The Use of Implants as Orthodontic Anchorage

Tsung-Ju Hsieh, D.D.S., M.S.D.

Why use implants?

- Intra-oral anchorage:
  - Palatal or lingual bars, the Nance holding arch, and intermaxillary elastics
  - Disadvantage:
    - protrusion of the incisors,
    - extrusion and tipping of the teeth,
    - negative influence on the occlusal plane
- Extra-oral anchorage: headgear
  - Disadvantage: Compliance

Absolute anchorage

- Retromolar Implant
- Palatal Implant
- Biodegradable implant
- Micro-screw implant

Retromolar implant

Advantages of Retromolar Implant

- Anchorage for realigning teeth
- Closing edentulous spaces so prostheses are not required
- Reestablishing proper anteroposterior and mediolateral positions for malposed molar abutments.
- Intruding and/or extruding teeth.

Missing Teeth

- most commonly missing teeth: mandibular first, maxillary first, mandibular second, and maxillary second molars
- Treatment option:
  - Fixed partial denture (FPD),
  - Single tooth implant (STR),
  - Retromolar implant

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Advantages of Retromolar Implant

• Correcting an anterior open occlusal relationship.
• Protracting/retracting one arch or the entire dentition.
• Providing anchorage for orthopedic movement.
• Predictable behavior and invisibility of the anchorage unit
• Compliance-independence

Disadvantages of Retromolar Implant

• Treatment time is long or longer than conventional treatment methods.
• The higher cost of orthodontic tx + retromolar implant.
• Access challenges for surgical procedures.

Rate of tooth movement

• Mesial movement of the mesial root apex was about
  – 0.6 mm/month for the first 8 months,
  – decrease to 0.34 mm/month afterwards

• Maximal when penetrating the predominately trabecular bone around the roots of the molars at the start of space closure.
• Decreased velocity: distal root engaging the more dense alveolar bone formed by the mesial root.
• Rate of tooth movement: related to the ability to remodel the relatively dense, immature bone formed by the mesial root.

Procedure of Retromolar Implant

• Implant: 3.75mm x 7 mm Standard Branemark fixture
• Location: 5 mm distal to the mandibular third molar
• Wire: .019”x.025” TMA
• After 2 week healing period, a 90° occlusal bend to the vertical slot of the Advant-Edge of the canine bracket.
Final setup

Location

Surgical Pitfalls

Pre-op pano

Location of osteotomy site

Guide pin shows direction
When to bend the wire

- During the surgery
  - longer time
- At least 1 day before surgery
  - bend the archwire on the cast
  - No loop for the covering screw, yet
  - Put it in Peridex for sterilization for 24 hours
  - Put another new wire in Peridex for backup
  - Fit the anterior part of the wire in the mouth
  - Mark on the wire where the loop should be
  - Form a loop to fit the covering screw

Wire Passive in Md Anterior

- Adults
- Adults (no intrusion)
- Intrusion
- Shallow vestibule

Final Setup

Loop on Canine Wire

Closing Stage (Occlusal)

Wire Position
Wire Position

1 week POT

1 month POT

Pre-Op

1 month POT

Implant trephination
Palatal Implant
Palatal implant - Midpalatal Suture

- Broad to narrow palatal suture with straight running compact bone zones adjacent to the sutures
- Less broad suture with a low degree of interdigitation
- Narrow palatal suture with a high degree of interdigitation

Midpalatal Suture

- The latter two type may be more favorable, especially when one-stage surgery is intended, with respect to primary stability and amount of anchoring surface of small orthodontic implants within the bone

Palatal implant - Bone Quantity

- Can be determined on lateral cephalograms
- The angulation cannot be selected freely because it depends on the position in the palate and the angulation of the lingual surface of the palate.
- Incisive canal

Timing

- Complete ossification of the midpalatal suture is rare before the age of 23 years.
- The failure rate of palatal implants should be higher in patients under 17 years.


Location

- The anterior midpalatal suture is less often ossified than the posterior region.
- A bone bed more favorable to osseointegration might be found posterior to the interconnecting line of the first premolars.

Palatal Implant

- Length: 4 and 6 mm
  - owing to the reduced bone height in the palate
  - determined by assessing the apparent vertical bone height in the desired implantation.
- Diameter: 3.3mm, 4mm
  (replacement implant)
- Material: unalloyed titanium

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Advantage of Straumann Orthosystem

- Transmucosal healing (no need for second operation)
- One-part implant with self-tapping thread
- Sand-blasted and acid-etched surface (SLA)
- Smooth transmucosal neck section
- Low trauma implantation
- Small dimensions
- Maximal anchorage vertically and anterior-posteriorly

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Palatal Implant- Surgical Procedure

- Remove palatal mucosa by a standard punch
- Drill the endosseous cavity with a pilot drill and a profile drill
- Careful probing with 0.2N to detect any bony perforation to the nasal sinus
- The bony quality was assessed by careful scratching with the probe
- Insert the implant
- Lateral cephalogram taken

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Advantage of surface treatment

- Higher removal torque
- Reduced healing time for implants
- Good primary stability by rounding-off the cutting edges of the tapping portion of the implant.

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- Local anesthesia for palatine nerve on both sides, and incisive nerve
- Mucosa trephine and elevator

- 2.3mm in diameter Round bur

- Profile drill
- Continue drilling until a complete seat is created, maximally to the stop

Replacement implant
- Twist drill 3.5mm in diameter for 4mm in diameter replacement implant

Ortho inserting device
• Ortho healing cap or ortho healing screw
• Tightening torque of 15 Ncm
• Retaining sleeve can be removed for better view

• Healing phase lasts 12 weeks
• Avoid tongue pressure
• A surgical stent can be used to cover the fixture to protect it for the first few weeks.

Impression
• Take impression 10 weeks after the surgery

Steel coping and Yoke

Nasal floor perforation?
The truth is….  

• In none of 12 patients was a perforation to the nasal cavity found. However, in five subjects the implant projected into the nasal cavity on the post-operative cephalogram.
• Vertical bone support is at least 2 mm higher than apparent on the cephalogram.
• If a slight perforation of the bony structures should occur, the thick nasal mucosa will prevent an open connection to the nasal sinus.

– Wehrbein, H 1999

Implant Length

If MCBI = MCBPC, a safety distance to the nasal sinus of at least 2 mm should be present

– Wehrbein, H 1999

Stability of short titanium screw implants

• Bonefit: 2 dogs -> 4 implants per dog -> P1/P2 region v.s. palatal suture -> submersion depth 6mm inserted in regions with reduced vertical bone height of maxilla -> 8 weeks healing period -> ~2N continuous horizontal force -> compare implant mobility, implant dislocation

– Wehrbein, H, 1997

Stability of short titanium implant

• No implant mobility was recorded either during the unloaded implant healing or during the force application period.
• Clinical measurements and histological evaluation revealed no implant dislocation.
• Conclusion: short titanium screw implants inserted in the alveolar bone and palatal suture region retain their stability during long-term orthodontic loading, even following a relatively short unloaded implant healing period.

Protocol of Palatal implant

• Analysis of the vertical bone quantity
• Select suitable implant length
• Antibiotics administered pre- and post-operation
• Surgical procedures take only 10 minutes
• 10 weeks post-op: extract 1st premolar
• 11 weeks: remove hyperplastic peri-implant soft tissue
• 12 weeks: impression taken for transpalatal arch (TPA)

Palatal Implant – orthodontic application

A  B  C  D

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• OB: 6mm
• OJ: 9mm
• Full cusp class II molar on both sides

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• 5x6mm Branemark implant
• TPA attached to molar bands with acrylic resin

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• Tx time: 2 years 8 months

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• Mx incisors: intruded 4 mm, retracted 7 mm

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Biodegradable Implant Anchor for Orthodontics System (BIOS)

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BIOS

- Disadvantage of the aforementioned implants: should be removed in a secondary operation at the conclusion of orthodontic treatment.
- Ideal solution: resorbed within the tissues.

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Degradation Process

- Implants: biodegradable polylactide alpha-polyester
- Period of stability: 9-12 months

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BIOS

- Biodegradable implant body:
  - produced by injection moulding and sterilized using ethylene oxide
  - derived from ITI-Bonefit screw implant
- Metal abutment:
  - a superstructure
  - anchored by internal thread located in the plastic implant

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Strength of BIOS

- Shear strength test: deflection under horizontal force of 50 N (ultimate clinical force application)
  - BIOS: 0.26mm ± 0.13mm with a maximum deflection of 0.58mm
  - Bonefit: 0.07 ± 0.01 mm with a maximum of 0.08mm

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BIOS

- BIOS: Vertical force tests: 155 ± 80 N with a maximum value of 244 N.
- Bonefit: 422 ± 21 N with a maximum value of 460 N
- Conclusion: the loading capacity of the BIOS implant was found to be adequate for clinical application in orthodontics.

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After first trials with resorbable material, it became apparent that only titanium can provide the long-term stable osseointegration that is required to withstand different types of loading, axial or nonaxial, that are prevalent in the orthodontic application.

– Wehrbein, H 1998

Micro-screw implant

• 1.2 mm in diameter, 6 mm long
• Implanted at a 60° angle between teeth
• Apply orthodontic force 2 weeks after implantation

5mm out of 6mm is embedded in the bone
• The depth of penetration was only 2.5mm
• The average thickness of cortical bone


Class I bialveolar protrusion

• Convex profile

Initial canine retraction 2 weeks after implantation

Micro-implant between 1st and 2nd molar was tied to the archwire with elastic thread to reduce mandibular plane angle
Pretreatment

Post-treatment
Tx time: 18 months

Impacted canine

• 21-year-old female with impacted upper right canine

Application for the impacted canine correction and protraction of 2nd and 3rd molars

• Park HS, et al. JCO 2004; 38: 297-302
Summary

- Retromolar implant
- Palatal implant
- Biodegradable implant anchor for orthodontic system (BIOS)
- Micro-screw implant