, but there were no clinical symptoms of joint pain/discomfort or limitation in movement. She had a 5 mm overjet and an anterior openbite of -2.5 mm. There was 4.5 mm of crowding in the maxillary arch and 6 mm of crowding in the mandibular arch. The treatment plan included extraction of the upper first and lower second premolars, retraction of the maxillary anterior teeth, and intrusion of the

maxillary posterior teeth to close the anterior open bite.

Maxillary micro-screw implants (Length: 8 mm; Diameter: 1.2 mm; Osteomed Company, Dallas, Texas) were placed buccally between the maxillary second premolars and first molars, and the anterior teeth were retracted against the micro-implant anchorage. The surgical procedure for placing the micro-screw implants has been described in detail previously.^{6,7,9} The same micro-implant then served as the anchor unit to intrude in the maxillary molars (Figure 2). During intrusion a soldered transpalatal bar was used to retain the form of the maxillary arch and to prevent the roots of the molars tipping buccally. The micro-implants remained firm throughout treatment and were removed by rotating them counterclockwise.

The intrusion force was applied for 8 months, and the total treatment time was 23 months. The final occlusion is shown in Figure 2. The maxillary posterior teeth were intruded 1.5 mm and moved distally. The maxillary anterior teeth were retracted and intruded (Figure 2).

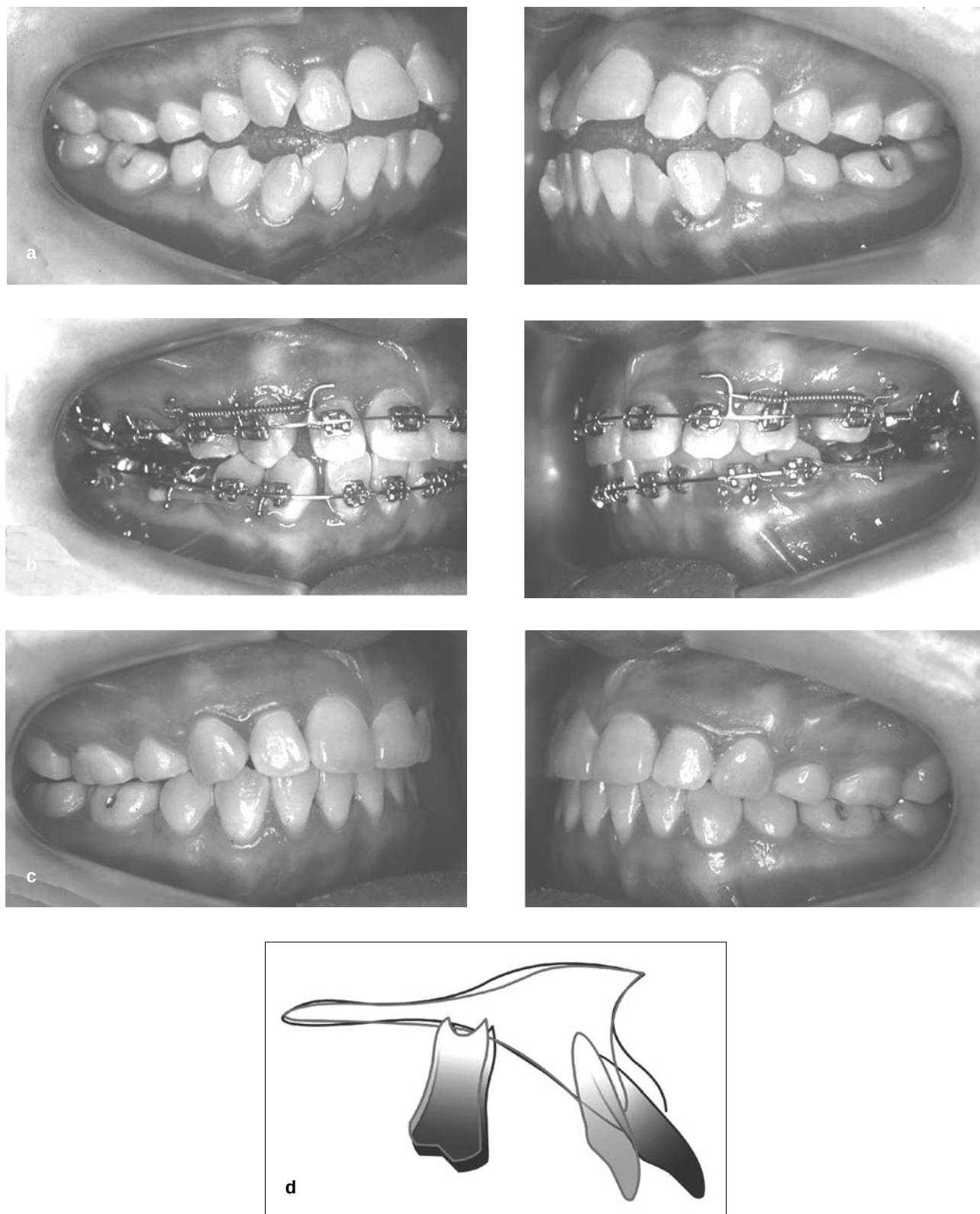


Figure 2. Case 1. a: Pretreatment intra-oral photographs showing an openbite.
 b: Forces to intrude the molars and retract the anterior teeth applied from a buccal micro-implant.
 c: Posttreatment intra-oral photographs.
 d: Pretreatment and post-treatment tracings.

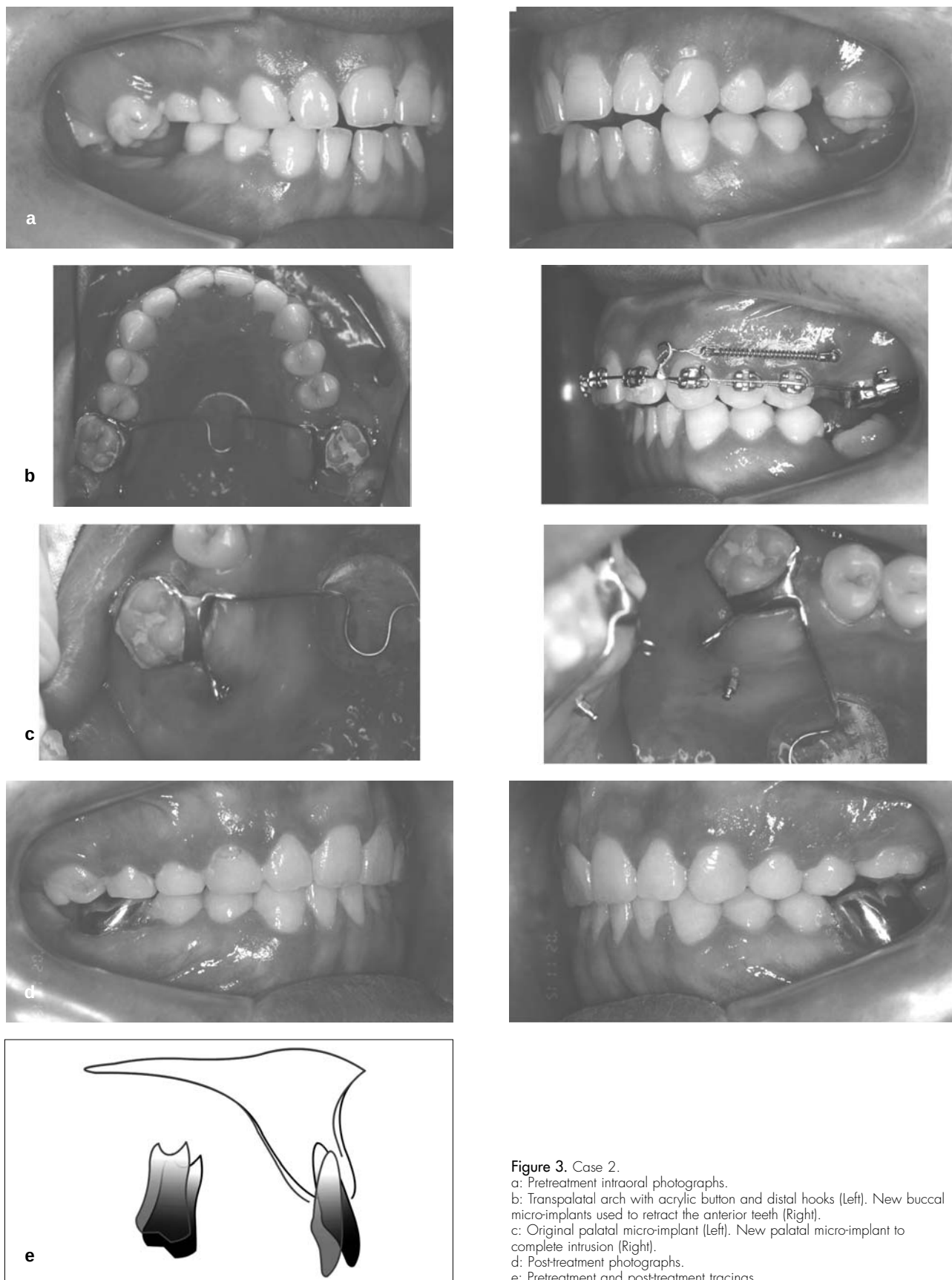


Figure 3. Case 2.
a: Pretreatment intraoral photographs.
b: Transpalatal arch with acrylic button and distal hooks (Left). New buccal micro-implants used to retract the anterior teeth (Right).
c: Original palatal micro-implant (Left). New palatal micro-implant to complete intrusion (Right).
d: Post-treatment photographs.
e: Pretreatment and post-treatment tracings.

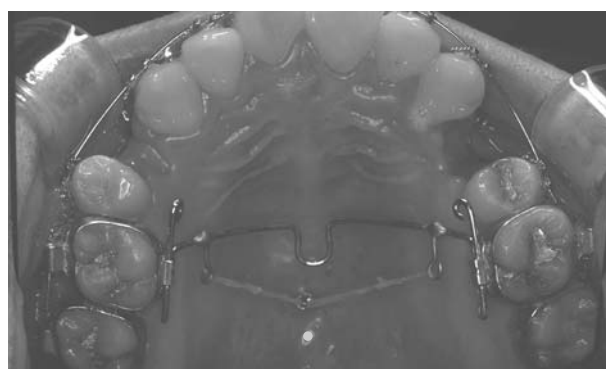


Figure 4. Case 3.

a: Pretreatment photographs.

b: Single micro-implant placed paramedially (Left). Removable-type transpalatal arch, hooks and traction from micro-implant (Right).

c: Pretreatment and post-treatment tracings.

Case 2

A 23 year-old male patient presented with extrusion of maxillary molars after the lower posterior teeth had been extracted (Figure 3). To intrude the upper second molars, a micro-screw implant (Length: 10 mm; Diameter: 1.2 mm; Osteomed Company, Dallas, Texas) was placed in the palatal alveolar bone between the second and third molars on each side (Figure 3). A transpalatal bar was soldered to the upper molar bands with an acrylic button to utilise pressures from the tongue as an additional intrusive force. The transpalatal bar had distal hooks for elastomeric thread, and there was a 4 mm space between the anatomical surface of the acrylic button and the palatal mucosa. Elastomeric thread (Super thread,

RMO, USA) was tied between the micro-implants and the distal hooks two weeks after placement of the micro-implants. The force was 100 grams.

After 7 months of treatment approximately 2.5 mm intrusion was obtained. As the molars moved closer to the micro-implant further intrusion was difficult to achieve due to the limited span between the hooks and the micro-implants. Therefore, two new micro-implants (AP12-110; Dentos Company, Daegu, Korea) were placed further apically (Figure 3). Two weeks later the intrusive force was again applied to the molars. To replace the missing lower molars, the maxillary third molars were autotransplanted to the lower edentulous ridge. The maxillary incisors, canines and premolars were then retracted against

two new micro-implants placed mesial to the second molars (Figure 3). At the end of active treatment the molars had been intruded 3 mm (Figure 3). The post-treatment occlusion is shown in Figure 3. On the radiographs there was a small amount of root resorption of the upper left second molar roots.

Case 3

This 23 year-old male patient presented with over-erupted maxillary molars. A micro-implant (AX1311-106; Absoanchor Dentos Company, Daegu, Korea) was placed in the paramedian area of the palate, and a removable transpalatal bar with bilateral distal hooks for elastics fitted. Elastomeric threads were tied between the micro-implants and the distal hooks two weeks later (Figure 4). After 9 months of treatment the upper molars were intruded approximately 2 mm (Figure 4). On the post-treatment frontal radiograph the root of the maxillary right first molar had moved buccally, underlining the importance of using a well-fitting rigid transpalatal arch.

Discussion

Most types of orthodontic tooth movement can be achieved with the aid of micro-implants without loss of anchorage or reliance on patients' compliance for wearing elastics and extra-oral appliances. Micro-implants can be used to facilitate *en masse* retraction of anterior teeth, retract whole maxillary and mandibular dentitions, protract teeth, close edentulous spaces, and intrude anterior and posterior teeth. The new generation of micro-implants are small enough to be placed between the roots of adjacent teeth, in interradicular bone, the palate, the retro-molar area, the inferior surface of the zygomatic arch, and in the anterior nasal spine or chin.⁸

Several factors need to be considered when choosing a site(s) for a micro-implant. Firstly, the force vector should be planned to meet the aims of treatment, and secondly the anatomic relationships between the teeth and bone examined closely so as to avoid damage to the roots. For concurrent molar intrusion and retraction of the anterior teeth a buccal micro-implant(s) is an effective and simple means of applying both intrusive and retraction forces. In our experience palatal micro-implants have a slightly higher success rate than buccal micro-implants: 100 per cent and 94.6 per cent respectively.¹¹

Furthermore, the palatal roots are more widely spaced and the thick and firmly attached palatal mucoperiosteum tends to resist inflammation.

One of the disadvantages of a micro-implant placed midpalatally is the large horizontal component to the intrusive force (Figure 1). Left unchecked this can cause the tooth to tip buccally, but it can be reduced if not eliminated completely, by using a rigid, soldered transpalatal bar. In Case 3, the roots of the upper right first molars tipped buccally because the removable transpalatal bar was not rigid enough. Palatal micro-implants are better placed paramedially because the midpalatal suture may be patent, even in adults.¹⁵ Bone in the midpalatal area tends to be less dense than bone to one side of the median palatal suture.

During molar intrusion mesiodistal tipping can occur also. While a transpalatal bar will prevent buccolingual tipping other means must be used to prevent mesiodistal tipping. One method is to place a micro-implant(s) high in the vestibule, at 30-40 degrees to the surface of the bone, and in line with the long axis of the tooth. Alternatively, if some mesial/distal tipping is desired the micro-implant can be sited slightly off the long axis of the tooth.

For molar intrusion Melsen and Fiorelli³ suggested applying buccal and lingual forces together to avoid an undesirable rotation. Chun and colleagues² stressed that the most critical factor for molar intrusion was the point of application of the intrusive force. To direct a force through the centre of resistance of a molar, simultaneous buccal and palatal forces should be applied. When intruding a single molar, four micro-implants (two buccal and two palatal) can be used to prevent bucco-palatal and mesiodistal tipping (Figure 1). When both upper molars are to be intruded a rigid soldered transpalatal bar will efficiently prevent bucco-palatal and mesiodistal tipping. When a single molar is to be intruded a hinge-type of transpalatal bar can be used to prevent unwanted tipping and/or rotation. In Cases 1 and 2 a transpalatal bar was used to avoid unwanted rotation and lingual tipping. As we mentioned above, a removable-type of transpalatal bar will not prevent buccal root movement if it works loose in the lingual sheath. Therefore, a rigid, soldered transpalatal bar is recommended.

In Case 2, the first micro-implants were not placed high enough to provide sufficient working distance

for the elastics to intrude the molars the desired amount. If micro-implants are not placed high enough in the palate or vestibule to complete all the tooth movements required new micro-implants will have to be placed. Sometimes a micro-implant must be moved or a new one placed if the roots of the tooth being moved are likely to contact the existing micro-implant. Because micro-implants are small they can be placed between the roots of teeth. A replacement micro-implant should be placed at least 4 mm from its previous location and in sound bone.

As a rule patients readily accept micro-implants, although palatal micro-implants can cause tongue irritation and discomfort for about a month. Micro-implants placed in the vestibule generally cause no discomfort. The palatal acrylic button was employed in Case 2 to utilise intrusive forces from the tongue, but it did not seem to be effective.

Openbites can be difficult to retain. For example, Sugawara *et al.*¹⁶ reported that intruded lower molars relapsed about a third during a one year retention period. They recommended overcorrection as a means of 'overcoming' relapse. When posterior teeth are to be intruded to treat an anterior openbite it is prudent to overcorrect them or provide suitable retention. Teeth that have overerupted because the opposing teeth are missing are generally stable after intrusion and restoration of the antagonists.

Melsen and colleagues^{17,18} reported that premolars that had lost their periodontal support, but were otherwise healthy, could be intruded with a low continuous force passing close to the centres of resistance of the teeth. Intrusion resulted in a significant gain of attachment. As micro-implant based appliances are relatively straight-forward in design and mechanics, and use few/no teeth for anchorage oral hygiene is relatively simple in patients susceptible to periodontal disease.

Conclusion

With micro-implant anchorage maxillary molars can be successfully intruded without movement of the anchorage units.

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