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Brochure for the AbsoAnchor® Orthodontic Microimplant

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Brochure for the AbsoAnchor®
Orthodontic Microimplant

Shift of Paradigms in Orthodontics

Microimplant (AbsoAnchor®) for orthodontic anchorage

AbsoAnchor® microimplant is a titanium alloy screw for orthodontic anchorage that is implanted on maxillary and mandibular bone, and acts as a fixing agent, providing a fixed anchorage point for attachment of orthodontic appliances to facilitate the orthodontic movement of teeth.

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Development of the Orthodontic Microimplant (AbsoAnchor®)

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1. Introduction

The control of anchorage is one of the most critical factors in orthodontic treatment. The reinforcement of an anchorage usually needs a complete understanding of biomechanics and patient compliance. Unfortunately, there are many orthodontic treatments during which absolute anchorage is needed. Considering Newton's Third Law, it is virtually impossible to achieve absolute anchorage condition in which reactional force produces no movement at all, especially with intraoral anchorage. Extraoral anchorage, such as head gear, is traditionally used to reinforce anchorage. However, the use of extraoral anchorage demands full cooperation of patient as well as 24 hours of continuous wear which cannot always be done. Therefore, it is extremely difficult to attain excellent result without compromising treatment in some way.

Hence, to treat patients without patient compliance, clinicians and researchers have tried to use skeletal anchorage. Gainsforth and Higley (1945) placed metallic vitallium screws in dog's ramus as anchors and applied elastics to the maxillary arch wire for distalization of maxillary dentition as long ago as 1945. However, all screws failed within one month. There were no more published reports of attempts to use skeletal anchorage to move teeth until the clinical case report of Linkow (1969, 1970), who used mandibular blade-vent implants in a patient to apply class II elastics.

After Brånemark and co-workers reported successful osseointegration of prostodontic implants in bone, osseointegrated implants (Sherman, 1978; Roberts et al., 1994; Wehrbein et al, 1999) have been used as intraoral orthodontic anchorage, but their usage has many limitations for routine orthodontic practice. First of all, it is difficult to select a proper insertion site for a conventional implant in orthodontic patients due to the large diameter of implant. Also, waiting time for osseointegration, high cost, severity of surgery, etc. are known problems for both patients and orthodontists. Thus, a smaller diameter miniscrew has been developed for orthodontic anchorage rather than bulky conventional dental implants. Creekmore & Eklund (1983) reported the use of a small-sized vitallium bone screw as anchorage for the intrusion of maxillary incisors. The screw was inserted below the anterior nasal spine, and elastic thread was applied to the archwire. After the treatment, maxillary central incisors were elevated by about 6mm. The screw was stable over a long period of time without infection, pain & pathology. Even though the successful use of the screw for orthodontic treatment, there was no clinical report using screws for orthodontic treatment until Kanomi (1997) introduced micro-screws as orthodontic anchorage. He showed that 1.2mm diameter of micro-screw is enough for intrusion of anterior teeth.
Since 1998, Park & Bae (Park, 1999; Park et al, 2001; Bae et al, 2002; Bae et al, 2002) have started to use surgical micro-screws (1.2mm in diameter) to retract maxillary anterior teeth after placing them between the roots of upper 2nd premolars and 1st molars. The treatment was very successful without any complications. They also showed that almost all kinds of tooth movement were possible including molar intrusion, molar protraction and whole dentition retraction using small diameter of micro-screws. These micro-screws were inserted into many areas of maxilla and mandible such as in between roots of adjacent teeth and midpalatal suture which were previously unavailable for conventional dental implants. In addition, they showed that micro-screw head can be exposed when it is placed on the attached gingival area.

Originally, micro-screw was used to fix mini-plate into bone in surgical fields. So, it was difficult to apply orthodontic elastomers onto the screw head without forming connectional ligature wire loop on the cervical portion of the screw. Thus, there was periodontal involvement which was caused by the location of ligature wire that is under the screw and towards gingival, even though the screw itself was located on the attached gingival area. This micro-screw location allowed gingival embedment of ligature wire producing steady irritation on soft tissue and also caused difficulty for patients in keeping good oral hygiene around the screw.

To compensate for these drawbacks, we developed orthodontic Microimplant (AbsoAnchor®), which has been designed specifically for orthodontic purpose and has a button-like head with a small hole. Also, by giving inclination on cervical area of the button allows natural separation of elastomers from gingiva. A hole is made in upper structure for smooth application of elastomer such as elastomeric thread and/or ligature wire (Fig.1). This newly designed microimplant has helped to solve the main objections to previous implants and surgical screws (Sung et al, 2006). AbsoAnchor® microimplants come in several sizes of diameter ranging from 1.2mm to 2.7mm. These titanium alloy (Ti6Al4Va) micro-implants also come with different types of head for different applications and sites (Fig.1-1).

However, many orthodontists are still hesitating to use orthodontic microimplants, because many of them are afraid of surgical intervention and post-surgical complications. But unlike prosthetic implants, there is little complication, and every dentist including orthodontist can insert orthodontic microimplants due to its ease of application. Here, we would like to introduce you to AbsoAchor microimplant system as an orthodontic anchorage for your practice.
Fig. 1. A typical surgical microscrew (left) and the newly designed AbsoAnchor® microimplant with nickel titanium coil spring attached (middle & right).

Fig. 1-1. Orthodontic AbsoAnchor® microimplants developed by Dentos Inc.
2. Terms used in skeletal anchorage

There are many terms used in orthodontic skeletal anchorage, such as, skeletal anchorage system (SAS), mini-screw, micro-screw, mini-implant, micro-implant, mini-screw implant, micro-screw implant, Temporary Anchorage Device (TAD) etc. A prefix of micro- comes from Greek and mini- comes from English. The terms, micro- and mini-, have the same meaning of being small when they are used as adjective. Generally, however, the term micro is used to express a size that is a little bit smaller than mini-, such as mini-car and micro-car, mini-scan disk and micro-scan disk. Academically the term of micro- is used more rather than mini-, for example, micrognathia, microglossia, microdontia, etc. Also, implantologists already used the term mini-implant, which is a kind of temporary implant to make temporary crown during osseointegration of implant. The diameter of prosthodontic mini-implant is a bit larger than orthodontic implants. The term skeletal anchorage can include all kinds of skeletal anchorage devices including prosthodontic implant and onplant. Many doctors are using the term TAD, however, almost all kinds of conventional anchorage, such as transpalatal bar, lingual arch, etc. can be classified into temporary anchorage device. Prosthodontic implants vary from screw implants to non-screw type implants. Usually, however, we do not differentiate them as screw-implant or non-screw implant. Every orthodontic implant has screw portion. For the same reason, we do not need to put the term screw, such as micro-screw implant. Therefore, we prefer to use the term microimplant for orthodontic screw.

3. Types of AbsoAnchor® Microimplant

![Various types of AbsoAnchor® microimplants.](image)
Length: 5mm ~ 12 mm, Diameter: 1.2mm ~ 2.7 mm
Several types of AbsoAnchor microimplants are available for different tasks and sites (Fig. 2). Different types of head structures can be chosen depending on kinds of elastomers, biomechanics, sites of placement and individual preference. In Bracket head type, right handed and left handed screws are available for use depending on the driving directions. Left handed screw should turn counter clockwise direction during driving. (Fig. 3 and 4). When you need to apply moment to the microimplant head using wire, you can choose proper screw type depending on the applied moment.

In the Joint Head type, many different kinds of upper head shape can be joined with the lower part the screw portion (Fig. 2). Also, non-invasive mini-plate can be joined without surgical flap (Fig. 5).

![Fig. 3. Possible applications of right-handed and left-handed Bracket Head (BH) type screws.](image-url)

![Fig. 4. Clinical applications of Bracket Head type microimplants.](image-url)
4. Terms used in Microimplant surgical procedures

Microimplant Anchorage (MIA) in orthodontics is a relatively new field in orthodontic treatment. So here we are going to introduce some descriptive terms, that are used in this brochure.

1) According to head exposure (Fig. 6)

(1) Open Method

For open method, the head of microimplant is exposed in the oral cavity. Usually, this method is possible when the microimplant is placed in a tight soft tissue area like the attached gingiva.

(2) Closed Method

For closed method, the head of the microimplant is embedded under the soft tissue. When the microimplant is placed in a movable soft tissue area with the open method, the soft tissue will grow around and embed the microimplant head during treatment. Instead of trying to have the microimplant head sufficiently away from the growing soft tissue, it is better to have the microimplant head under the soft tissue.
2) According to the Driving methods

(1) Self-Tapping (Pre-Drilling) method (Fig. 7)
A tunnel is drilled into the bone first by way of a bone drill, followed by the implant being driven into that tunnel. This method is used with small diameter microimplants and microimplants that are made of low grade pure titanium.

(2) Self-Drilling (Drill-Free) method (Fig. 8)
The implant itself drills into the bone as it is being driven. This method is for larger diameter pure-titanium microimplants or microimplants that are made of titanium alloy.

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Fig. 7. One-step (upper) and two-step (lower) self-tapping procedures. When the cortical bone is too dense, it is better to redrill the cortical bone with a slightly larger sized drill (lower).

Fig. 8. One-step (upper) and two-step (lower) self-drilling procedures. When the microimplant is inserted in a diagonal direction, it is better to make an indentation first in the cortical bone using a round bur (two-step protocol) to prevent slippage of the microimplant during driving.
3) According to the path of Microimplant insertion (Fig. 9)

(1) Diagonal (or Oblique) direction
When the microimplant is inserted into the bone in a direction oblique to the bone surface. This method can be used when the interradicular space between the teeth is very narrow. The microimplant is inserted at an angle of 30~60 degrees to the long axes of the teeth, both buccally and lingually. Such angulated placement can reduce the risk of contacting the adjacent root during implant placement.

(2) Perpendicular direction
When the microimplant is inserted into the bone in a direction perpendicular to the bone surface. Although this direction of insertion is the easier of the two, it can be used only when there is sufficient space between the roots of the teeth.

Fig. 9. Diagonal (left) and perpendicular (middle & right) insertion of microimplants.

5. Selection of Microimplants

1) According to the Length of Microimplant

The length of screw portion ranges from 5mm to 12mm. Longer microimplants lead to better mechanical stability like dental prosthetic implants, but more possibilities of invading adjacent anatomical structures, such as roots, maxillary sinus and nerves. According to our clinical experiences, 6mm of screw depth is sufficient for maxillary bone, and 5mm is sufficient for the mandible. However, you should always take into consideration the thinkness of soft tissue when choosing proper length of microimplants. Especially palatal mucosa may be very thick in many instances. If soft tissue is 6mm thick, in order to place 6mm of screw portion into the bone, the microimplant with at least 12 mm length should be used. This protocol requires that the soft tissue thickness as well as the bone quality must be evaluated at the location of placement.
Also, in choosing the proper length of a microimplant, the path of insertion of the microimplant must be considered. A microimplant can be placed either in a diagonal direction or a perpendicular direction depending on the cortical bone condition. It is better and easier to place microimplant in a perpendicular direction, but, there are many situations in which the microimplant should be placed in a diagonal direction so as to avoid injury to an adjacent tooth root. When the microimplant is placed in a diagonal direction rather than perpendicular direction, it is better to use a slightly longer microimplant (Fig.10).

Fig.10. Perpendicular (left) and Diagonal (right) insertion of microimplants. When the microimplant is placed in a diagonal direction, it is better to select a slightly longer microimplant.

2) According to the Diameter of Microimplant

There are various diameters of AbsoAnchor microimplants which range from 1.2mm to 2.7mm for placement anywhere in the oral cavity. Depending on the inter-radicular distance, the quality of bone and the site of placement, we can choose different diameters of microimplants.

Larger the diameter of the microimplant, the greater mechanical retention becomes. However, the thicker microimplants do not always guarantee higher success rate. There is even a report that microimplant of smaller diameter showed higher success rate than thicker ones (Kuroda et al, 2007-a). Also, thicker microimplants may be more difficult to remove due to osseointegration. Thus, we prefer microimplants of smaller diameter whenever possible. When the microimplants are placed between roots and if we choose larger diameter microimplants, we run into possibility of contacting the roots. If microimplant is contacting the root, the failure rate is increased significantly (Kuroda et al, 2007-b).

The followings are general tips for selecting proper diameter of microimplants depending on the inserting sites;

a. buccal & labial areas of maxilla (Fig.11) : Cortical bone in these areas is not thick, so use tapered microimplant with neck of 1.3-1.4mm thick and tip of 1.2~1.3mm thick. Microimplants made by titanium alloys of this thickness can be inserted safely without pre-drilling on maxillary buccal and labial areas.

b. buccal & labial areas of mandible (Fig.11) : Cortical bone of mandible is denser than maxilla, so a thicker microimplants (1.4~1.6mm) are better for preventing breakage, especially for self-drilling (drill-free) method.
5. Selection of Microimplants

Fig.11. Buccal & labial anterior microimplants for anterior en masse retraction in extraction case.

c. palatal areas of maxilla (Fig.12): Soft tissue is thick, so usually microimplants of longer than 10mm is needed. However, the longer the microimplants are the higher the possibility of breakage; so, use a slightly thicker microimplants (1.5~1.6 mm of neck) in comparison to buccal areas. The distance between roots is greater in palatal area than buccal area, there is less possibility of root contact even when using thicker microimplants.

Fig.12. Palatal alveolar microimplants for en masse retraction in lingual fixed appliance.

d. midpalatal and para-midpalatal suture (Fig.13): Microimplants of diameter larger than 1.7mm is recommended for sutural area and there is no worry for root contact. Even 2.7mm diameter microimplant can be used for younger patients.

Fig.13. Various clinical applications of the midpalatal and para-midpalatal microimplants. (Courtesy of Dr. Carlo Marassi & Alfredo Alvarez)
6. Various clinical sites for Microimplant placement

The followings are our recommended guidelines of microimplant sites, and recommended sizes for orthodontic anchorage purpose.

1) In Maxillary zone

(1) Infrazygomatic crest area (Fig.14)
Purpose: Retraction of the entire maxillary or maxillary anterior dentition. Intrusion of the maxillary molars.
Recommended Microimplants: Diameter: 1.3 & 1.4mm, Length: 6 & 7mm

![Infrazygomatic crest microimplants](image)

(2) Maxillary tuberosity area (Fig.15)
Purpose: Retraction of the maxillary posterior teeth. Intrusion of the maxillary molar.
Recommended Microimplants: Diameter: 1.3 – 1.5mm, Length: 7 & 8mm

![Maxillary tuberosity microimplants](image)
(3) Between the maxillary 1st & 2nd molars buccally (Fig.16)
Purpose: Retraction of the maxillary anterior teeth.
Intrusion of the maxillary molars.
Recommended Microimplants: Diameter: 1.2 & 1.3mm, Length: 7 & 8mm

Fig.16. The inter-dental microimplants in between the maxillary 1st & 2nd molars for molar intrusion (left & middle). The hook of the 1st molar tube is used to prevent gingival impingement by the coil spring (right).

(4) Between the maxillary 1st molar & 2nd premolar buccally (Fig. 17 & 18)
Purpose: Retraction of the maxillary anterior teeth.
Intrusion of the maxillary buccal teeth. Intermaxillary elastics.
Recommended Microimplants: Diameter: 1.2 & 1.3mm, Length: 7 & 8mm

Fig.17. The mesio-buccal root of the maxillary 1st molars are sometimes curved mesially. To avoid root injury, drill the bone somewhat mesial to the contact point between the 2nd premolar & 1st molar. Arrow: A fractured microimplant due to root contact during driving (Osteomed Co., dia: 1.2mm).

Fig.18. If the space between the roots is very narrow, the microimplant can be placed after making adequate space by moving the roots. If the wall of the maxillary sinus is very low, also, space can be made first and then the microimplant can be placed in a more perpendicular direction rather than in an oblique direction.
(5) Between the maxillary canine & premolar buccally (Fig.19)
Purpose: Distal & mesial movement of the maxillary molars.
Intrusion & extrusion of maxillary buccal teeth.
Recommended Microimplants: Diameter: 1.2 & 1.3mm, Length: 7 & 8mm

Fig.19. The microimplants in between maxillary canine & 1st premolar to move molar distally (left), *en masse* retraction and intrusion (right).

(6) Between the maxillary incisors facially (Fig.20)
Purpose: Intrusion & torque control of the maxillary incisors.
Recommended Microimplants: Diameter: 1.3 ~ 1.6mm, Length: 6 & 7mm

Fig.20. The microimplants between maxillary incisors.

(7) Between maxillary 2nd premolar, 1st molar & 2nd molars palatally (Fig.21)
Purpose: Retraction of the maxillary anterior teeth (Lingual ortho. Tx.).
Intrusion of the maxillary molars.
Recommended Microimplants: Diameter: 1.5 & 1.6mm, Length: 10 ~ 12mm

Fig.21. Palatal implants for *en masse* retraction in lingual treatment (left).
Molar intrusion by combination of palatal and buccal microimplants.
6. Various clinical sites for Microimplant placement

(8) Midpalatal and para-midpalatal (Fig. 22)
Purpose: Unilateral constriction.
Molar movement with transpalatal arch.
Recommended Microimplants: Diameter: 1.5 ~ 2.7mm, Length: 5 & 6mm

Fig. 22. Microimplants on the midpalatal & para-midpalatal area (courtesy of Dr. Skander Ellouze & Alfredo Alvarez).

Excellent implant sites in the maxilla are below the anterior nasal spine and in the midline of the palate. These areas contain very good quality of cortical bone. When placing the microimplant into the sutural area, it is better to choose a slightly thicker microimplant due osseous sutures. However, if the bony resistance of suture area is great, the microimplant can be shifted adjacent to the suture.

2) In Mandibular zone

(1) Retromolar area (Fig. 23 & 24)
Purpose: Uprighting of the tilted mandibular molar.
Retraction of the mandibular teeth or whole dentition.
Recommended Microimplants: Diameter: 1.4 ~ 1.6mm, Length: 8 ~ 10mm

Fig. 23. Microimplant in the retro-molar area for uprighting molar (left) and for retraction of the entire mandibular dentition (right).
Fig.24. Microimplant used for lingually tipped 2nd mandibular molar. It can be placed in the same surgical procedure of extraction of third molar.

(2) Between the mandibular 1st & 2nd molars buccally (Fig.25 & 26)
Purpose: Retraction of the mandibular anterior teeth. Intermaxillary elastics. Intrusion & distal movement of the mandibular molars.
Recommended Microimplants: Diameter: 1.3 ~ 1.6mm, Length: 5 ~ 7mm

Fig.25. The microimplants between the mandibular 1st & 2nd molars buccally.

Fig.26. Microimplants for uprighting lingually tipped mandibular molars.
(3) Between the mandibular 1st premolar, 2nd premolar and 1st molar buccally (Fig.27)
Purpose: Retraction of mandibular anterior teeth.
Intrusion of mandibular buccal teeth. Uprighting of tilted mandibular posterior teeth.
Recommended Microimplants: Diameter: 1.3 ~ 1.6mm, Length: 5 ~ 7mm

Fig.27. The microimplants between the mandibular 1st premolar, 2nd premolar and 1st molar buccally.

(4) Between the mandibular canine & premolar buccally (Fig.28)
Purpose: Protraction of the mandibular molars.
Recommended Microimplants: Diameter: 1.3 ~ 1.6mm, Length: 5 ~ 7mm

Fig.28. Microimplants between the mandibular canine & 1st premolar.

(5) Mandibular symphysis facially (Fig.29)
Purpose: Intrusion of the mandibular anterior teeth.
Recommended Microimplants: Diameter: 1.2 ~ 1.4mm, Length: 5 & 6mm

Fig.29. Microimplants placed in the mandibular symphysis.
(6) Edentulous area (Fig.30)

Purpose: Controlling the adjacent teeth of edentulous area including molar uprighting, distalization, mesialization, intrusion, extrusion & torque (*using two microimplants)

Recommended Microimplants: Diameter: 1.3 ~ 1.6mm, Length: 7 & 8mm

![Fig.30. Two microimplants are placed in the edentulous area for bracket attachment. And sectional edgewise wire was used to move adjacent teeth three dimensionally.]

3) Others (Fig.31, 32)

The AbsoAnchor® microimplant system is available in variable diameters and lengths of screws for orthodontic anchorage in any area of the mouth, if there is bone present. For example, the mandibular tori and the bone adjacent to residual roots that will be extracted at a later date can be used for the placement of the microimplants.

![Fig.31. A microimplant which are placed on a torus (left) & into roots (middle & right).]

![Fig.32. Microimplants were used for temporary implants (left) and molar uprighting (right). (Courtesy of Dr. Corrodi Ritto & Maria E.Cabana)
7. Surgical Procedures

1) Anesthesia

Small amount of local anesthetic is sufficient for the simple surgical procedure to insert the AbsoAnchor® microimplant. It is not necessary for the clinician to achieve profound anesthesia of the teeth; rather only the soft tissue need be anesthetized. Only one-fourth of a local anesthetic carpule is needed for this type of anesthesia. Sometimes, only topical anesthetic agent (Dentipatch®, Mucopain®, Painless patch®, Lidocaine spray etc) is enough for microimplant placement. If the patient feels some sensitivity during drilling or microimplant driving, that sensation is a sign of the microimplant touching the roots - the drill or microimplant should be redirected away from them.

When anesthetizing the palatal mucosa, the needle also can be used to probe and measure the mucosal thickness, which helps to determine the screw length necessary for anchorage (Fig.33). When the palate is anesthetized, the position of the greater palatine artery and nerve should be reviewed so as to avoid injuring them (Fig.33).

When planning the use of one or more microimplants in extraction patients, the microimplants can be placed just before the teeth are removed. Combining microimplant placement and tooth extraction at the same appointment eliminates additional surgical procedure.

Fig.33. Sometimes, only topical anesthesia agent is enough for microimplant placement. Palatal mucosa varies greatly in thickness, which requires measurement during or after local anesthesia in order to select the proper length microimplant. Review the positions of the greater palatine artery and nerve so as to avoid them.
2) Aseptic Preparation

Zepherin® (benjalkorium chloride) sponge or other common disinfecting agent can be used to prepare an intraoral & extraoral scrub for keeping the surgical area aseptic (Fig. 34).

![Fig. 34. Aseptic intraoral and extraoral preparation with disinfecting agent.](image)

3) Drilling

Mark the implant sites by using brass wires as shown in Figs. 32 & 38. Clinicians should use a speed-reduction contra angle hand piece (64:1 or 20:1 etc.) to make the original entry into the bone (Fig. 35).

![Fig. 35. Various types of drill bits (left) and speed-reduction contra angle: 64:1 (Right).](image)

Before using the pilot drill, use a #2 round bur (0.9mm diameter) first to make a small indentation on the bony surface. Round bur also can penetrate attached gingiva directly to the bone. Small indentation on the bone surface can prevent slippage of pilot drill especially when drilling diagonally. The indentation can be very useful especially when encountering extremely dense cortical bone (Fig. 7&8). Using round bur can also help to reduce the blunting of pilot drill since the pilot drill is much more expensive than the bur.

Drill-free method can be used when a larger diameter pure titanium microimplants or microimplants that are made of titanium alloy. It is recommended to extend the drill to the full length of the screws if using a smaller diameter of pure titanium microimplants.

The diameter of the drill end should be at least 0.2/0.3mm smaller than that of the selected microimplant. Before beginning the surgical penetration, the clinician should check the drill for any unwanted bends in the shaft that might cause it to wobble while drilling, resulting in unduly large opening. The microimplant depends almost entirely upon mechanical retention within the bone and must have a slightly tight fit to ensure its retention.
The drill can penetrate the mucosa, attached gingiva and underlying bone without a surgical flap (Fig.36). However, when making an entrance around movable soft tissue, a small vertical incision (less than 4mm) will prevent a soft tissue roll-up around the drill (Fig.37). If you do not want to make an incision, you can use drill guide to prevent rolling of soft tissue (Fig.38).

Fig.36. Maxillary and mandibular micro-implants applied to attached gingiva (pre-drilling method).

Fig.37. Vertical incision is needed when microimplant applied to maxillary and mandibular movable soft tissue (pre-drilling method).

Fig.38. Construction of a indirect drill guide. Using of indirect drill guide can reduce root touch.
To reduce heat production, drilling speed should be around 500-1000rpm. When drilling into dense cortical bone, move the drill carefully up and down as well as stop and go strokes with normal saline irrigation to compensate for the heat generated during drilling. To increase torque with reduced rpm, prosthetic implant engine is a good but expensive choice, so speed reduction contra angle (64:1 or 20:1, Fig.35) would be a reasonable alternative. Non-speed reduced low speed (1:1) contraangle gives high rotation speed (maximum 30,000rpm) which leads to excessive heat production. On the other hand, lowering the rotation speed of 1:1 contraangle to reduce heat leads to weaker torque, so that it may not penetrate dense bone.

The microimplant sites in the maxilla require 30-60 degrees of angulation to the long axes of the teeth, both buccally and lingually (Fig.36). Such angulation augments the surface area contact between the microimplant and the cortical bone and also increases retention while lowering the risk of making contact with a root.

In the mandible, the bone has a thicker cortex and a higher density than the maxilla. However, the volume & thickness of buccal bone is less available from the lower anteriors to the distal of the 1st molar (Fig.42). Thus in these areas, the microimplant is usually inserted more perpendicular to the long axis of the teeth. In the 2nd molar area, more volume and thickness of buccal bone is available and the microimplant can be placed in a more oblique or vertical direction (Fig.36). Nevertheless, doctors should remember that cortical bone density and volume will vary from patient to patient and from side to side, even in the same patient.

A final surgical caveat-do not use excessive force with the drill. Any great resistance after passing through the cortical plate is probably due to root contact. The drill angulation needs to be changed.
Fig. 41. Maxillary microimplant applied to palatal mucosa with a pre-drilling method. Note that more space exists between palatal roots than buccal ones.

Fig. 42. Mandibular microimplant applied to attached gingiva (pre-drilling method). Note the thickness of the cortical bone in the mandibular labial and buccal area.

Fig. 43. Mandibular microimplant applied to movable soft tissue with a surgical incision and a pre-drilling technique.
8. Advice for Microimplant driving

There are 2 types of driver: hand drivers and engine drivers (Fig.45).

A clinician may use engine driven method to insert microimplant, using speed reduction contra angle (256:1; about 30rpm) like prosthetic implants (Fig.46), but this may lead to more possibility of microimplant breakage, thus it is safer to use hand driver to feel resistance of microimplant driving torque. One should never give excessive force when placing a microimplant. If microimplant is broken during driving, it may be difficult to remove.

A long hand driver may be used on buccal areas of mandible and maxilla. For the sites where the long hand driver cannot be used (ex, palatal or retromolar area, etc), a short hand driver may be used instead (Fig.45).

However, the short hand driver may be inconvenient to handle. So, recently developed Hand-Driven Contraangle (Fig.46) may be a better choice. Hand-driven contraangle driver can be connected to low speed contraangle (1:1) in dental unit chair. Engine driver of appropriate size should be attached to the contraangle, and then microimplant should be fixed to engine driver (Fig.47).
8. Advice for Microimplant driving

To prevent breakage of microimplant during driving, a long hand driver with a built-in torque restrain has been developed (Fig.48). The smaller size of pure titanium microimplant (1.2 & 1.3mm diameter) can be broken easily, if torque forces of more than 1Kgf.cm are applied. Usually less than 0.5Kgf.cm is more than enough to get initial mechanical stability. So in order to prevent breakage of microimplants while driving, the clinician must know the maximum tolerable torque-resisting force of microimplants that he is using to load them accordingly. Fig.51 shows the torque resisting force of titanium alloy microimplants (Dentos Inc.) in relation to their diameters.
Fig. 48. Long hand drivers with torque gauge. The torque force can be adjusted from 0.5Kg.cm to 2Kg.cm.

Fig. 49. Sterilization package for AbsoAnchor® microimplant (left). The package can be cut with scissors just before use and the driver can engage the microimplant in its package (middle & right). Do not touch the microimplant part with fingers.

Fig. 50. Pre-sterilized (γ-radiation) package of AbsoAnchor® microimplant.

Fig. 51. The torque resisting force of microimplants of Dentos Inc. (Daegu, Korea) depend on the diameters. (*1kgf=9.8N)
9. Avoiding root damage

If a microimplant touches the root during driving, an increased resistance is felt and often patients will complain of dull pain, if shallow anesthesia was given to patients. In this situation, the microimplant can be redirected after redrilling or a shorter length of microimplant with a size larger in diameter (rescue microimplant) can be used. Slight injury to the root surface by the microimplants is not so harmful to teeth, but root contact of microimplant is one of the main reasons for the failure of the implants. The masticatory forces inducing the mobility of the tooth when the microimplants that are in contact with the roots will eventually result in loosening of the microimplants.

Using light forces (less than 0.7Kgf.cm) while driving microimplants can avoid microimplant fracture. When an operator encounters heavy resistance, the microimplant should be withdrawn and then redrill the bone with the next larger drill and resume the microimplant driving. For example, if 0.9 mm diameter of drill was used at the first time, then 1.0mm diameter of pilot drill should be used for redrilling. At this time, redrilling should be done only in the cortical bone area (Fig. 7 : Two-step drilling).

To reiterate, success with microimplants depends upon initial tightness. Before drilling, check the straightness of drill and make sure it does not vibrate during drilling. If there is no initial mechanical tightness of the microimplant after placement, choose one size larger microimplant. When such tightness does not occur, replace the implant with the next larger size. Occasionally, a new site adjacent to the original onsite may be prepared.

9. Avoiding root damage

The proximity of microimplants to the roots of teeth present orthodontists with an important challenge. They must use extreme care to avoid roots when positioning the microimplant. Serial periapical X-rays taken by tube shift technique can help determine if adequate space exists for the implant between teeth. CT scans offer 3-D images for precise interpretation (Fig.52), but this brings up the issues of radiation exposure and extra expense. To date, root damage has not presented many problems. Roots typically demonstrate good recuperative power, even when severely challenged as it happens during apicoectomies. The day after placing microimplant, patients will complain of a dull pain during mastication, if a microimplant comes in contact with a root, moving the root away from the implant will usually relieve patient discomfort. However, occasionally there are no adverse signs and symptoms whilst the root comes in contact with the microimplant, by virtue of their own movement. Thus, a diagonal path of microimplant insertion will help to avoid root injury when placing the microimplant between roots. If there is not enough inter-radicular space, the roots can be moved apart orthodontically before placing the implants (Fig.18).

Fig.52. Review root approximation by microimplant with a conventional radiographs or CT scans.
10. Orthodontic Force application

Theoretically, we have to wait 2-3 months for osseointegration between titanium surface and bone tissue. Also, it is better to wait about 2 weeks for soft tissue healing before applying orthodontic force when we do use stab incision for implantation. However, when we attempt distraction osteogenesis (DO), we do not wait for osseointegration between screw pin and bone before force application. Similarly we can commence immediate loading after implantation, if needed. Actually, there were no clinical differences in failure rates between immediate loading and delayed loading the applied the force was kept to less than 300gm. It can be inferred that the mechanical stability is far more important than osseointegration in microimplant anchorage systems. Light continual forces as generated by nickel titanium coils are more favored over chain elastomericas that often have excessive initial forces.

11. Postoperative patient management

There is little to report about noticeable pain or side effect like infection after microimplant placement. Antibiotics prescription is not necessary with microimplant installation without incision. Also analgesics or NSAIDs is not necessary since microimplant of small diameter rarely induces pain or swelling. However patients should be told to revisit the clinic when feeling pain during mastication. This kind of pain is usually derived from microimplant contact with root. If it is diagnosed to be root contact, one should move teeth away from microimplant. If only slight mobility is felt, retighten the microimplant instead of removing it.

Although patients seldom need any medication, doctors should make prescriptions of antibiotics and other pain medications available for them on a needed basis.

Microimplant sites require excellent oral hygiene with soft brushing and possibly water irrigation. From time to time chemotherapeutic rinses may ward off any inflammation and infection. Also patients should be warned not to touch microimplant by their fingers and chopsticks etc.

12. Explanation for possibility of failure

Microimplant has a failure rate of 5~25% depending on the operators’ technique, patient type and insertion sites. Usually more failures occur in mandible than maxilla. The patients should be fully aware with the possibility of failure before starting microimplant treatment.

13. Microimplant removal

Fortunately, strong osseointegration does not occur between titanium alloy microimplant and bone, and this simplifies the removal of the microimplant. In the open method, a clinician can easily remove the microimplant by engaging the microimplant head with the driver and turn it in the opposite direction of the
insertion. What is more, local needle-stick anesthesia is not needed during this procedure. Patients may have some minor discomfort when the implant irritates the soft tissue during its removal, but this gives far less discomfort than an anesthetic needle-prick. Topical anesthesia is enough if you want to avoid any pain during removal of microimplant. In the closed method, small incision is made over the head portion of microimplant to expose it after local anesthesia. The initial turn, sometimes does offer some resistance, so, use caution with the first turn so as not to fracture the microimplant.

Fig. 53. Removal of microimplant (AbsoAnchor®, Dentos Inc.) using hand driver on the buccal surface of maxilla (upper row) and the palate (lower row). There is no need of needle-stick anesthesia for its removal. Only a topical anesthesia is recommended.

Fig. 54. Removal of microimplant using a speed reduction engine driver on the palatal surface without needle-stick anesthesia (above). Hand-Driven contraangle drive is also very useful to remove the microimplant (below).
14. Concluding remarks

The AbsoAnchor® microimplant system was developed specifically for orthodontic anchorage and comes variable sizes and lengths for wide application. Microimplants are small enough to be placed virtually in any area of the mouth, if there is bone available. A microimplant can be placed without mucoperiosteal incision or flap, so there is almost no pain or swelling after implantation. Routine placement of a microimplant takes less than a few minutes. Orthodontists and general dentists can easily place microimplants in their practices.

Unfortunately, one cannot achieve a 100% success rate when placing microimplants for temporary orthodontic anchorage. Maxillary microimplants have had a high success rate of more than 90%, a rate that is similar to that of prosthodontic implants. The success rate of mandibular microimplants is less than 90%. It is our mission to find ways to increase the success rate of microimplant placement.

Microimplant anchorage has become one of the most effective and powerful tool for absolute anchorage, which up until now was one of the biggest dreams of the practicing orthodontist. This treatment approach can bring about a paradigm shift in orthodontic treatment planning in contemporary orthodontic world. By adding this new type of anchorage system to the armamentarium of the practicing orthodontists, we can broaden the domain of orthodontic treatment possibilities. Many other applications for microimplant anchorage will be developed by creative orthodontists in the near future.
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