Implant-Supported Crowns to Replace Congenitally Missing Lateral Incisors: 2B-3D Rule for Ideal Implant Position

Abstract

A 29-year-old male patient presented for orthodontic consultation concerned with multiple spaces in the maxillary and mandibular dental arches. Clinical evaluation revealed modest Class II buccal segments, generalized anterior spacing, congenital absence of both maxillary lateral incisors, but there were no other manifestations of malocclusion. The malocclusion Discrepancy Index (DI) was 12, but implant site deficiencies added an additional 8 points, resulting in an overall Interdisciplinary DI of 20. A diagnostic wax set-up showed that implant replacement was esthetically superior to canine substitution bilaterally. A full fixed orthodontic appliance with passive self ligating brackets was used to correct the malocclusion and prepare the implant sites. Open coil springs in the edentulous areas closed the midline diastema and consolidated the space at the desired location of the implants. Because of the Class II buccal segments, pre-implant alignment of the maxillary anterior region produced overjet. Extra-alveolar (E-A) bone screws were inserted bilaterally in the infrazygomatic crests to provide osseous anchorage to retract the entire maxillary arch to Class I. Implants were placed with bone augmentation to increase the width of the alveolar process to cover the endosseous portions of the fixtures. The posttreatment Cast-Radiograph Evaluation (CRE) was a near ideal 7, and the Pink & White dental esthetic score was 5. (Int J Ortho Implantol 2015;37:22-57) .

Key words:

Congenitally missing maxillary lateral incisors, OrthoBoneScrew, extra-alveolar bone screws, maxillary midline diastema, passive self-ligating brackets, early light short elastics (ELSE), Atherton's patch, apical fenestration, bone augmentation, GBR (guiding bone regeneration), 2B-3D rule.

History and Etiology

Congenitally missing maxillary lateral incisors are the second most common dental agenesis, exceeded only by third molars. The congenital absence of one or more maxillary lateral incisors usually compromises esthetics and may also be associated with dental midline and functional occlusion problems. Treatment planning to achieve an ideal result is often challenging and may involve interdisciplinary procedures. To achieve an optimal result it is important for the orthodontist to be involved in the entire process.

The most common orthodontic options are related to space management. Space can be opened for prostheses, usually implant-supported crowns, or closed for canine substitution.

Many factors must be considered in formulating a treatment plan to achieve an optimal result, including the: 1. patient preference, 2. overall cost, 3. shape and size of the adjacent central incisor and canine,

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Fig. 1: Pre-treatment facial photographs

Fig. 2: Pre-treatment intraoral photographs

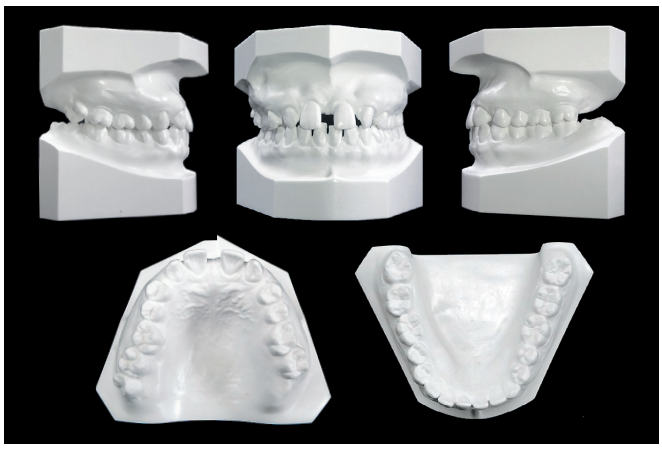
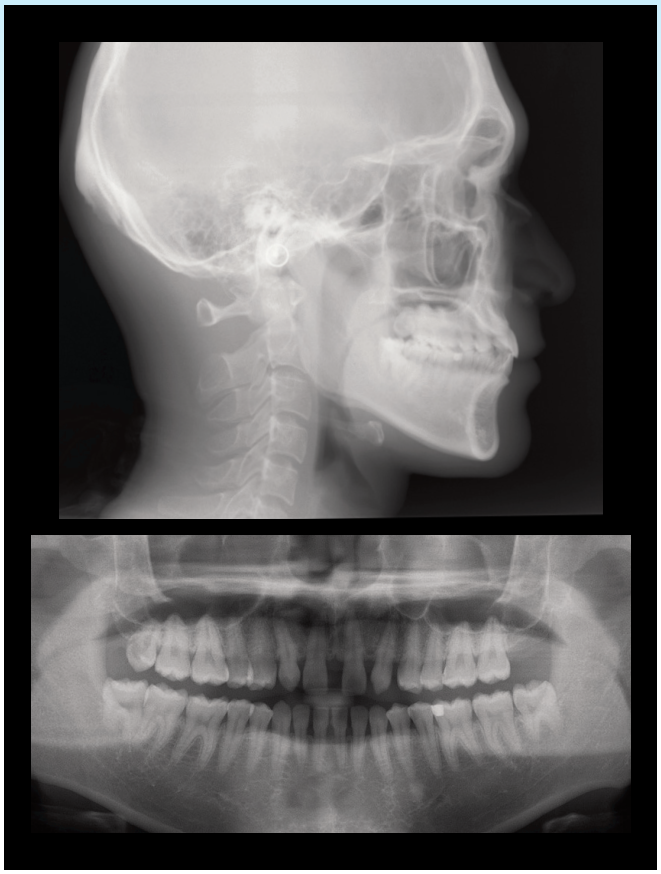


Fig. 3: Pre-treatment study models (casts)

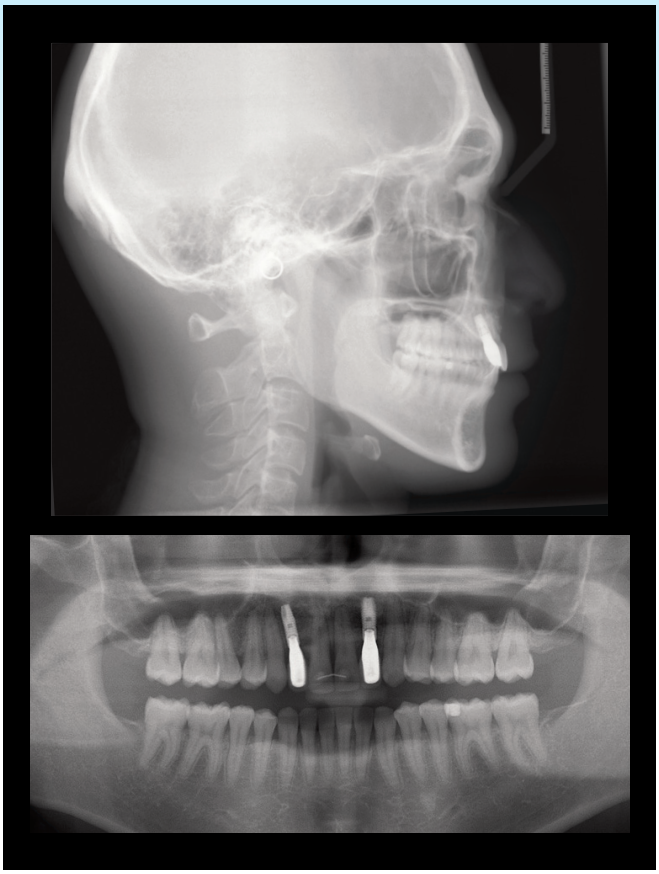
Fig. 4: Post-treatment facial photographs

Fig. 5: Post-treatment intraoral photographs

Fig. 6: Post-treatment study models (casts)



■ *Fig. 7:*
Pre-treatment panoramic and lateral cephalometric radiographs



■ *Fig. 8:*
Post-treatment panoramic and lateral cephalometric radiographs

■ *Fig. 9:*
Superimposed tracings of pre-treatment (black) and post-treatment (red) lateral cephalometric radiographs document the skeletal and dental treatment. The upper lip was protruded to improve the facial profile.

CEPHALOMETRIC			
SKELETAL ANALYSIS			
	PRE-Tx	POST-Tx	DIFF.
SNA°	87°	89°	2°
SNB°	85°	85°	0°
ANB°	2°	4°	2°
SN-MP°	29°	29°	0°
FMA°	22°	22°	0°
DENTAL ANALYSIS			
U1 TO NA mm	4 mm	3 mm	1 mm
U1 TO SN°	115°	113°	2°
L1 TO NB mm	5 mm	5 mm	0 mm
L1 TO MP°	97°	97°	0°
FACIAL ANALYSIS			
E-LINE UL	-5 mm	-3 mm	2 mm
E-LINE LL	-3 mm	-2 mm	1 mm

■ Table 1: Cephalometric summary

and 4. presenting occlusion, particularly with regard to the sagittal plane (*Class I, II or III*). Canine substitution may be the best long-term biologic solution, but mesial translation of the canine is difficult to achieve without compromising the occlusion of adjacent teeth. Furthermore, it is often necessary to extensively reshape the entire anterior segment to achieve acceptable esthetics. Preprosthetic alignment may be problematic in the presence of a substantial malocclusion. Implant-supported prostheses have immediate appeal for many patients, but preprosthetic alignment to achieve an optimal result may be challenging for the orthodontist, particularly if the buccal segments are Class II.

A 29-year-old male patient presented for orthodontic consultation, concerned about unesthetic anterior dental spaces (*Figs. 1-3*). The initial clinical examination revealed the congenital absence of both maxillary lateral incisors that was associated with a maxillary midline diastema (*Fig. 10*). The lateral cephalometric radiograph showed a normal skeletal pattern (*ANB 2º, SN-MP 29º*) , his pre-treatment facial profile revealed a straight profile with an acceptable soft tissue E-line projection (*Fig. 7*). There was no other contributory medical or dental history. The patient was treated to an acceptable result as documented photographically in Figs. 4-6. The cephalometric and panoramic radiographs document the pre-treatment condition (*Fig. 7*) and the post-treatment results (*Fig. 8*). The superimposed cephalometric tracings from before and after treatment are shown in Fig. 9. The details for the diagnosis and subsequent treatment will be discussed.

The etiology of the malocclusion was related to excess space in the developing arch due to congenitally missing maxillary lateral incisors. The major problems were: 1. central incisors had drifted distally, 2. canines had erupted into the lateral incisor space, and 3. mesial drift of the canines was associated with Class II buccal segments. The patient preferred an interdisciplinary treatment plan to align and restore his teeth with implants, prosthetics. An additional advantage was a shorter treatment time compared to canine substitution.

Diagnosis

Skeletal:

1. Skeletal Class I (*SNA 87°, SNB 85°, ANB 2°*)
2. Normal mandibular plane angle (*SN-MP 29°, FMA 22°*)

Dental:

1. Right: *end on Angle Class II molar relationship,*
   Left: *Angle Class I molar relationship*
2. The overbite was 2.5 mm and overjet was 1.5 mm
3. Tooth Size Arch Length Discrepancy: *spacing of 10 mm in the maxilla and 2 mm in the mandible*
4. Bilateral congenitally missing maxillary lateral incisors
5. Maxillary midline diastema

Facial:

- Straight profile with an acceptable soft tissue E-line projection

The ABO Discrepancy Index (*DI*) was 12 and 8 points were added for implant site evaluation for an overall Interdisciplinary DI of 20. Scoring details as shown in the subsequent worksheet.[1]

Specific Objectives of Treatment

Maxilla (*all three planes*):

- A - P: *Maintain*
- Vertical: *Maintain*
- Transverse: *Maintain*

Mandible (*all three planes*):

- A - P: *Maintain*
- Vertical: *Maintain*
- Transverse: *Maintain*

Maxillary Dentition

- A - P: *Maintain*
- Vertical: *Maintain*
- Intermolar Width: *Maintain*
- Intercanine Width: *Maintain*
- Buccolingual Inclination: *Maintain*

Mandibular Dentition

- A - P: *Maintain*
- Vertical: *Maintain*
- Intermolar Width: *Maintain*
- Intercanine Width: *Maintain*
- Buccolingual Inclination: *Maintain*

Facial Esthetics: *Maintain the acceptable profile*

Treatment Plan

A Damon Q® .022" slot self-ligating appliance (*Ormco, Glendora, CA*) was indicated, utilizing standard torque brackets for both upper and lower incisors. Bilateral compressed coil springs between the central incisors and canines were prescribed to open spaces for implantation of the congenitally missing maxillary lateral incisors. Although maxillary lateral incisor width ranges from 5 to 7 mm, a 7mm space is preferable for implant surgery. Bone screws (*2x12mm OrthoBoneScrew®, Newton's A Ltd, Hsinchu, Taiwan*) were indicated bilaterally in the infrazygomatic crests to control incisal flaring during space opening, and to achieve Class I buccal segments with optimal width for the implant sites. Class II early light short elastics were planned to retract the maxillary anterior segment and reduce the overjet.

Bone augmentation, followed by guided bone regeneration (*GBR*) when the implants are placed, was planned to increase the apical bone dimension and prevent an apical fenestration problem. The

retention plan was for fixed anterior and clear overlay retainers in both arches.

Appliances and Treatment Progress

Following extraction of the remaining 3rd molars, passive self-ligating brackets with standard torque were bonded on upper arch. The initial archwire was .014" CuNiTi with resin "*pearls*" bonded on the ends of the wire to prevent mucosal irritation. Open coil springs were placed bilaterally, between the central incisors and canines, to open spaces for restoration of the missing maxillary lateral incisors.

After one month of initial alignment and leveling in the upper arch, the lower arch was bonded, utilizing standard torque brackets in the mandibular anterior region, and fitted with a .014" CuNiTi archwire (*Fig. 11*). At the same appointment, another set of open coil springs were placed between the upper left 2nd premolar and 1st molar to open a space for restoration of the mesial caries on the 1st molar (*Fig. 12*).

Five months after the initiation of treatment, the maxillary archwire was replaced with a .018" NiTi wire. The maxillary midline diastema was closed, and Atherton's patches were noted distal the upper central incisors (*Fig. 13*). The latter transient gingival defects apparently contributed to insufficient

Fig. 10:
The initial clinical examination revealed the congenital absence of two maxillary lateral incisors and maxillary midline diastema.

Fig. 11:
Standard torque brackets were bonded on both upper and lower incisors. Open coil springs were placed bilaterally between the central incisors and lateral incisors to open spaces for restoration of the missing maxillary lateral incisors.

Fig. 12:
Other open coil springs were placed between the upper left 2nd premolar and 1st molar to open a space for restoration of the mesial caries on the 1st molar (circle).

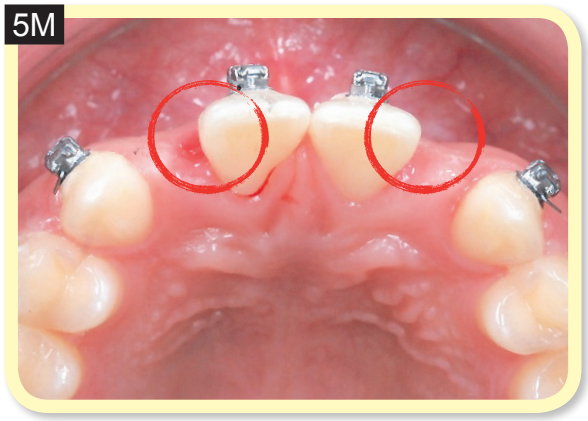
papillae between the central incisors and the implants.

In the 6th month of treatment, archwire changes were .014x.025" CuNiTi in the upper arch and .018" NiTi in the lower. Drop in hooks were inserted into the brackets of the upper canines bilaterally. The patient was instructed to wear Class II early light short elastics (*Parrot 5/16, 2oz.*) bilaterally from the upper canines to the lower 1st molars to retract the upper anterior teeth and reduce the overjet.

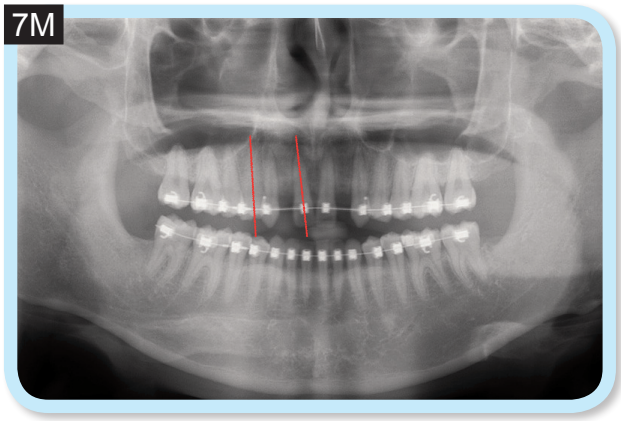
One month later, a progress panoramic radiograph was exposed to evaluate axial inclinations and reposition brackets on inadequately aligned teeth (*Fig. 14*). The brackets of the upper right central incisor and 1st premolar were repositioned as needed to achieve a precise finished alignment.

After 8 months of initial alignment and leveling in both arches, the archwire was changed .017x.025" low friction TMA in the lower arch and ligated with a figure-eight tie using a .012" SS. Drop in hooks were inserted into the brackets of the lower canines, and elastometric chains were attached from the lower canines to 2nd molars to retract the mandibular anterior segment (*Fig. 15*).

Two weeks later, a .017x.025" low friction TMA



■ *Fig. 13:*
The maxillary midline diastema was closed but an Atherton's patch (red circles) occurred along the edentulous ridge distal to the maxillary central incisors.



■ *Fig. 14:*
A progress panoramic radiograph was exposed to evaluate axial inclinations (red lines) and reposition brackets on inadequately aligned teeth.

■ *Fig. 15:*
The archwire was changed .017x.025 low friction TMA in the lower arch and ligated with a figure-eight tie using a 0.012" SS. Drop in hooks were inserted into the brackets of the lower canines, and elastometric chains were attached from the lower canines to 2nd molars to retract the mandibular anterior segment.

archwire was used on the maxillary arch. Two resin pontic teeth were bonded in the upper arch to replace the missing lateral incisors. The modified ovate pontic teeth were designed to eliminate or at least minimize the "black triangle" between the teeth and the interproximal papillae. This procedure precluded the need to augment the edentulous ridges in height (*Fig. 16*). Bilateral Parrot 5/16, 2oz Class II early light short elastics were used from the upper canines to the lower 1st molars.

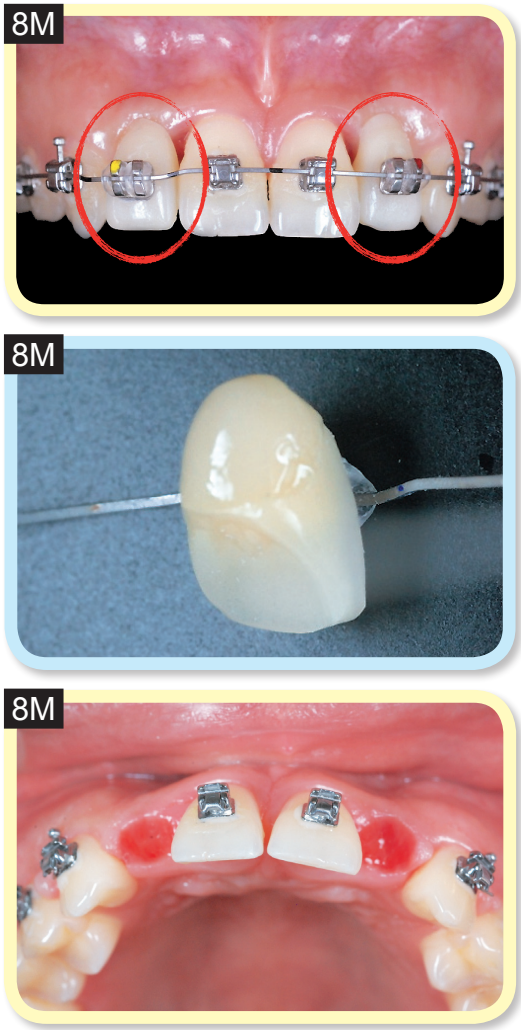


Fig. 16:
Two resin pontic teeth (red circles) were bonded on the upper arch to replace missing lateral incisors. The modified ovate pontic teeth were fabricated to eliminate or minimize of the "black triangle" between the teeth, so little or no ridge augmentation was required prior to the final restoration.

One month later, Class II early light short elastics were progressed to heavier elastics (*Fox 1/4, 3.5oz.*) only on the right side, because of the upper midline had shifted to the left (*Fig. 17*). At the same appointment, the present patient complained about a painful sensation over his TMJ area, which might have been caused by occlusal interferences during the orthodontic treatment. Mild analgesia medication helped to relieve the patient's discomfort.

In the 11th month, a 2mm overjet of the anterior segment was noticed. E-A bone screws (*2x12mm*

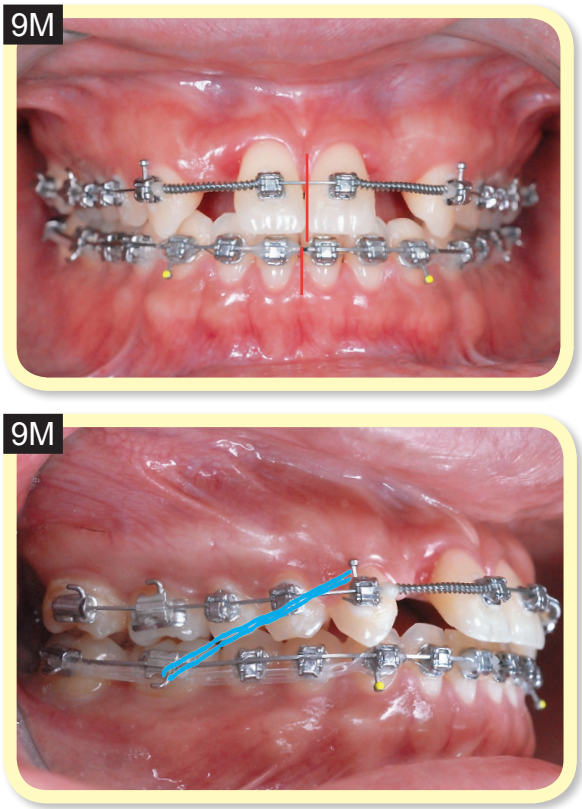
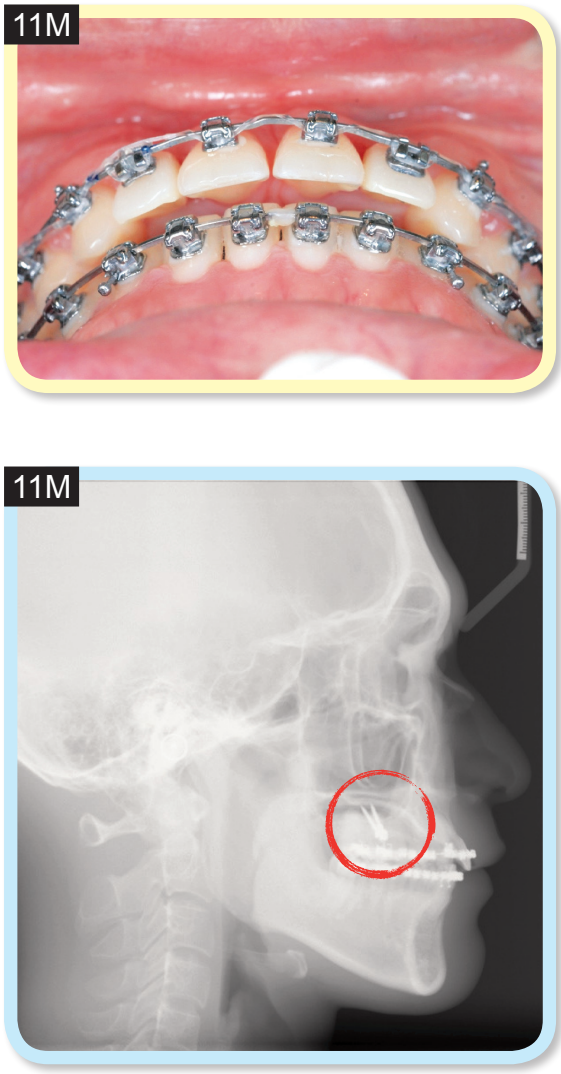


Fig. 17:
The Class II early light short elastics (Fox 1/4, 3.5oz.) were used only on the right side because the upper midline had shifted to the left.

OrthoBoneScrew®) were implanted bilaterally in the infrazygomatic crests (*Fig. 18*). Class II early light short elastics (*Fox 1/4, 3.5oz*) were used bilaterally from the upper canines to the lower 1st molars to retract the upper anterior teeth and to continue reduce the overjet.



■ *Fig. 18:*
A 2mm overjet of the anterior segment was noticed. E-A bone screws (2x12mm OrthoBoneScrew®) were implanted bilaterally in the infrazygomatic crests (red circle).

Implant Placement

A preoperative CT scan was used to evaluate the alveolar bone volume (*Fig. 19*). The spaces were 6mm in width on the right side and 6.5mm in width on the left side. Temp-Bond® (*Kerr Corporation, Orange, California*) was cemented on the two resin pontic teeth surfaces to simulate the future prosthesis position. Radiographic slices from the CT scan showed the alveolar process was intact at the crest and was ~1 mm thick along the facial surface. Following the 2B-3D rule, the implant was inserted virtually into a slice of the CT scan to confirm the appropriate diameter and length of the fixture, as well as to be consistent with the ideal prosthetic position of the implant-supported crown.

The angulation and location of the fixture were duplicated on the cast, and a surgical stent was prepared [2] (*Fig. 20*) to facilitate precise implant placement in three dimensions. The implant fixtures were positioned 3mm below the future crown margin, with a distance of at least 1.5mm from the adjacent teeth. Since there was insufficient bone volume on the apical third of the alveolar bone on both sides, simultaneous maxillary bone grafting and implant placement was indicated.

A crestal incision was performed at the palatal line angle of the edentulous space with a No.15c scalpel. Sulcular incisions were made on the buccal and palatal sides of the adjacent teeth for flap reflection. After exposing the bone with full-thickness flaps, the buccal-palatal width of the implant site was measured with the dental calipers. The mesial-distal width and depth was measured with a periodontal probe (*Fig. 21*).

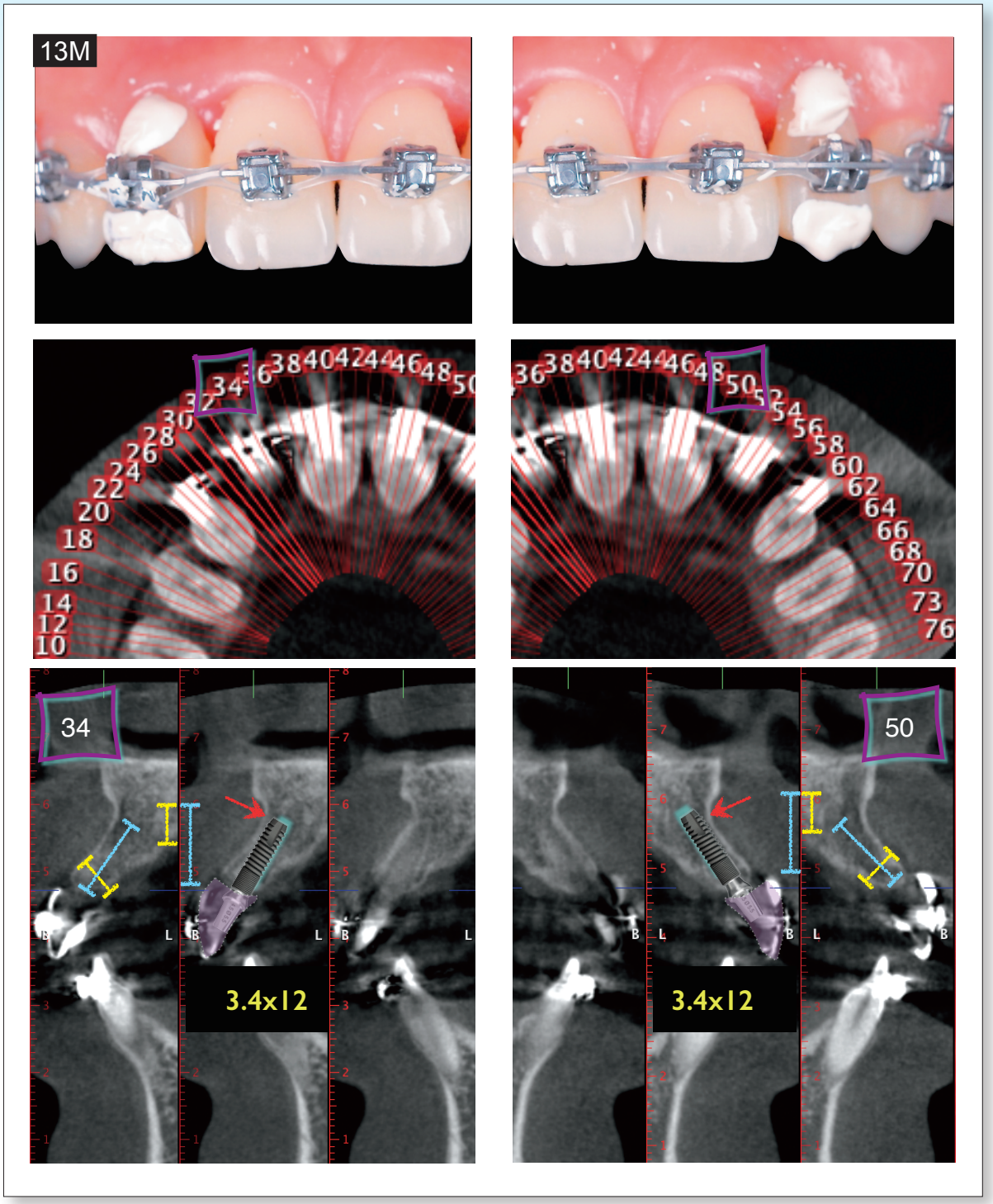


Fig. 19:

A preoperative CT scan was used to evaluate alveolar bone volume. There was insufficient bone volume on the apical third of both edentulous spaces, so simultaneous maxillary bone grafting and implant placement was indicated. Temp-Bond® (Kerr Corporation, Orange, California) was cemented on the two resin pontic teeth surfaces to simulate the future prosthesis position. Radiographic slices from the CT scan (No.34 and No.50) showed the alveolar process was intact at the crest and was ~1 mm thick along the facial surface.

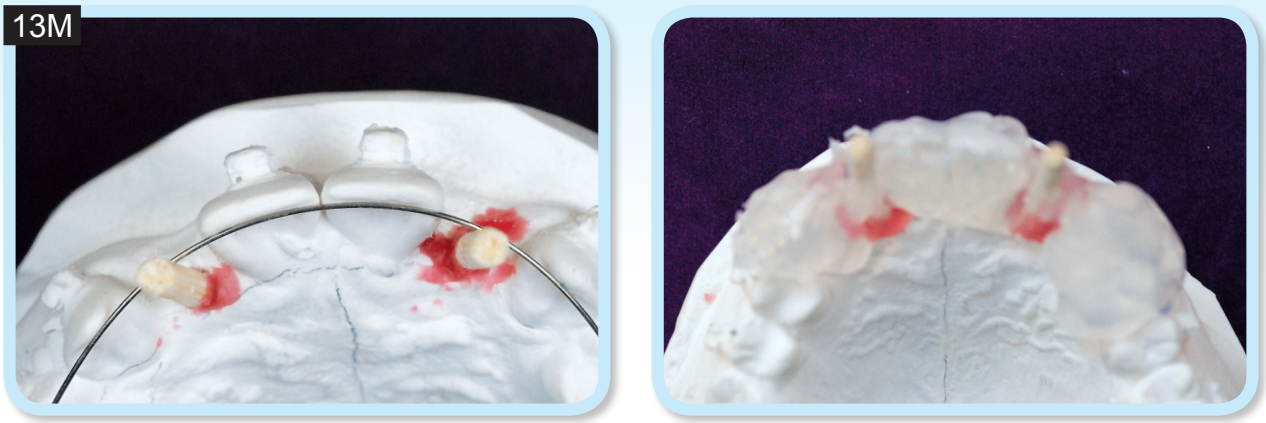


Fig. 20:
A surgical stent was fabricated to guide the path for the osteotomy burs and the archwire helped confirm that the proposed implant position follows the 2B-3D rule.

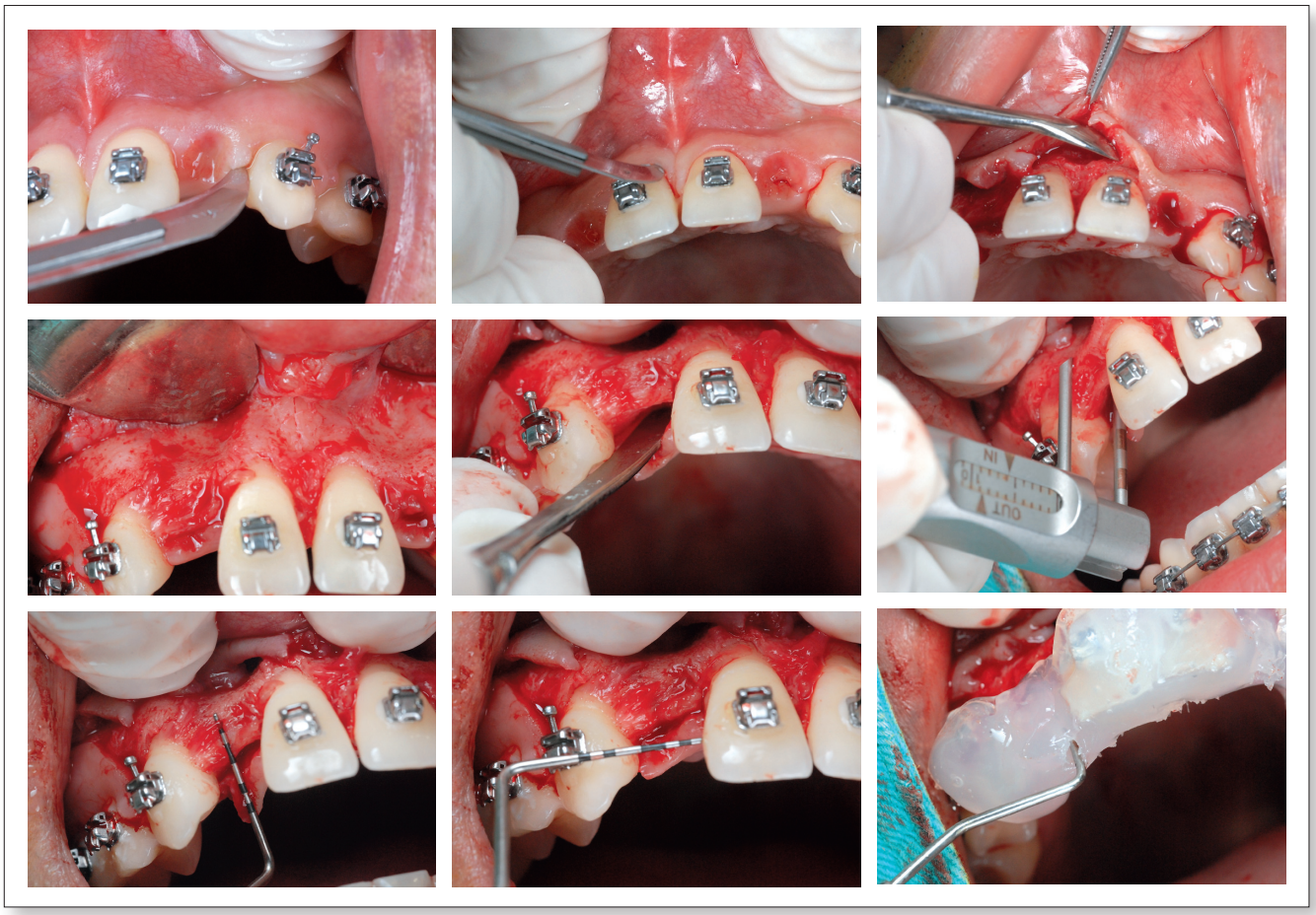


Fig. 21:
A crestal incision was performed at the palatal line angle with a No.15c scalpel. Sulcular incisions were made on the buccal and palatal sides of the adjacent teeth for flap reflection. After exposing the bone with full-thickness flaps, the buccal-palatal width was measured with dental calipers. The mesial-distal width as well as the depth of the osteotomy was measured with a periodontal probe.

The surgical stent, fitted to the teeth, served as a guide for the first lancer drill to initiate the osteotomy. A surgical guide pin was placed in each osteotomy and the occlusal view revealed the location of the further fixtures was expected to follow the arch form (*Fig. 22*). Consistent with the desired position for the final prostheses, the path of the fixture insertion was carefully prepared step-by-step with the surgical burs. Before implant placement, bilateral apical fenestrations of the labial bone were noticed. The fixtures, 3.4mm in diameter and 12mm in length, were inserted bilaterally and closing screws (*healing caps*) were placed. Subsequently, bone grafting procedures were performed to correct the apical fenestrations.

Autogenous bone grafts were harvested from the anterior nasal spine and lower piriform aperture by using a bone chisel and a bone scraper. A buccal-releasing incision was made at the distofacial line angle of the left maxillary canine to the right maxillary canine for increasing the flap reflation. The bone grafting material (*Bio-Oss®, Geistlich Biomaterials, Princeton, NJ*) and anterior nasal spine

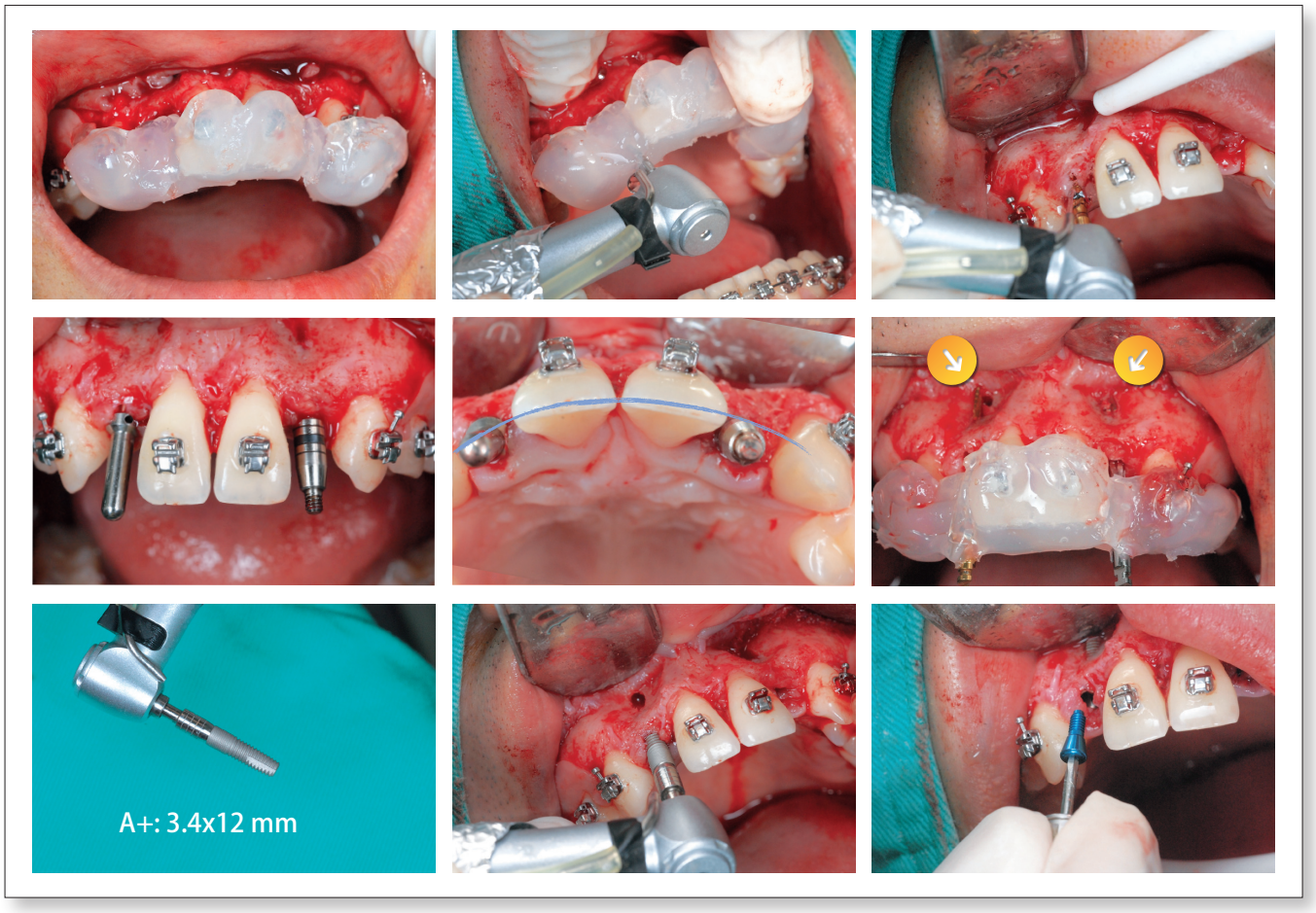


Fig. 22:
The surgical stent was fitted to guide the first lancer drill for the initial osteotomy. Before implant placement, the apical fenestrations of the labial bone were noticed (arrows). The fixtures, 3.4mm in diameter and 12mm in length, were inserted bilaterally and closing screws were placed.

chips mixed with whole blood were used to cover the apical fenestrations. A collagen membrane (*Bio-Gide®, Geistlich Biomaterials , Princeton, NJ*) was positioned over the bone grafting material. The soft tissue flap was repositioned and closed with interrupted 4-0 Gore-Tex® sutures (*W. L. Gore & Associates, Flagstaff, AZ*). The archwire and the resin pontic teeth were repositioned to maintain the space (*Fig. 23*). Comparison and pre-op and post-op periapical radiographs (*Fig. 24*) indicated the implants may be too superficial.

Fig. 23:
The fenestration areas (arrows) were filled with the bone grafting material (Bio-Oss® , Geistlich Biomaterials) and anterior nasal spine chips mixed with whole blood . A collagen membrane (Bio-Gide® , Geistlich Biomaterials) was positioned over the bone grafting material. The flap was repositioned and closed with interrupted 4-0 Gore-Tex sutures. The archwire and the resin pontic teeth were repositioned to maintain the space.

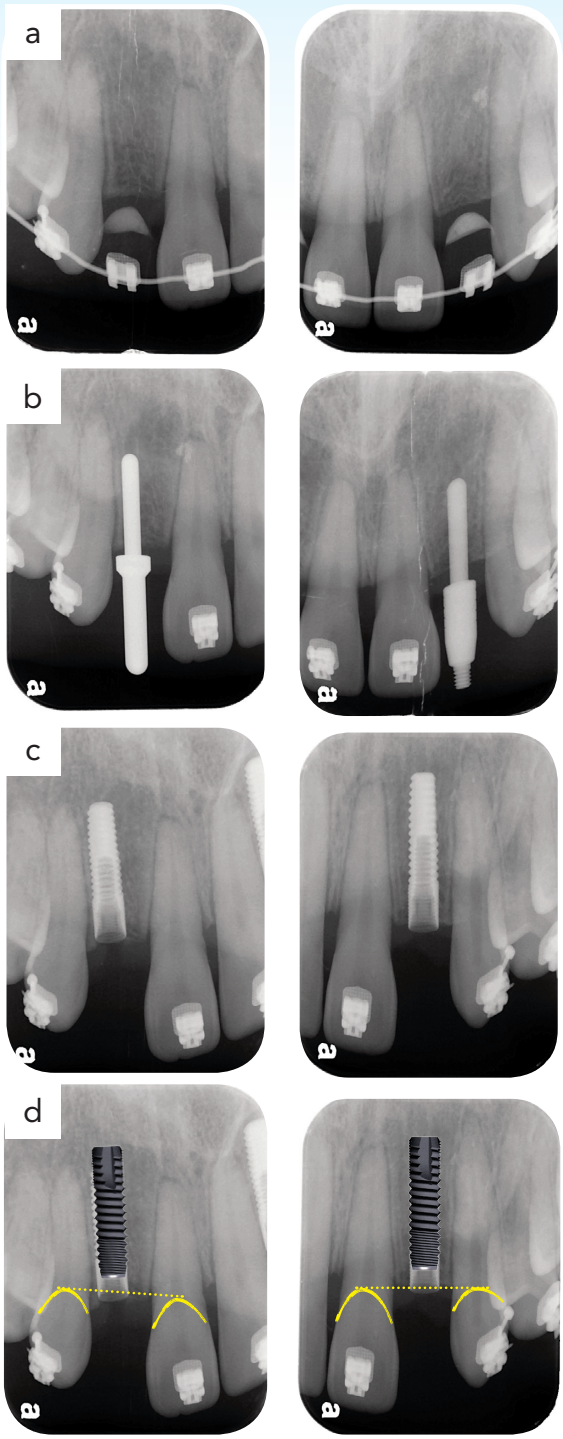


Fig. 24:
Serial periapical X-rays showing pre-operation and post-operation of implants.

Three weeks after the implants were placed, the sutures were removed. Orthodontics treatment was initiated with Class II elastics (*Fox 1/4, 3.5oz.*) bilaterally from the upper canines to the lower 1st and 2nd molars to retract the maxillary anterior segment to reduce the overjet.

After a three month healing period, exposure of the cover screw over the upper left lateral incisor was noticed (*Fig. 25*), suggesting the implants were placed too superficial to achieve an ideal gingival contour (*Fig. 26*). The pre-op and post-op series of

Fig. 25:
Notice the exposure of the cover screw over the upper left lateral incisor.

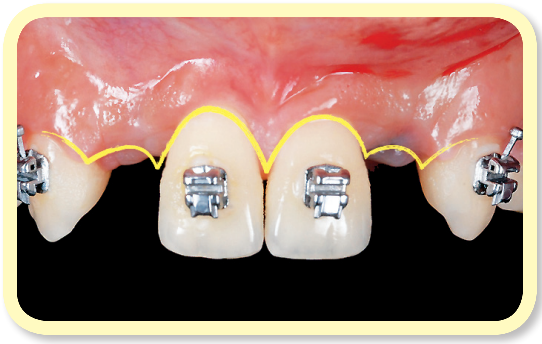


Fig. 26:
The gingival margins of the central incisors are normally at the same level or slightly lower than those of the canines, while the gingival margins of the lateral incisors are lower than those of the central incisors.

periapical X-rays (*Fig. 24*) revealed: 1. spaces of the congenital missing lateral incisors had been created, 2. surgical guide pins were placed to assess the orientation of the osteotomies, 3. post-operative periapical radiographs show the implants in position, and 4. evaluation of each implant relative to axial inclination and cementoenamel junction (*CEJ*) of adjacent teeth showed that the implants were ~2mm too occlusal.

Ideally, an implant should be placed ~0.5 mm below the osseous crest, and 1-2 mm below the facial CEJ of the adjacent teeth (*Fig. 24*) to achieve a more natural contour of the gingival margins (*Fig. 26*).[3] Treatment options to correct the problem were:

1. repositioning of the implants, or
2. soft tissue management of the lateral incisors.

To optimize esthetics with the most predictable procedure, a second stage of surgery was performed to position the implants ~2mm deeper into the alveolar process. The cover screws were removed with a screw driver, and the fixtures were extracted by reversing the ratchet wrench to fracture the initial osseointegration at the implant interface. An implant depth gauge was used to check the depth of the socket (*Fig. 27*).

Upon the placement of an implant into a surgical site, there is a cascade of molecular and cellular processes that provide for osteogenic cell differentiation and new bone growth and along the biomaterial surface.[5] To insure an ideal healing response, the previous fixtures were not used again. Following the manufacturer's recommended drilling and insertion protocol, the twist drill Ø 3.2mm

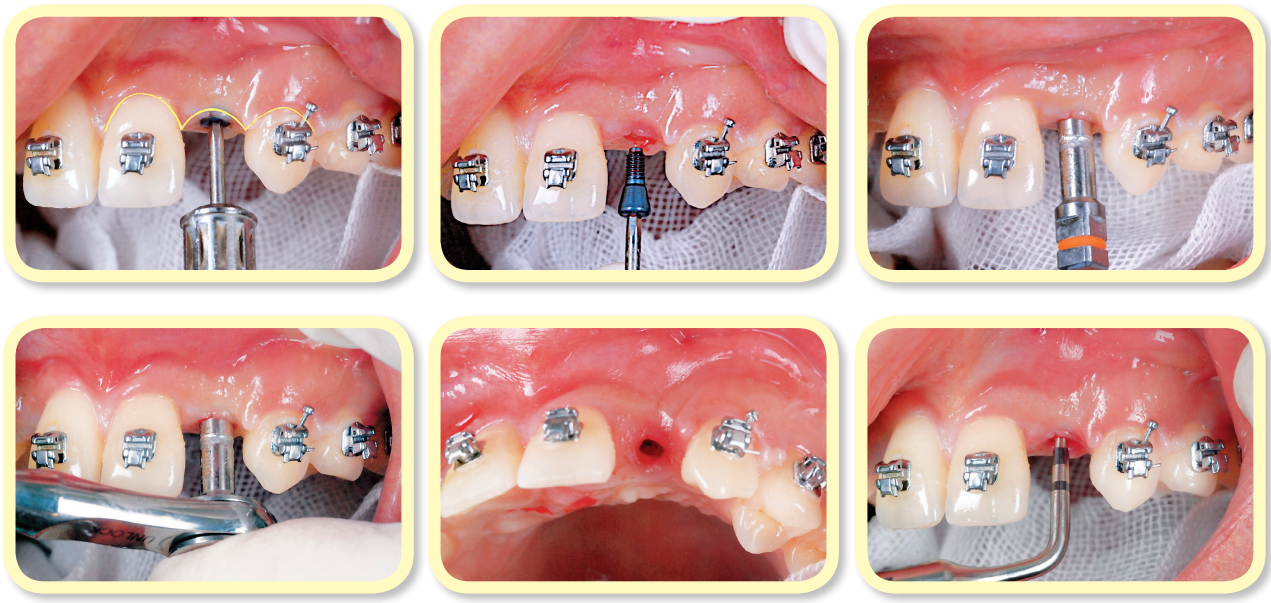


Fig. 27:
The cover screws were removed by using a screw driver and the fixtures were reversed by using a ratchet. After osseointegration was broken, the fixtures were removed from the sockets. An implant depth gauge was used to check the depth of the implant site.

was used to drill each implant site 2mm deeper (*Fig. 28*), and a new fixture (*3.5x11mm OsseoSpeed™ TX, Dentsply International, York, PA*) was installed. According the 2B-3D rule,[2] a 3mm biological width of soft tissue is required, meaning the guide pin should submerge into the soft tissue until the 2nd white band just disappeared (*Fig. 29*). An implant depth gauge was used to check the depth of the fixtures relative to the gingival margin was about 4mm. Overall, the clinical procedures were identical for the left (*Fig. 29*) and right (*Fig. 30*) sides. Flared healing abutments (*Ø4.5-H4*) were used to help form the peri-implant mucosal contour to conform to the cervical contour of the restoration. The distal separated papilla of the right implant was closed with an interrupted 5-0 Chromic Gut suture. From the occlusal view, the healing abutments were in an optimal position relative to the arch form (*Fig. 31*).

Two resin pontic lateral incisors were mounted on an .017x.025" low friction maxillary TMA archwire and trimmed to simulate a harmonious gingival margin. This optimal relationship is more predictable for the future abutment and prosthesis when the implant is positioned according to the 2B-3D rule. Following the revision surgeries, post-operative periapical X-rays confirmed that the implants were in the correct positions. Radiographic slices from

Fig. 28:
The previous fixtures were not used again. Following the manufacturer's recommended drilling and insertion protocol, the twist Drill Ø 3.2 was used to drill the implant site 2 mm deeper.

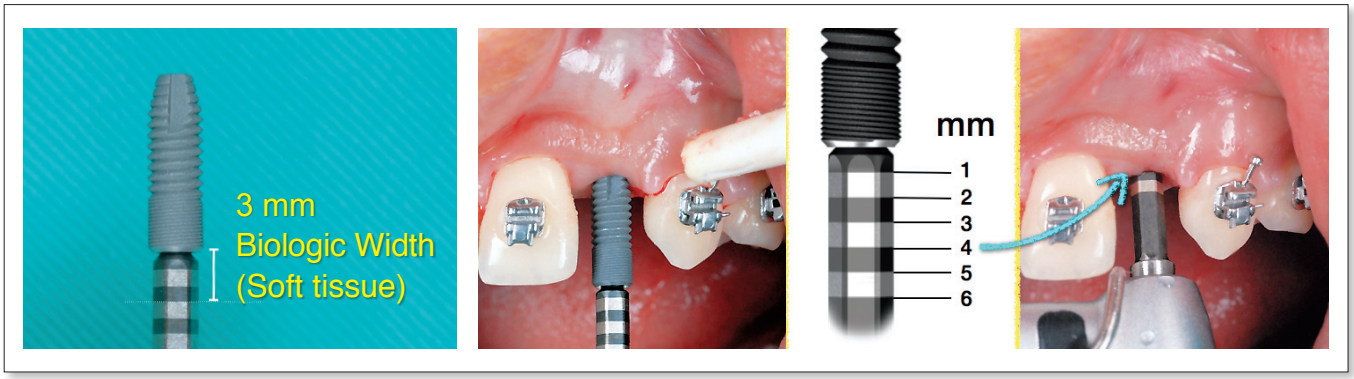


Fig. 29:
A brand new implant fixture (3.5x11mm OsseoSpeed™ ,TX) was installed. Following the 2B-3D rule, the 3mm biological width of soft tissue should remain, meaning the guide pin should be submerged into the soft tissue until the 2nd white band disappeared.

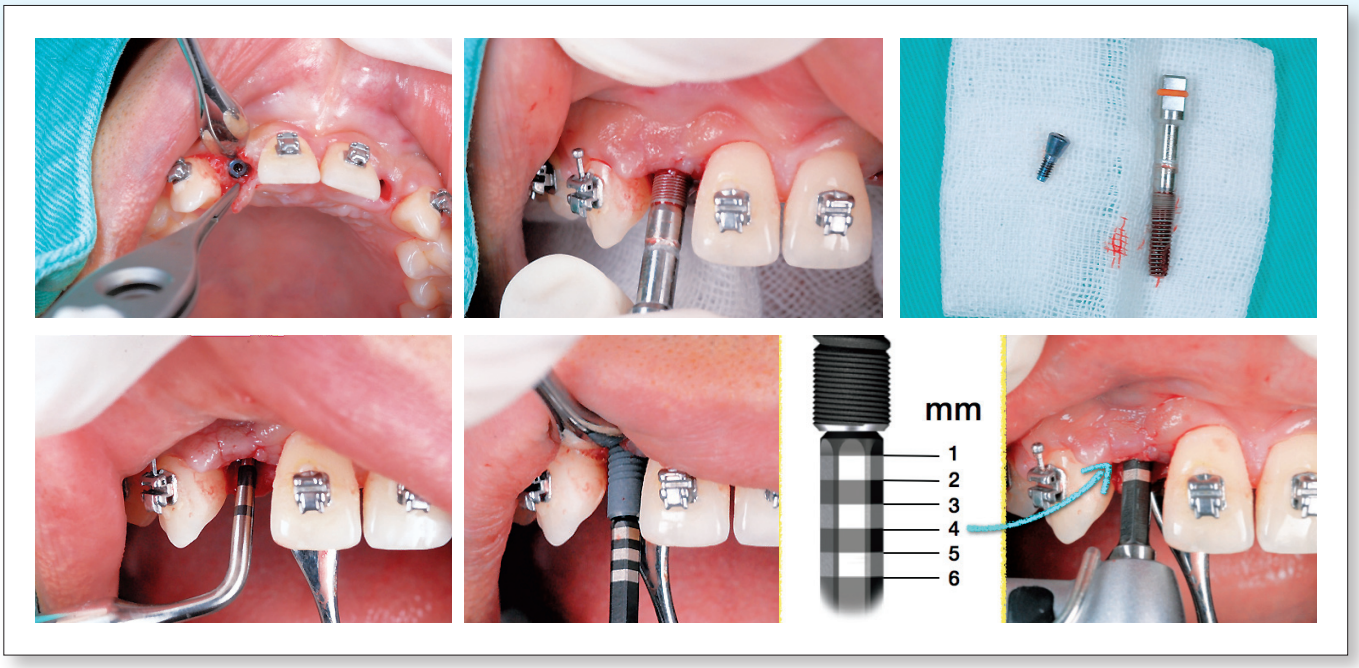


Fig. 30: After finishing the left side implant installation, the right implant was installed following the same procedure.

Fig. 31:

An implant depth gauge was used to check the depth of the fixtures to the gingival margin (GM); it was about 4mm. The flared healing abutments(Ø4.5-H4) were used to help form a peri-implant mucosal contour to approximate the restoration cervical contour. The distal separated papilla of the right implant was closed with an interrupted 5-0 Chromic Gut suture. From the occlusal view, the healing abutments were placed within the arch form.

the CT scan showed that the alveolar process supplemented with the bone graft material fully covered the implants in three dimensions (*Fig. 32*).

Orthodontic Finishing Stage

In the 20th month, the alignment of the dentition was almost complete, but the buccal flaring of the upper right posterior segment was noted. The .017x.025" low friction TMA archwire was adjusted to deliver -20° of torque in the right posterior maxillary segment to adjust the angulation of the posterior teeth (*Fig. 33*).

In the 24th month of orthodontic treatment, which included 10 months for the two implant surgeries with post-op healing phases, all brackets were removed. To prevent relapse of the 4mm maxillary midline diastema, elastics were used to completely close the space between the upper two central incisors, and a multi-stranded stainless steel wire was bonded on the palatal surface to serve to achieve long-term retention (*Fig. 34*). Clear overlay retainers were delivered for both arches, and the patient was scheduled for fabrication of the implant prosthesis (*Fig. 35*).

Implant Prosthesis Fabrication

One month later, a marker pen was used to

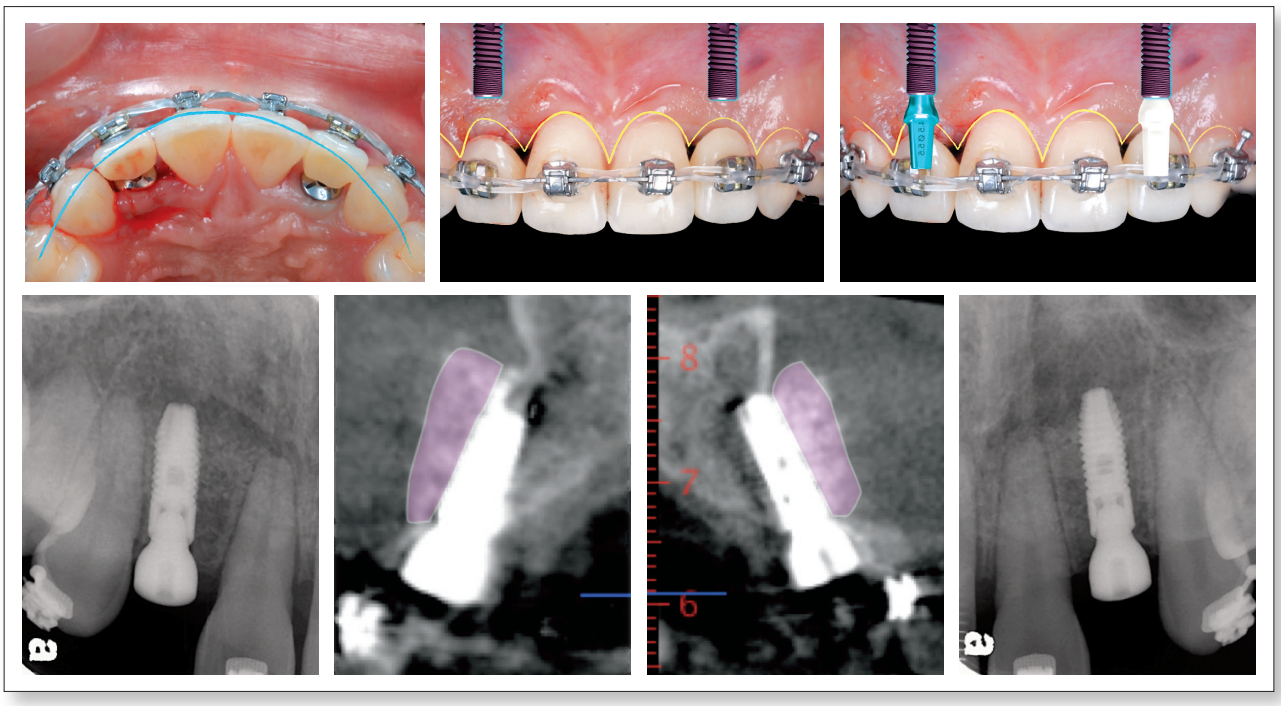


Fig. 32:
The .017x.025 low friction TMA maxillary archwire is fitted with two resin pontic teeth. The harmonious gingival margin helps predict the desired abutment contour according to the 2B-3D rule. Post-operative periapical X-rays show that the implants are inserted into the appropriate positions. Radiographic slices from the CT scan show that the alveolar process is fully covered with the bone graft material.

Fig. 33:
Buccal flaring out of the upper right posterior teeth was noticed. The .017x.025 low friction TMA maxillary archwire was adjusted with -20° in the affected area to correct the problem.

Fig. 34:
Preventing relapse of the maxillary midline diastema required definitive space closure with elastics followed the bonding of a multi-strand stainless steel wire on the palatal surface of the incisors to provide long-term retention.

Fig. 35: Post-orthodontic treatment intraoral photographs.

delineate the desired tooth proportion of the upper right central incisor and the portion that was subsequently removed with a diamond fissure bur (*Fig. 36*). Following The Abutment Decision Tree® copyrighted in 2009 by Dr. Baldwin Marchack (*http://simpletooth.com*), the stock abutments (*ZirDesign™ Dentsply, Waltham, MA*) were chosen. The gingiva formers were removed and the ZirDesign™ abutments (*Ø4.5mm and 3mm cuff height*) were fitting. The soft-tissue margin, the desired vertical dimension and the mesial-distal width were outlined on the abutments with a fine-tip permanent marker. The ZirDesign™ abutments were positioned on the implants, and secured with light finger force (*Fig. 37*).

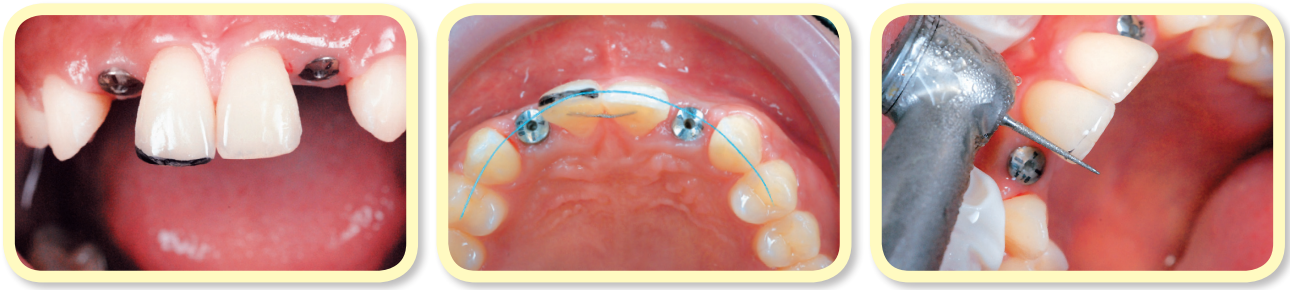


Fig. 36:
A marker pen was used to delineate the desired tooth proportion of the upper right central incisor and the portion that was subsequently removed with a diamond fissure bur.

Fig. 37:
The gingiva formers were removed and the ZirDesignTM abutments (Ø4.5mm and 3mm cuff height) were fitted. The soft-tissue margin, the correct vertical dimension and the mesial-distal width were outlined on the abutment with a fine-tip permanent marker. ZirDesignTM abutments were positioned in the implants and secured with the abutment screws by tightening with light finger force.

The abutments were then modified with a diamond bur mounted on a high speed handpiece to accommodate occlusal function while maintaining a desirable soft tissue contour. The post height of the abutments were reduced to provide 2 mm of occlusal clearance for the fabrication of the porcelain crowns.

To prevent micro-cracks during grinding, excessive heat development with the bur was avoided using high volume water cooling during the grinding procedure (*Fig. 38*). The buccal thickness of the abutments was reduced as needed.

Before taking an impression, the abutment screws were torqued to 20-N-cm with a screw driver and a torque ratchet (*Fig. 39*). Double gingival retraction cords were packed into the peri-implant sulcus, and a direct impression was obtained with polyvinyl siloxane (*Fig. 40*), which was then poured with type IV dental stone.

The post-treatment periapical X-rays showed that the ZirDesign™ abutments were in the desired position. The provisional restorations were fitted, carefully inspected intraorally, and polished with a rag wheel to a smooth, semi glossy finish (*Fig. 41*).

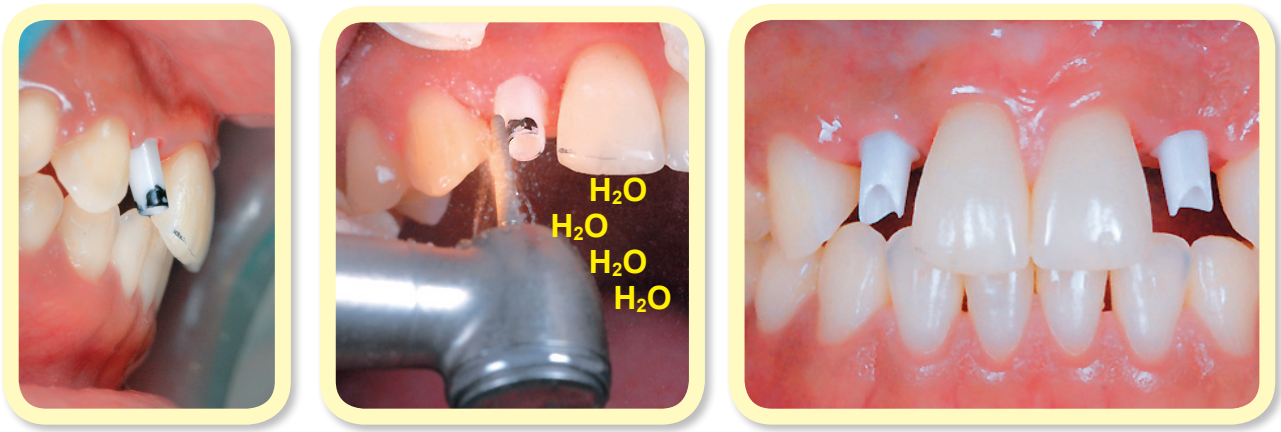


Fig. 38:
The post height of the abutments were reduced to provide two mm of occlusal clearance for the fabrication of the porcelain crowns. Excessive heat development was controlled with water cooling (H_2O) during the grinding process to prevent micro-cracks.

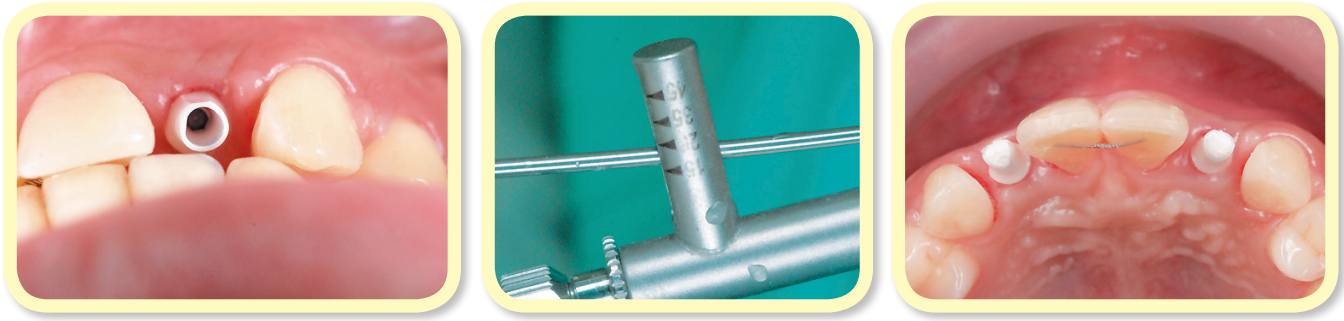


Fig. 39: The abutment screws were torqued to 20-N-cm with a screw driver and a torque ratchet.

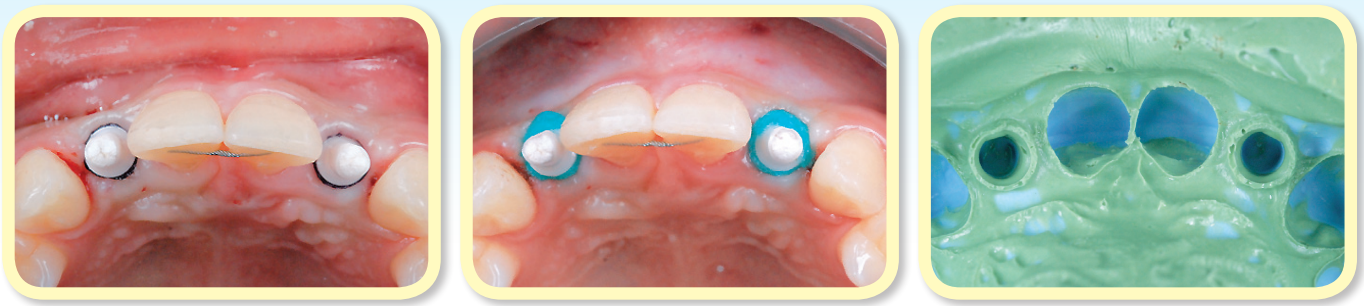


Fig. 40:
Two gingival retraction cords were positioned in the peri-implant sulcus with a packing instrument. A direct impression was obtained with polyvinyl siloxane.

Fig. 41:
The post-treatment periapical X-rays showed that the ZirDesignTM abutments were inserted in the right positions. The provisional restorations were fitted, carefully inspected intraorally, and polished with a rag wheel to a smooth, semi glossy surface.

Two weeks later, the full ceramic crowns were fitted, and the abutments were carefully inspected. The permanent crowns showed some occlusal and contour discrepancies that required adjustment. The porcelain margin was modified to achieve adequate marginal seating and esthetics, as well as to develop a dental profile that was consistent with the adjacent teeth (*Fig. 42*). The desired morphology was carefully adjusted to achieve a natural appearance. An undesirable tooth shape may contribute to a blunted papilla (*black triangle*), but it can at least be partially corrected with restorative procedures. Prosthetic reshaping of dental contours can lengthen the contact area apically, displacing the soft tissue labially so that there is at least partially filling the black triangle. After completion of the final prosthesis, appropriate tightness of the contact area was confirmed with articulating paper. Following clinical adjustment and verification of the fit and occlusion, cotton balls were placed over the abutment screws to prevent them being sealed with the restorative composite. The permanent crowns were completed and luted into place extra-orally with permanent cement (*Maxcem Elite® Kerr*

Corporation, Orange CA). After removing the superfluous cement, the full ceramic crowns were seated intraorally and the luting cement was light cured (*Fig. 42*).

Fig. 42:
Final subtle adjustments for the permanent restoration achieved a light occlusal contact, and the appearance of the restoration that was in harmony with the adjacent natural dentition.

Results Achieved

Maxilla (*all three planes*):

- A - P: *Protruded*
- Vertical: *Maintained*
- Transverse: *Maintained*

Mandible (*all three planes*):

- A - P: *Maintained*
- Vertical: *Maintained*
- Transverse: *Maintained*

Maxillary Dentition

- A - P: *Maintained*
- Vertical: *Maintained*
- Intermolar Width: *Maintained*
- Intercanine Width: *Maintained*
- Buccolingual Inclination: *Maintained*

Mandibular Dentition

- A - P: *Maintained*
- Vertical: *Maintained*
- Intermolar Width: *Maintained*
- Intercanine Width: *Maintained*
- Buccolingual Inclination: *Maintained*

Facial Esthetics: The acceptable profile has been maintained

Retention

The maxillary fixed retainer was bonded on the two central incisors. Upper and lower clear overlays were delivered, with the instructions to wear the retainers full time for the first 6 months and nights only thereafter. The patient was trained in home care as well as in maintenance of the retainers.

Final Evaluation of Treatment

The final ABO CRE score[1] was 7 points. The major residual discrepancies were: alignment / rotation 3 points, overjet 2 points, and root angulation 2 points. The patient's principal concern was addressed by opening space and restoring the congenitally missing maxillary lateral incisors with implant-supported prostheses. Smile esthetics were substantially improved by closing the diastema, establishing optimal incisal exposure, and providing for an optimal gingival display. The occlusal function was improved by achieving optimal protrusive guidance and occlusal contact in centric occlusion. Overall, dental esthetics, smile dynamics and occlusal function were substantially improved. The patient was well satisfied with the result.

DISCUSSION

Congenital absence of one or more teeth (*hypodontia*) is the most common developmental dental anomaly in humans. Prevalence reportedly ranges from 2.3% to 10.1%. Silverman[6] reported that Werther and Rothberg in 1936 found 2.3% of 1,000 schoolchildren were missing 1 or 2 teeth, and maxillary lateral incisors were the most frequently missing teeth. However, more recent studies have indicated the prevalence of hypodontia is ~5%, with the maxillary lateral incisor being the second most commonly missing tooth. The mandibular second premolar was the most common.[6]

There are several treatment modalities available to correct missing maxillary lateral incisors. Each of the approaches has inherent advantages and disadvantages, but all should be considered when evaluating a specific patient. The two major treatment approaches are orthodontic space closure

and restoration with a fixed prosthesis or single-tooth implant.[7]

In considering canine substitution, there are several patient-specific dento-facial criteria that must be considered: degree of malocclusion, amount of crowding, facial profile, canine shape and color, lip level, and gingival contours.[8,9] A fixed prosthesis or single-tooth implant is usually indicated if any of the above criteria are not optimal. Patients with a missing permanent incisor(s) superimposed on a significant malocclusion should be managed with a comprehensive treatment plan that optimizes esthetics, function and long-term dental health.

Canine substitution may require extraction of a deciduous canine to facilitate movement of the permanent canines to contact the central incisor. Lateral incisor brackets on the canines help correct the facial surface to simulate a lateral incisor. Furthermore, it may be necessary to correct the contour of the incisor edge of the canine, and then position the bracket relative to the gingival contour, to achieve optimal soft tissue esthetics.

Class I skeletal and dental relationships, with no significant crowding or dento-alveolar protrusion is usually a good indication for implant-supported prostheses to restore the missing canines. As the permanent canine is moved distally to create space for a prosthesis or implant, an optimal alveolar ridge is created, but it is important to correct the maxillary midline and optimize the smile-line to achieve optimal esthetics.

The first step in opening space for a tooth-supported prosthesis or single-tooth implant is to determine how much space is needed for an optimal outcome. There are several methods that can be used: 1. according to the "golden proportion" [10] the lateral incisor should have a ratio of 1:1.618 relative to the dental incisor, 2. use the contralateral lateral incisor as a reference[11] if it has normal shape and proportions, 3. perform a Bolton analysis,[12] and/or construct a diagnostic wax set-up. Generally, the maxillary lateral incisor width ranges from 5 to 7 mm, but implant placement surgery placement is difficult if the space is <7mm. It is often wise to open the space to 7mm, place the implant, and then close space as needed to achieve the correct proportion with the adjacent central incisor.

There are three types of tooth-supported, fixed restorations that are commonly considered: 1. resin-bonded to one or more teeth, 2. cantilevered from the canine or central incisor, and 3. conventional full-coverage prosthesis. The primary consideration among these options is conservation of tooth structure. Ideally, the treatment choice is the least invasive option that satisfies both the esthetic and functional objectives for the patient.

Currently, the single-unit implant-supported prosthesis is the most common treatment alternative for the replacement of a missing lateral incisor. For implant treatment to be successful, there must be an adequate intercoronal and interradicular space, consistent with appropriate root angulation of the adjacent teeth. The adjacent teeth should be stable and their apical areas remote from the planned implant site.[13]

Dental implant-supported prostheses conserve adjacent tooth structure, and have excellent success and survival rates. However, they are expensive,

and multiple procedures are required, including at least one surgery. The quantity and quality of bone must be adequate in the implant site or the patient will need a separate surgical procedure for ridge augmentation. There should be a minimum of 10mm of bone height and a minimum of 6.0mm of bone width in the proposed implant site. A cone beam CT radiograph is essential for assessing available bone prior to implant surgery.

A diastema is an area of interdental space between two or more teeth, and the problem is most frequent between the maxillary central incisors. The problem may result from a tooth size discrepancy, missing teeth or a hypertrophic labial frenum. It may be secondary to a malocclusion such as overjet or incisor protrusion.[14] A diastema due to congenitally absent maxillary lateral incisors can be managed with canine substitution or opening space for a prosthesis. Orthodontic space closure is subject to interdental spacing reappearing after treatment. This problem is best managed by bonding a permanent retainer on the lingual surfaces of the affected teeth.

Patients with a hypertrophic labial frenum may require a surgical consult for a frenectomy. This procedure involves sectioning the frenum and repositioning it to prevent the diastema from reopening.

Atherton's patch[15] is a gingival depression that occurs when space between teeth is opened rapidly because the interproximal papilla remains adjacent to the tooth that is not being moved. The deterioration of the interproximal papilla is an esthetic concern for implant-supported prostheses. Kokich[16] proposed an advancement flap to create a more natural papilla adjacent to an implant placed in an edentulous space compromised with an Atherton's patch. The technique consisted of placing a 2 mm healing abutment following implant placement via a submerged technique. Kokich[16] also pointed out that the age of the patient is an important factor for management of Atherton's patch. Natural reformation of the papilla is predictable in young patients with growth potential, but the same problem in adults adults may fail to heal and restore the papilla.

The present patient complained about a painful sensation over the temporomandibular joint as the maligned teeth were corrected. This problem self-corrected once the dentition was aligned.

The potential for developing periodontal fenestrations and dehiscences must be carefully evaluated. Exposure of alveolar bone during periodontal and oral surgery procedures may reveal fenestrations and dehiscences that can complicate the outcome during the healing process.[17] The maxillary first molar, mandibular first molar, as well as the mandibular canine and first bicuspid area are high risk zones for bone deficiencies and must be carefully evaluated during and after oral surgery procedures. Fenestrations and dehiscences may occur in multiple areas of the same patient and bone augmentation may be necessary before or during implant placement particularly if the procedure is in an area where a tooth was extracted.[18]

Sufficient alveolar bone volume and favorable architecture of the alveolar ridge are essential for obtaining ideal function and esthetics following implant therapy.[19] Grafts are generally classified

according to their original source as follows: 1. autograft: a. oral: mandible symphysis, retromolar area, maxillary tuberosity. b. extraoral: calvarium, iliac, tibia, clavicle, scapula. 2. allograft: freeze-dried bone allograft (*FDBA*), demineralized freeze-dried bone allograft (*DFDBA*), for example: Puros®(*Zimmer Dental Inc., Carlsbad, CA*), ProSpace® (*B. Braun Medical, Bethlehem, Pennsylvania*), DBX Putty® (*Densply, York, PA*). 3. xenograft: anorganic bovine bone, coralline hydroxylapatite (*HA*), for example: Bio-Oss®, Geistlich Biomaterials, Princeton, NJ. 4. alloplasts: low density hydroxyapatite (*HA*), beta-tricalcium phosphate, dense HA, bioglass, polymer, calcium sulfate, for example: Bone Ceramic® (*Straumann, Basel, Switzerland*). Guided bone regeneration (*GBR*) uses a barrier membrane over an osseous defect to prevent soft tissue from occupying the bone defect and preventing normal bone healing.

A predictable intraoral GBR approach was developed in the late 1980s and early 1990s.[20] It has become a predictable surgical method for enhancing new bone formation in peri-implant bone deficiencies and alveolar ridge defects. The technique can be applied to extraction socket defects, horizontal and vertical ridge augmentation sites, and is also helpful for correction of osseous dehiscence and fenestration defects adjacent to implants. Factors that have been suggested that may inhibit bone healing with GBR: smoking, excessive swelling, passive flap tension, cortical penetration, morphology, length and orientation of the defect, membrane fixation, and materials used. The method for using GBR to reduce the loss of ridge volume is well documented, but it requires a long healing period before the implant can be placed.[21]

Bone adaptation or integration of an implant is characterized by a series of biological reactions that start with bone turnover at the interface (*a process of localized necrosis*), followed by rapid repair. The wound healing response is guided by an activation of macrophages leading to tissue turnover and new osteoblast differentiation on the implant surface. Implant surface topography plays an important role in regulating biological factors that guide the development of the bone-implant interface (*Fig. 28*).[22] For this reason, endosseous implants must never be reused even in the same patient.

A modified ovate pontic has the following advantages: 1. excellent esthetics because it produces a correct emergence profile, 2. provides adequate function, 3. more convenient hygiene, 4. an effective seal preventing air or saliva leakage, 5. presents a natural contour of the free gingival margin and interdental papilla, 6. eliminates or minimizes "black triangles" between the teeth, and 7. little or no ridge augmentation is required prior to the final restoration (*Fig. 16*). [23]

Planning tooth contacts, connectors, and embrasures is important for restoring an appropriate smile. The connector (*also referred to as the interdental contact area*) is where the incisors and canines "*appear*" to touch. The contact point is greatest between the central incisors and tends to progress apically from the midline to the posterior dentition. The embrasures are the triangular space incisal to the contact area,

and they should become larger as the teeth progress posteriorly. The gingival shape of the mandibular incisors and the maxillary lateral incisors should exhibit a symmetrical half-oval or half-circular shape. The maxillary centrals and canines should exhibit a gingival shape that is more elliptical. Thus, the gingival zenith, the most apical point of the gingival tissue, is located distal to the longitudinal axis of the maxillary central incisors and canines. The gingival zenith of the maxillary lateral and mandibular incisors should coincide with their longitudinal axis. (*Figs. 32 and 42*).[24] The loss of papilla can lead to a cosmetic deformities called "*black triangle disease*" which may result in phonetic problems and lateral food impaction. Reconstruction of a lost interdental papilla is one of the most challenging and least predictable procedures. Abnormal tooth shape may contribute to a "*missing*" papilla, and appropriate restorative techniques may be used as a creeping procedure to displace soft tissue to simulate a new papilla. By a prosthetic reshaping of the contours of the teeth, the contact point may be lengthened and located more apically to reduce the embrasure to enhance coronal displacement of the interdental gingiva to simulate a papilla (*Fig. 42*).[25]

There are 3 keys for creating an esthetic anterior prosthesis:

1. Shade characterization
2. Shade data
3. Surface texture (*Fig. 43*).

The porcelain mix is created by mixing porcelain powder with liquid, and applying it to the crown with a paintbrush. Tissue paper is used to absorb any excess moisture. The pink colored porcelain turns more yellow to simulate dentine underneath the enamel of a natural tooth. A white porcelain mix turns into a light colored, transparent porcelain when fired, which replicates the natural appearance of enamel. The dental technician must increase the size of the crown because the porcelain shrinks slightly during firing. A photograph is used to adjust the shade of the porcelain, and layers are then built up to match the appearance as the patient's adjacent teeth. After firing, a bur is used to grind the porcelain into the desired shape to match the adjacent teeth. The curved surface of the tooth is smooth to match the other teeth, and it's size is adjusted as needed. A final furnace firing program

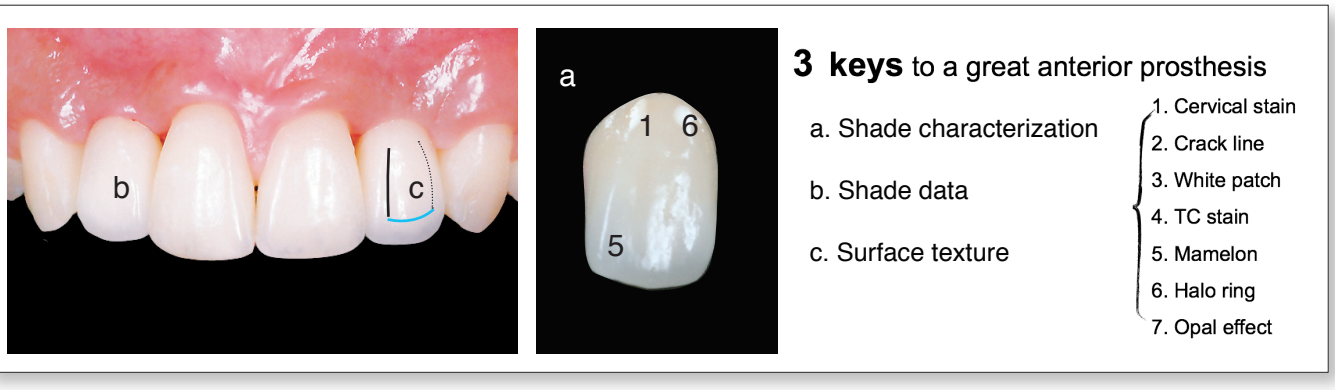


Fig. 43: 3 keys to a great anterior prosthesis including: 1. shade characterization, 2. shade data, 3. surface texture.

is used to glaze the crown and produce a shiny, natural finish.

A common technique to prepare for fixed prosthetic impressions is packing a cord in the gingival sulcus to control bleeding and assist in achieving good retraction of soft tissue before inserting the impression material. Packing a double retraction cord in the sulcus achieves better tissue displacement and results in a superior impression which facilitates a better result for the laboratory, dentist and patient. Packing two cords has distinct advantages over a single cord: 1. restoration margins are better defined and less likely to result in a deformed impression. 2. In a deep sulcus, using two cords helps prevent tissue from collapsing over the top of a single cord. Tissue collapse restricts access of the impression material to the restoration margins and can cause the material to tear (*Fig. 40*).[26]

In 2009, Dr. Baldwin Marchack (*http://simpletooth.com*) successfully copyrighted "*The Abutment Decision Tree®*" which includes flowcharts to simplify the decision making process when clinicians arrive at the restorative phase of a patient's implant treatment. "*The Abutment Decision Tree®*" focuses on principles and guidelines for selecting appropriate abutments and designing definitive prostheses for the single posterior or anterior implant, as well as for multiple implants to achieve optimal restorations. The presentation is of interest to both the experienced and novice practitioner, because it enhances the decision making which enables the restorative dentist to collaborate with the surgeon, and direct the laboratory technician relative to the design of each partially or fully edentulous implant procedure (*Fig. 44*).

ZirDesign™ is a two-piece component, fabricated in zirconia that is easily customized to provide an anatomically correct prosthetic solution with pristine esthetics. The color of the abutment offers a favorable base for creating outstanding esthetic porcelain work. ZirDesign™ works with all existing crown materials and the restoration can be luted with glass-ionomer or composite cement.

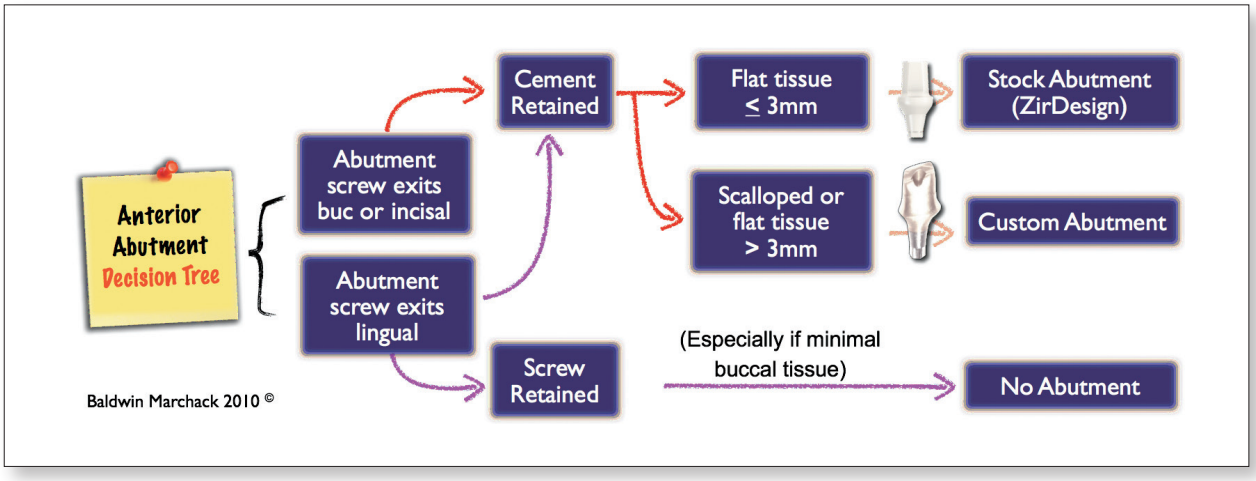


Fig. 44: "The Abutment Decision Tree®" copyrighted by Dr. Baldwin Marchack.

ZirDesign™ abutments can also be prepared by hand or secured in an Implant Replica. Note that water spray cooling is used to avoid creating micro-cracks due to overheating. Design the preparation with a shoulder or a chamfer to support an all-ceramic crown. Be sure to preserve rounded inner corners, and avoid sharp edges and corners to ensure a good fit between the abutment and the all-ceramic crown. Any inadvertent grinding below the final crown margin should be polished, preferably using a silicon rubber wheel with diamond paste. Cement the crown onto the abutment, and the permanent cementation can be performed with glass-ionomer or composite cement depending on the type of restoration. Zirconia cannot be etched. To bond it to the abutment, keep the surface rough to provide adequate mechanical retention.[27]

Healing abutments are the screws placed after second-stage surgery and before the prosthesis insertion. They are available in different lengths to project through the soft tissue into the oral cavity. They may be screwed directly into the fixture or in some systems, onto the abutment during second-stage surgery.

When esthetics is paramount, healing should be completed around the healing abutment to stabilize the gingival margin prior to crown fabrication. Healing abutments of appropriate length are then selected to ensure that the metal porcelain interface of the restoration is situated subgingivally (*Fig. 45*). [28]

Based on the biologic evidence, the 2B-3D rule is an ideal implant placement guide.[2] What is the 2B-3D rule? 2mm of buccal bone thickness should be preserved and the implant should be placed 3mm below the future prosthesis cervical margin. This 2B-3D rule is a practical guide, for both single implants or full mouth rehabilitation, to achieve ideal implant positions. When these conditions can not be satisfied at the time of implant placement, bone

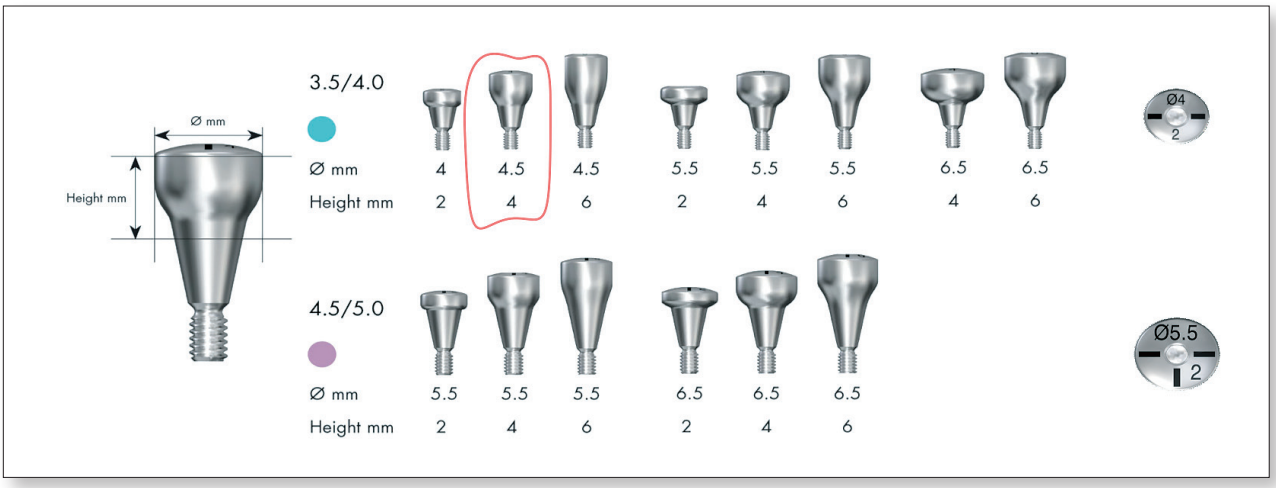


Fig. 45:
Healing abutments of appropriate length were selected to ensure that the metal porcelain interface of the restoration extends subgingivally.

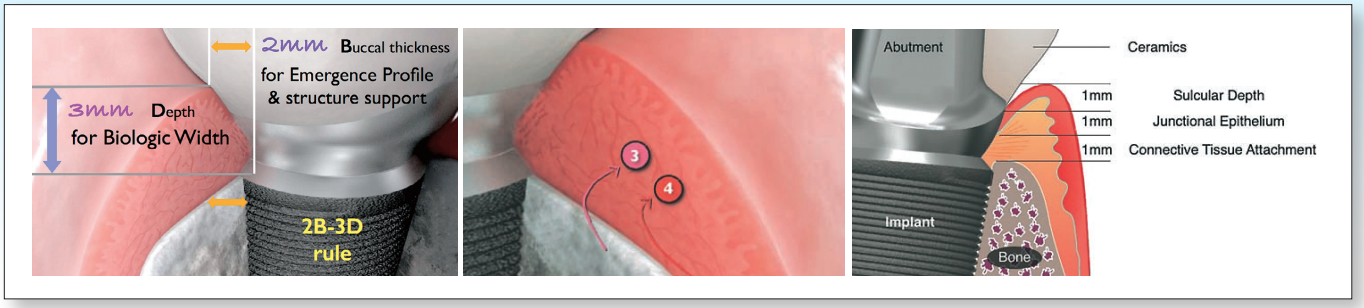


Fig. 46:
2mm of buccal bone thickness *helps prevent gingival recession because it provides for a more abundant collateral blood supply (3) from the cortical bone as well as within (4) the adjacent connective tissue. The implant head should be placed* ***3mm apical*** *to the future labial prosthesis margin position in order to allow development of the desired emergence profile, esthetics, and biological width.*

augmentation with GBR, bone reduction, lingually positioning of the implant or a smaller implant diameter may be necessary to ensure long-term stability of both hard and soft tissues (*Fig. 46*).[2]

Conclusion

Implants are commonly used to replace congenitally missing lateral incisors in orthodontic patients, but the restorations are often challenging because the alveolar crest is too narrow for the implant and may require bone augmentation. When the orthodontist opens the space, the papilla heights are adversely affected, and some patients have altered passive eruption after treatment that affects the level of the gingival margins.

Orthodontists typically limit tooth-reshaping to incisal edge adjustment. However, effective interdisciplinary treatment requires an effective interaction by all the clinicians to achieve an excellent smile. Dentists can control tooth shape by adding or taking away from the tooth, crown, or laminate.

The pleasing result achieved for the present patient required a series of complex clinical procedures, including removal and repositioning of the original implants. Because of the manner in which the complications were handled, this case report provides important information for clinicians. Carefully analyzing the outcomes provides an opportunity to improve clinical methodology and develop a more comprehensive treatment philosophy for future patients.

This difficult malocclusion (*DI =20*) was treated to a very good alignment (*CRE = 7*), and both the patient and the clinician were pleased with the results.

Acknowledgment

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Discrepancy Index Worksheet

TOTAL D.I. SCORE 20

OVERJET

0 mm. (edge-to-edge) =
1 – 3 mm. = 0 pts.
3.1 – 5 mm. = 2 pts.
5.1 – 7 mm. = 3 pts.
7.1 – 9 mm. = 4 pts.
> 9 mm. = 5 pts.

Negative OJ (x-bite) 1 pt. per mm. per tooth =

Total = 0

OVERBITE

0 – 3 mm. = 0 pts.
3.1 – 5 mm. = 2 pts.
5.1 – 7 mm. = 3 pts.
Impinging (100%) = 5 pts.

Total = 0

ANTERIOR OPEN BITE

0 mm. (edge-to-edge), 1 pt. per tooth
then 1 pt. per additional full mm. per tooth

Total = 0

LATERAL OPEN BITE

2 pts. per mm. per tooth

Total = 0

CROWDING (only one arch)

1 – 3 mm. = 1 pt.
3.1 – 5 mm. = 2 pts.
5.1 – 7 mm. = 4 pts.
> 7 mm. = 7 pts.

Total = 0

OCCLUSION

Class I to end on = 0 pts.
End on Class II or III = 2 pts. per side 2 pts.
Full Class II or III = 4 pts. per side _____ pts.
Beyond Class II or III = 1 pt. per mm. additional _____ pts.

Total = 2

LINGUAL POSTERIOR X-BITE

1 pt. per tooth Total = 0

BUCCAL POSTERIOR X-BITE

2 pts. per tooth Total = 0

CEPHALOMETRICS (See Instructions)

ANB ≥ 6° or ≤ -2° = 4 pts.

Each degree < -2° _____ x 1 pt. = _____

Each degree > 6° _____ x 1 pt. = _____

SN-MP
≥ 38° = 2 pts.
Each degree > 38° _____ x 2 pts. = _____

≤ 26° = 1 pt.
Each degree < 26° _____ x 1 pt. = _____

1 to MP ≥ 99° = 1 pt.
Each degree > 99° _____ x 1 pt. = _____

Total = 0

OTHER (See Instructions)

Supernumerary teeth _____ x 1 pt. = _____
Ankylosis of perm. teeth _____ x 2 pts. = _____
Anomalous morphology _____ x 2 pts. = _____
Impaction (except 3rd molars) _____ x 2 pts. = _____
Midline discrepancy (≥3mm) @ 2 pts. = _____
Missing teeth (except 3rd molars) _____ x 1 pts. = _____
Missing teeth, congenital 2 x 2 pts. = 4
Spacing (4 or more, per arch) 2 x 2 pts. = 4
Spacing (Mx cent. diastema ≥ 2mm) @ 2 pts. = 2
Tooth transposition _____ x 2 pts. = _____
Skeletal asymmetry (nonsurgical tx) @ 3 pts. = _____
Addl. treatment complexities _____ x 2 pts. = _____

Identify:

Total = 10

IMPLANT SITE

Lip line : Low (0 pt), Medium (1 pt), High (2 pts) = _____
Gingival biotype : Low-scalloped, thick (0 pt), Medium-scalloped, medium-thick (1 pt), High-scalloped, thin (2 pts) = 1x2=2
Shape of tooth crowns : Rectangular (0 pt), Triangular (2 pts) = 2x2=4
Bone level at adjacent teeth : ≤ 5 mm to contact point (0 pt), 5.5 to 6.5 mm to contact point (1 pt), ≥ 7mm to contact point (2 pts) = _____
Bone anatomy of alveolar crest : H&V sufficient (0 pt), Deficient H, allow simultaneous augment (1 pt), Deficient H, require prior grafting (2 pts), Deficient V or both H&V (3 pts) = 1x2=2
Soft tissue anatomy : Intact (0 pt), Defective (2 pts) = _____
Infection at implant site : None (0 pt), Chronic (1 pt), Acute(2 pts) = _____

Total = 8

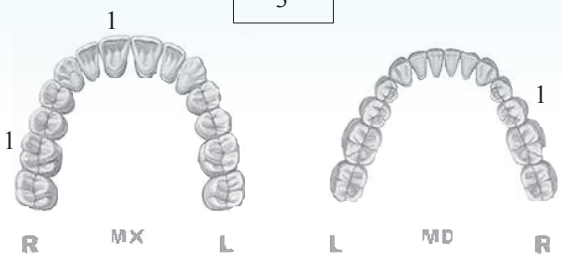
Cast-Radiograph Evaluation

ıse # Patient

Total Score: 7

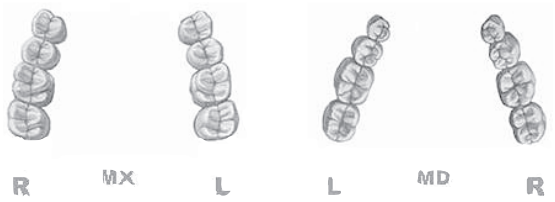
Alignment/Rotations

3



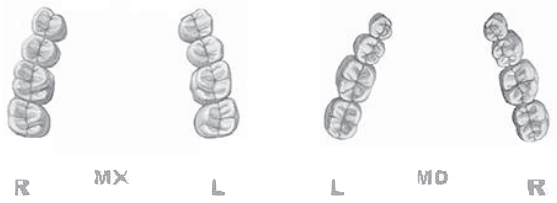
Marginal Ridges

0



Buccolingual Inclination

0

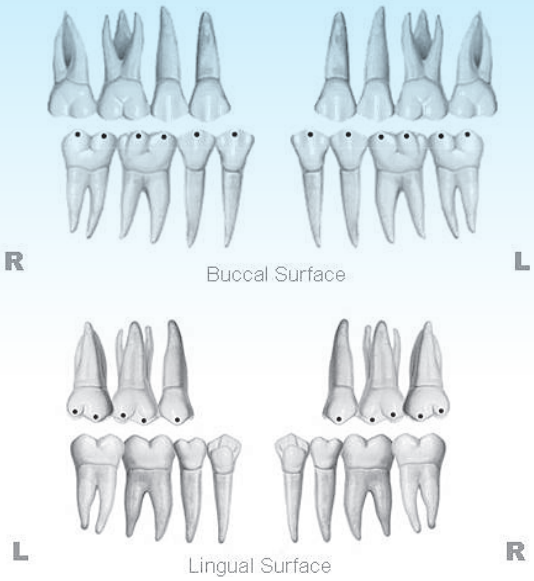


Overjet

2

Occlusal Contacts

0

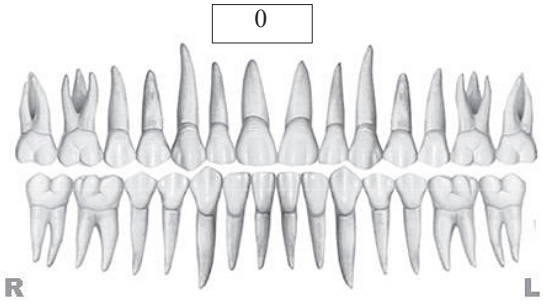


Occlusal Relationships

0

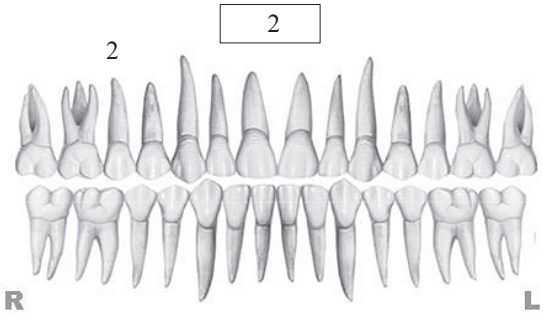
Interproximal Contacts

0



Root Angulation

2



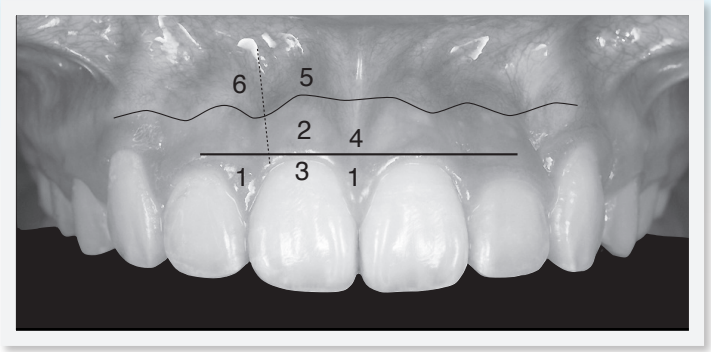
***INSTRUCTIONS:** Place score beside each deficient tooth and enter total score for each parameter in the white box. Mark extracted teeth with "X". Second molars should be in occlusion.*

IBOI Pink & White Esthetic Score

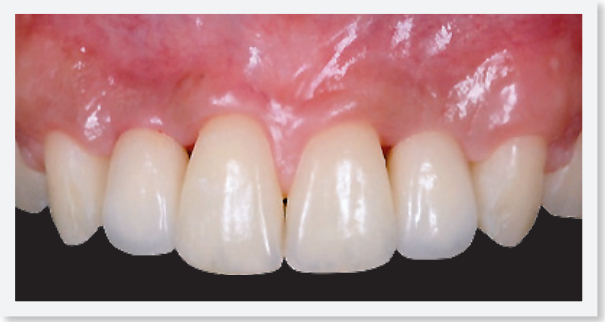
Total Score: = 5

1. Pink Esthetic Score

Total = 2



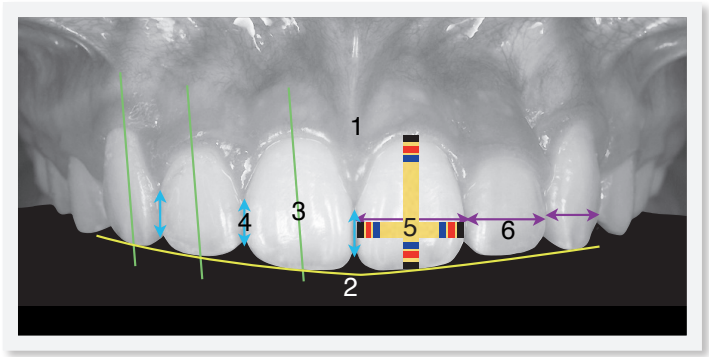
1. M & D Papillae	0	1	2
2. Keratinized Gingiva	0	1	2
3. Curvature of Gingival Margin	0	1	2
4. Level of Gingival Margin	0	1	2
5. Root Convexity (Torque)	0	1	2
6. Scar Formation	0	1	2



1. M & D Papillae	0	(1)	2
2. Keratinized Gingiva	(0)	1	2
3. Curvature of Gingival Margin	(0)	1	2
4. Level of Gingival Margin	0	(1)	2
5. Root Convexity (Torque)	(0)	1	2
6. Scar Formation	(0)	1	2

2. White Esthetic Score (for Micro-esthetics)

Total = 3

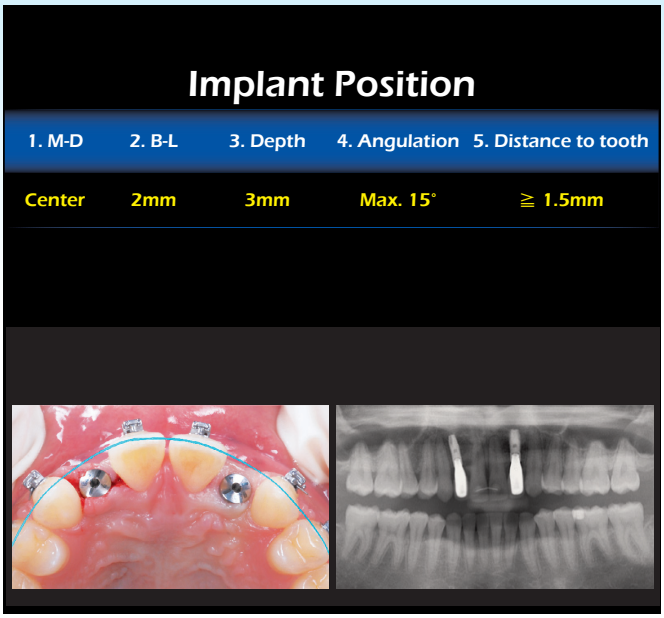


1. Midline	0	1	2
2. Incisor Curve	0	1	2
3. Axial Inclination (5°, 8°, 10°)	0	1	2
4. Contact Area (50%, 40%, 30%)	0	1	2
5. Tooth Proportion (1:0.8)	0	1	2
6. Tooth to Tooth Proportion	0	1	2

1. Midline	(0)	1	2
2. Incisor Curve	(0)	1	2
3. Axial Inclination (5°, 8°, 10°)	0	(1)	2
4. Contact Area (50%, 40%, 30%)	0	(1)	2
5. Tooth Proportion (1:0.8)	0	(1)	2
6. Tooth to Tooth Proportion	(0)	1	2

Implant-Abutment Transition & Position Analysis

3. Implant Position

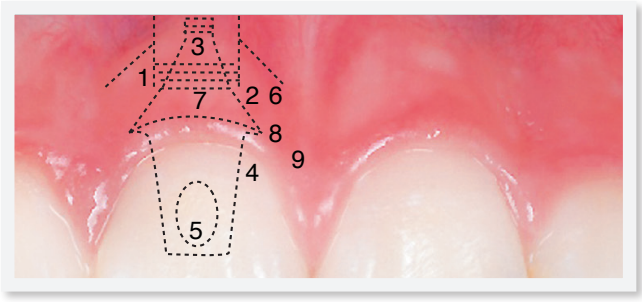


Total = 1

1. M & D (Center)	0	1	2
2. B & L (Buccal 2 mm)	0	1	2
3. Depth (3 mm)	0	1	2
4. Angulation (Max. 15°)	0	1	2
5. Distance to Adjacent Anatomy	0	1	2

1. M & D (Center)	(0)	1	2
2. B & L (Buccal 2 mm)	(0)	1	2
3. Depth (3 mm)	(0)	1	2
4. Angulation (Max. 15°)	(0)	1	2
5. Distance to Adjacent Anatomy	0	(1)	2

4. Abutment transition Contour



E : external connection,
I : internal connection,
S : screw type,
C : cement type,
P : palatal/central,
B : buccal

Total = 1

1. Fixture Cervical Design	N	Y	
2. Platform Switch	N	Y	
3. I-A Connection Type	E	I	
4. Abutment Selection	S	C	
5. Screw Hole Position	P	B	
6. Marginal Bone Loss	0	1	2
7. Modified Gingival Contour	0	1	2
8. Gingival Height	0	1	2
9. Crown margin fitness	0	1	2

1. Fixture Cervical Design	(N)	Y	bone level
2. Platform Switch	N	(Y)	platform
3. I-A Connection Type	E	(I)	11° morse taper
4. Abutment Selection	S	(C)	cement-retained
5. Screw Hole Position	P	B	incisor
6. Marginal Bone Loss	(0)	1	2
7. Modified Gingival Contour	(0)	1	2
8. Gingival Height	(0)	1	2
9. Crown margin fitness	0	(1)	2