The Use of Implants as Orthodontic Anchorage

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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

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

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.

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

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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

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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

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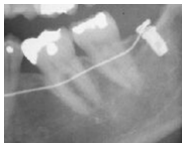
•Maximal when penetrating the predominately trabecular bone around the roots of the molars at the start of space closure

•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.



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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 90^0 occlusal bend to the vertical slot of the Advant-Edge of the canine bracket

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Final setup

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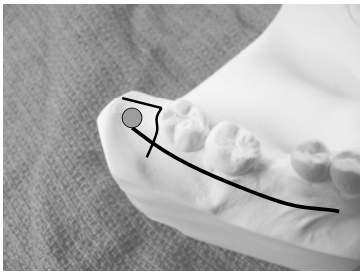
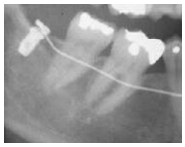
Location





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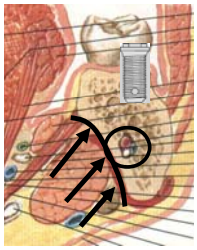
Surgical Pitfalls



Netter

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Pre-op pano

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Location of osteotomy site

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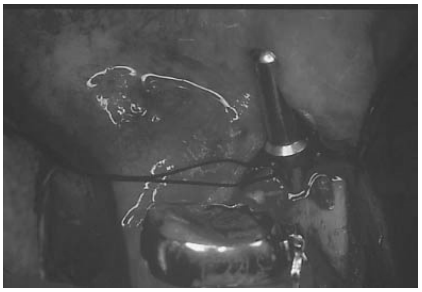
Guide pin shows direction



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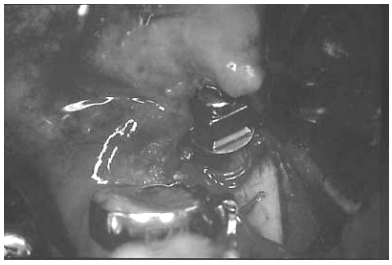
Implant and mount



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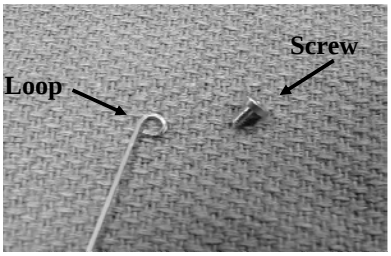
Forming Loop



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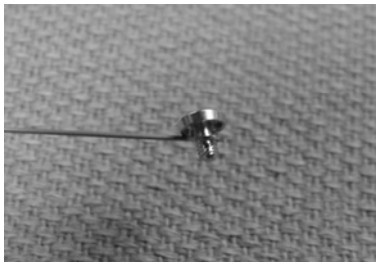
Forming Loop



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Forming Wire

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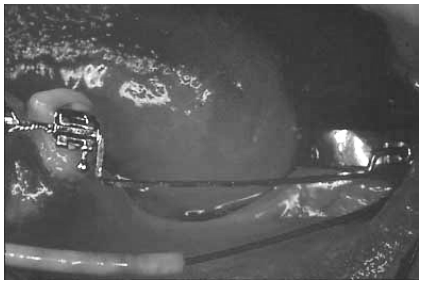
TMA wire in place



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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

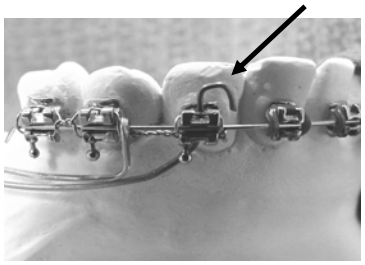
Intrusion

Adults (no intrusion)

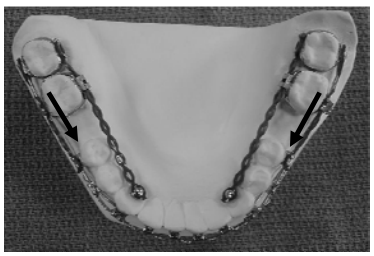
Shallow vestibule

Final Setup

Loop on Canine Wire

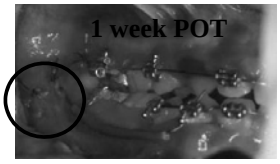


Closing Stage (Occlusal)



Wire Position

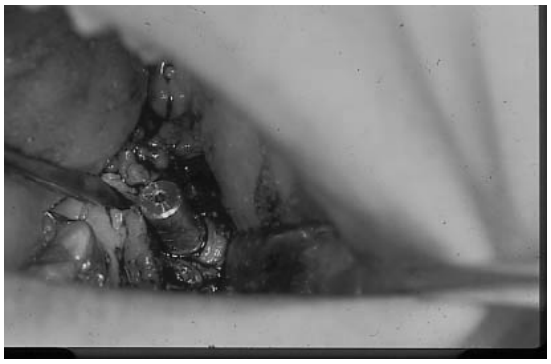
Wire Position



Wire Position

Pre-Op **1 month POT**

Implant trephination



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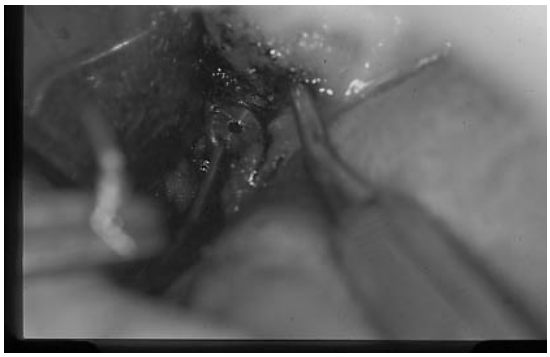

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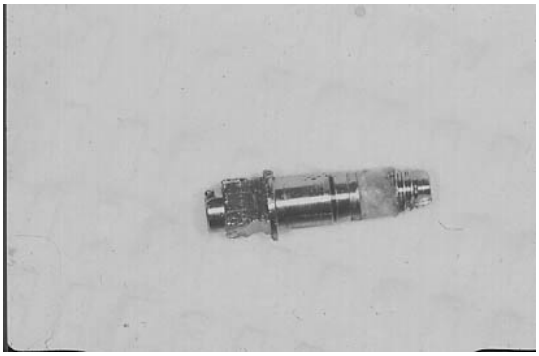

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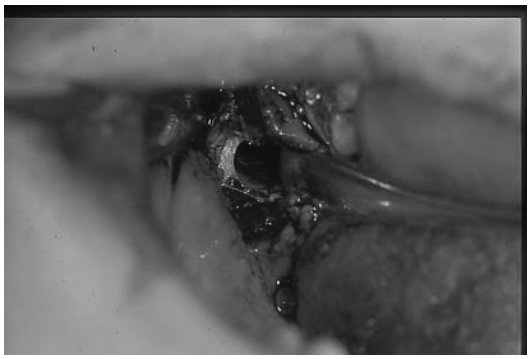

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Palatal Implant

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Palatal implant - Midpalatal Suture

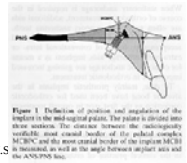
- Broad to narrow palatal suture with straight running compact bone zones adjacent to the sutures
- Less broad suture with a low degree of interdigitation
- Narrow palatal suture with a high degree of interdigitation

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

Table 2 Correlation of age and gender regarding SPM ossification

	Female			Male		
Age (y)	Without ossification	With ossification	Total	Without ossification	With ossification	Total
12 to 22	2	0	2	7	0	7
23 to 30	1	0	1	2	5	7
31 to 50	2	0	2	1	5	6
Total	5	0	5	10	10	20

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.
  - Schlegel KA, et al. Int J Adult Orthod Orthognath Surg 2002: 17: 133-139

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.
  - Schlegel KA, et al. Int J Adult Orthod Orthognath Surg 2002: 17: 133-139.

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

•Design: a screw shape in combination with surface treatment.

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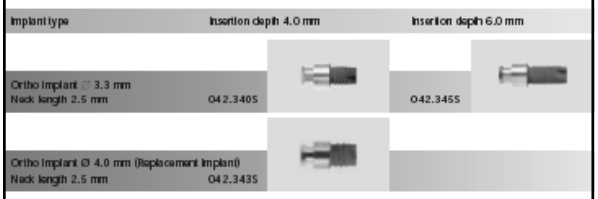

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Advantage of Straumann Orthosystem

- 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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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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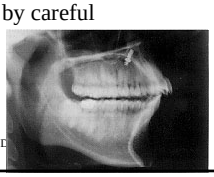
Palatal Implant- Surgical Procedure

- 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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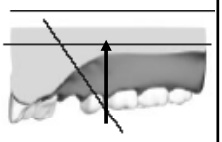
•A drill template can be made

•Ceph analysis to determine the optimal insertion site

•Para-median site for growing patient



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

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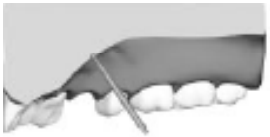
- 2.3mm in diameter Round bur



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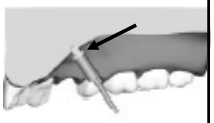
- Profile drill
- Continue drilling until a complete seat is created, maximally to the stop



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Replacement implant

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

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Ortho inserting device

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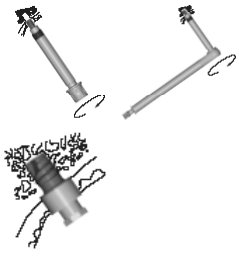

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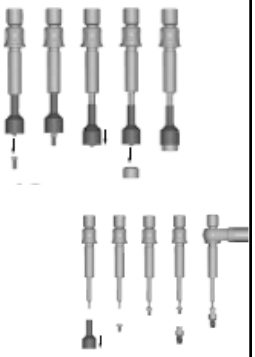
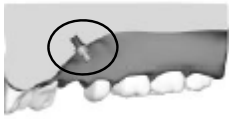
- Ortho healing cap or ortho healing screw
- Tightening torque of 15 Ncm
- Retaining sleeve can be removed for better view



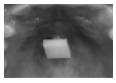
- Healing phase lasts 12 weeks
- Avoid tongue pressure
- A surgical stent can be used to cover the fixture to protect it for the first few weeks.

or:



Impression

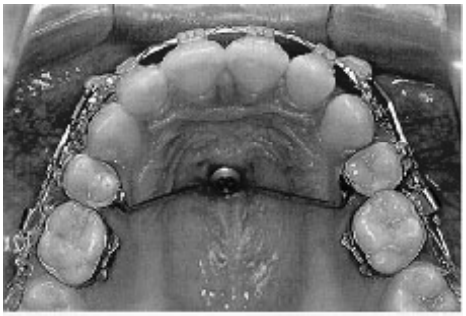
- Take impression 10 weeks after the surgery



Ortho
Impression cap

Ortho analog

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

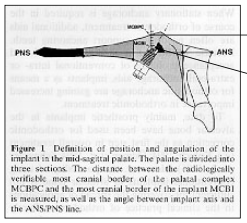


Figure 1. Definition of position and angulation of the implant in the mid-sagittal palate. The palate is divided into three sections. The distance between the radiologically verifiable most cranial border of the palatal complex MCBPC and the most cranial border of the implant MCBI is measured, as well as the angle between implant axis and the ANS/PNS line.

MCBPC

MCBI

- MCBI: most cranial border of implant
- MCBPC: most cranial border of palatal complex
- Maximal length: MCBI = MCBPC

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

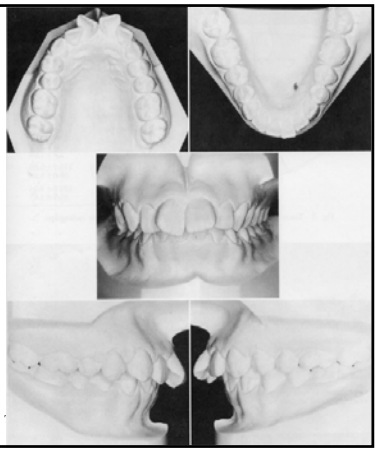
A

B

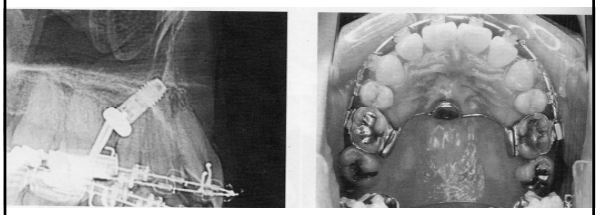
C

D

– Nojuma K, et al. Bull.Tokyo dent. Coll. 2001,42(3): 177-183

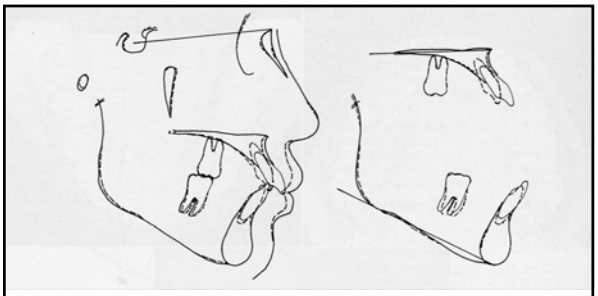


- OB: 6mm
- OJ: 9mm
- Full cusp class II molar on both sides



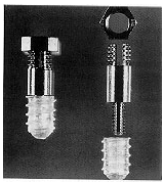
- 5x6mm Branemark implant
- TPA attached to molar bands with acrylic resin

- Tx time: 2 years 8 months



- Mx incisors: intruded 4 mm, retracted 7 mm

Biodegradable Implant Anchor for Orthodontics System (BIOS)

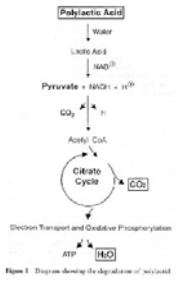


BIOS

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

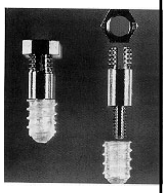
Degradation Process

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



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



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

Strength of 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.

BIOS

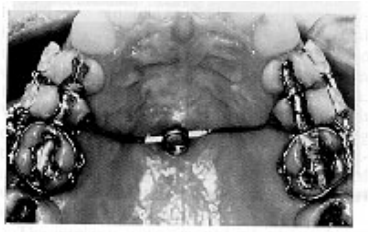


Figure 5 BIOS implant *in situ* integrated into the orthodontic segmented-arch appliance (> stainless steel TPA 0.32 × 0.32) during distalization of the maxillary molar in an adult patient.

BIOS

- 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

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Micro-screw implant

- 1.2 mm in diameter, 6 mm long
- Implanted at a 60^0 angle between teeth
- Apply orthodontic force 2 weeks after implantation

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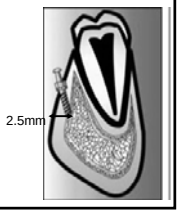
- 5mm out of 6mm is embedded in the bone
- The depth of penetration was only 2.5mm
- The average thickness of cortical bone



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Class I bialveolar protrusion

- Convex profile

Park HS, et al. JCO 2003; 35(7): 417-422.

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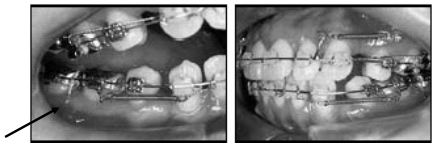
Initial canine retraction **2 weeks** after implantation

2 months after picture A



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

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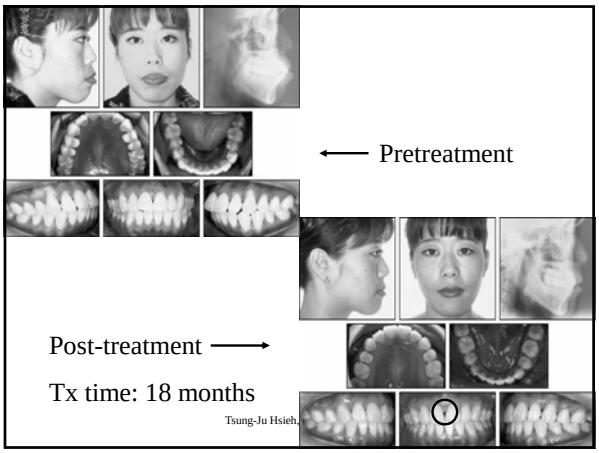
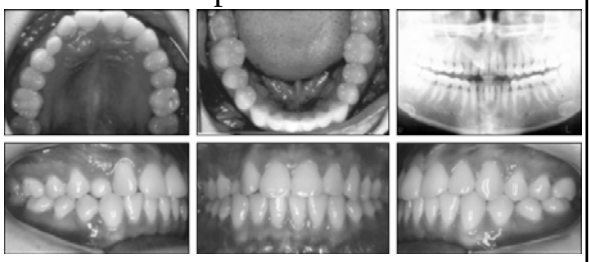


Impacted canine

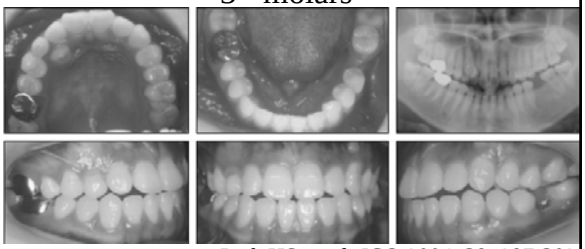


- 21-year-old female with impacted upper right canine

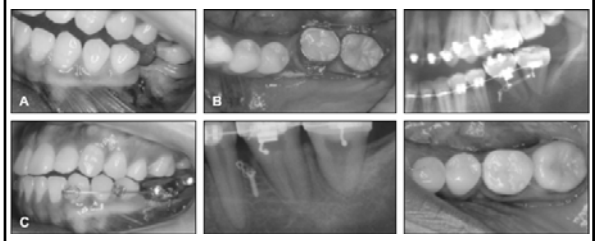
- Park HS, et al. JCO 2004; 38: 297-302

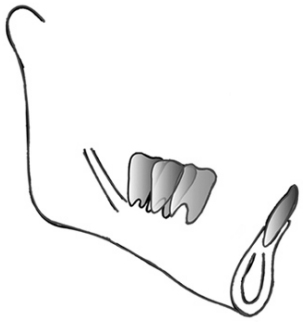
Post-treatment

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