Comprehensive Treatment of Oligodontia: Orthodontics, Sinus Lift Bone Grafting, and Implant-supported Prostheses

This report describes the interdisciplinary treatment of an acquired malocclusion in an adult male that was associated with oligodontia and anterior crossbite. Six premolars were congenitally missing, four in the maxilla and two in the mandible, resulting in multiple, intermaxillary edentulous areas. In the mandibular arch, all spaces were closed and incisors were retracted to correct the anterior crossbite. In the maxillary arch, space was consolidated to develop implant sites to replace the the missing first premolars. Due to inadequate bone height bilaterally, the edentulous areas were restored with dental implants placed with simultaneous sinus lift, bone grafting procedures. Prosthodontic restoration was then completed using implant-supported crowns. Occlusal function, dental esthetics and the smile-line were markedly improved. (Int J Ortho Implantol 2013;31:16-39.)

Key words: oligodontia, self ligation bracket, sinus lift, bone grafting, lateral approach, osteotome technique, sinus membrane perforation, implant-supported prosthesis

History and Etiology

A 23-year old man presented with a chief complaint of chewing problems due to multiple missing teeth (*Figs. 1-3*). The dental history revealed a probable genetic pattern associated with congenital absence of all four maxillary premolars and both mandibular second premolars. There was no other contributing medical history. Pretreatment photographs (*Figs. 1-2*) showed a relatively straight profile with inadequate maxillary incisor exposure when smiling. The nasolabial angle was within normal limits (*WNL*), but

Fig. 1: Pretreatment facial photographs

Fig. 2: Pretreatment intraoral photographs

Fig. 3: Pretreatment study models

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Fig. 4:
Post-treatment facial photographs showing considerable improvement in facial profile

Fig. 5: Posttreatment intraoral photographs

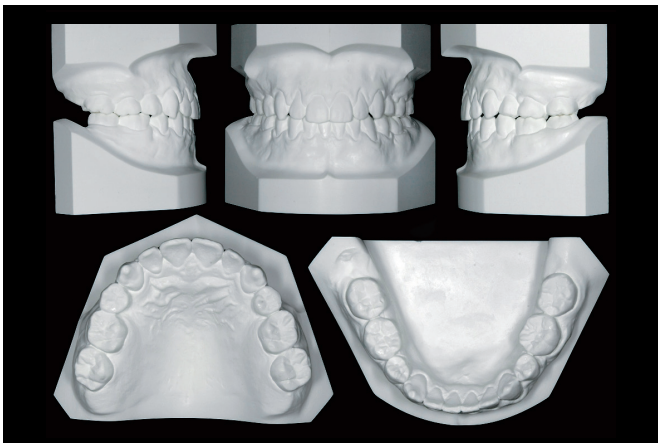

Fig. 6: Posttreatment study models

the lower lip was slightly protrusive relative to the upper lip. His chin point shifted to the left, there was a 5mm midline discrepancy.

The patient was treated to an acceptable result as shown in Figs. 4-6. Lateral head and panoramic radiographs before and after treatment are illustrated in Figs. 7-8, respectively. Radiographic evaluation revealed that all four maxillary premolars and both mandibular second premolars were missing (*Fig. 7*). Restorative neglect contributed to drifting and supra-eruption of other teeth, resulting in both functional and esthetic problems. Overall, the dentofacial management is documented with superimposed cephalometric tracings (*Fig. 9*). Careful examination of the pretreatment panoramic radiograph revealed morphologic asymmetry of the condyle heads (*Fig. 10*), which contributed to the mandibular deviation (*Fig. 1*).

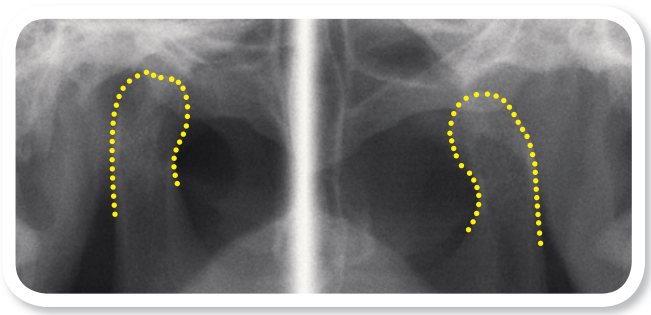

Fig. 10:
The morphologic asymmetry of the condyle heads was noted.

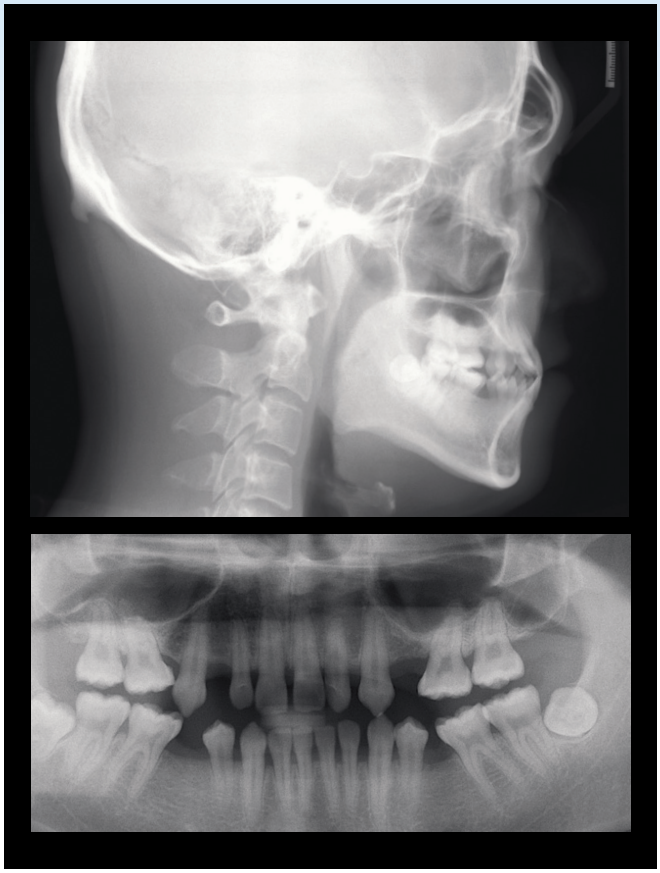

Fig. 7: Pretreatment pano and ceph radiographs.

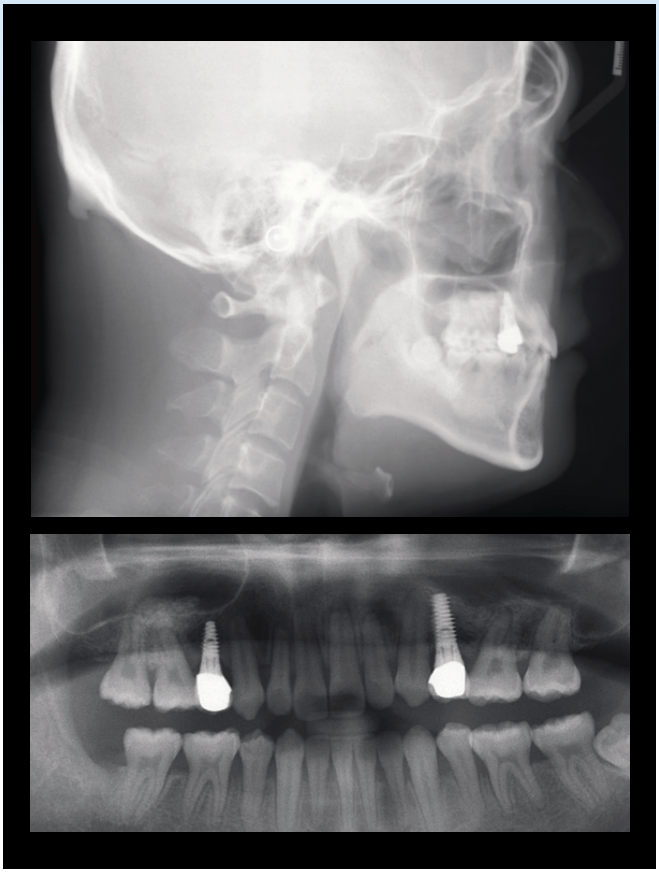

Fig. 8: Posttreatment pano and ceph radiographs.

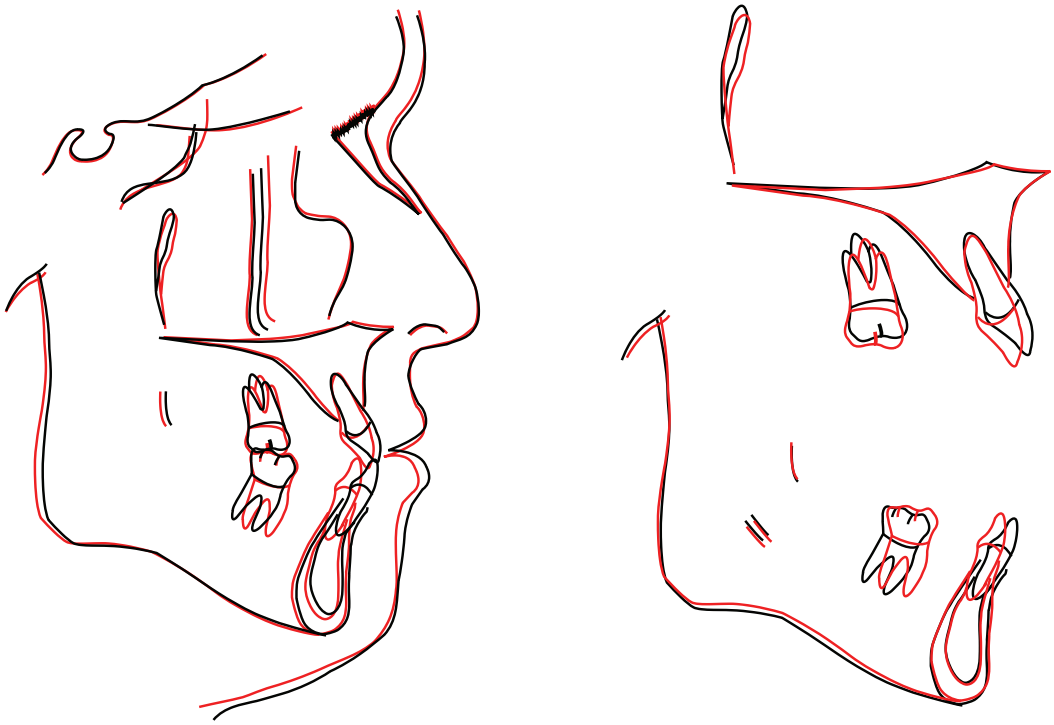

Fig. 9: Superimposed tracings revealed the tipping of maxillary and mandibular incisors, mesial movement of mandibular molars.

CEPHALOMETRIC			
SKELETAL ANALYSIS			
	PRE-Tx	POST-Tx	DIFF.
SNA°	80.5°	80.5°	0°
SNB°	80°	80°	0°
ANB°	0.5°	0.5°	0°
SN-MP°	26.5°	26.5°	0°
FMA°	19.5°	19.5°	0°
DENTAL ANALYSIS			
U1 TO NA mm	3.5 mm	2 mm	1.5 mm
U1 TO SN°	109°	101°	8°
L1 TO NB mm	3.5 mm	1 mm	2.5 mm
L1 TO MP°	91°	88°	3°
FACIAL ANALYSIS			
E-LINE UL	-3.5 mm	-2.5 mm	1 mm
E-LINE LL	-1 mm	-2 mm	1 mm

■ Table. 1: Cephalometric summary

Diagnosis

Skeletal:

- Skeletal Class I (*SNA 80.5°, SNB 80°, ANB 0.5°*)
- Low mandibular plane angle (*SN-MP 26.5°, FMA 19.5°*)
- Condylar heads are asymmetric in length

Dental:

- Class I molar relationship on the right
- Class II molar relationship on the left
- Canine relationship: Class III on the right side, Class I the left
- Anterior crossbite: upper left lateral incisor and canine were in crossbite; the upper right central and lateral incisors were edge-to-edge
- Mandibular midline: 5mm to the left of the facial and maxillary midlines
- Posterior lingual crossbite: maxillary left first molar (*#14*)
- Missing Teeth: all four upper premolars (*#4, #5, #12, #13*) and both second premolars (*#20, #29*)
- Spaces: maxillary midline diastema and multiple edentulous spaces in both arches

Facial:

- Straight profile with inadequate maxillary incisor exposure when smiling
- Slightly protrusive lower lip
- Facial asymmetry: the chin point was deviated to left The ABO Discrepancy Index (*DI*) was 44 as shown in the subsequent worksheet.[1] The major discrepancy (*12 points*) was the anterior crossbite, manifest as a negative overjet between the left upper and lower canines (*#6 and #27*) (*Figs. 2-3*).

Treatment Objectives

After careful review of the patient's facial profile, dental, and occlusal problems, the treatment objectives were as following:

- Close all of the spaces in the mandible.
- Close all of the spaces in the maxillary anterior region
- Leave 7mm spaces in the right and left maxillary first premolar regions for implant-supported crowns.
- Create sufficient alveolar bone volume for implant placement in the maxillary right and left first premolar regions.
- Establish normal overjet and overbite.

- Establish an Angle Class I molar and canine relationship.

The overall clinical objectives were to restore occlusal function and improve smile esthetics with interdisciplinary treatment, involving orthodontics, dental implant placement, and prosthetics.

Treatment Alternatives

Since the chin point was deviated and the condylar heads were asymmetric, orthognathic surgery would improve the facial profile, correct the deviation of the mandible, and allow complete closure of all space in the mandibular arch. Although this approach was probably the most ideal option, the patient was opposed to orthognathic surgery. Thus, a compromise treatment plan was devised involving only preprosthetic orthodontics treatment.

Treatment Plan And Sequence

1. Full fixed orthodontics appliance
2. Compressed NiTi open coil springs to create space for the implants in the maxillary first premolar regions
3. Establish a Class I preprosthetic occlusion with adequate protrusive guidance and canine protected lateral excursions.
4. Close all spaces in the mandible.
5. Sinus-lift bone grafting bilaterally to create sufficient bone height to place implants.
6. Place implants in the maxillary right and left first premolar regions.
7. Once the implants integrate, restore with crowns.
8. Retention of the corrected malocclusion using a clear retainer for both the maxillary and mandibular arches.

Appliances And Treatment Progress

Damon Q® 0.22" Brackets (*Ormco*) were used with standard torque in both arches. Compressed NiTi open coil springs were placed (*Fig. 11*) to open the spaces between the maxillary canines and first molars bilaterally. A bite turbo was bonded on the lingual surface of the left mandibular canine to facilitate the correction of anterior crossbite (*Fig. 12*). The patient was instructed to wear Class III elastics (*Parrot 5/16", 2 oz.*) full time.

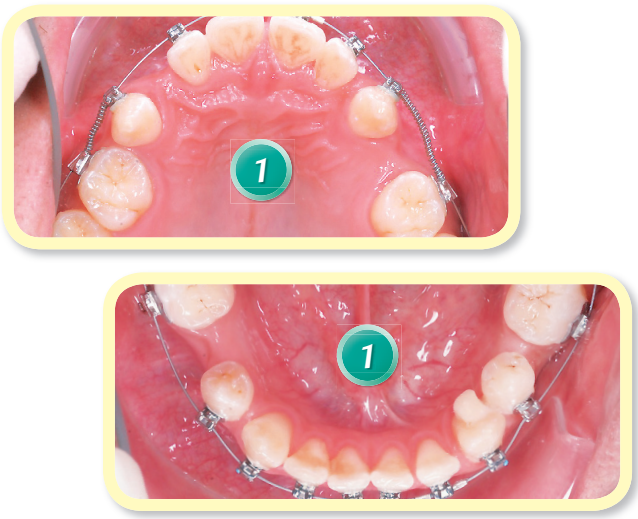

Fig. 11,12:
Compressed NiTi open coil springs were placed and a bite turbo was bonded on the lingual surface of the left mandibular canine.

After 6 months of treatment, the overjet and anterior crossbite were improved to an edge to edge position (*Figs. 13-14*). In maxilla, the arch wire was change to .017x.025" TMA. In mandible, the arch wire was changed to .016x.025" SS, and power chains were placed to close the spaces. The Class III elastics were upgraded to 3.5 oz (*Monkey 3/8", 3.5 oz*).

In the 9th month (*Figs. 15-16*), the overjet and overbite were corrected and the protrusive guidance was established. Class III elastics and power chains were utilized to close the spaces in mandible.

In the 16th month, the right and left maxillary first premolar space were established, and the occlusion was adequately corrected for initiating implant placement (*Fig. 17*). A panoramic radiograph was exposed to confirm that the roots adjacent to the implant sites were parallel.

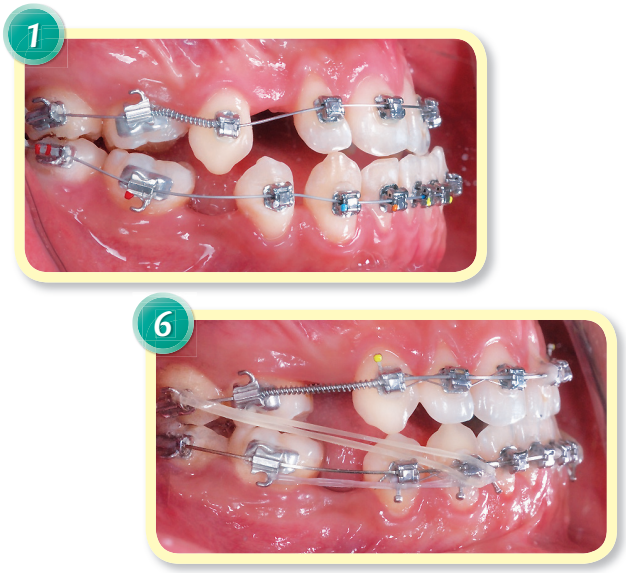

Fig. 13,14:
The overjet and anterior crossbite were improved to an edge to edge position in 6 months.

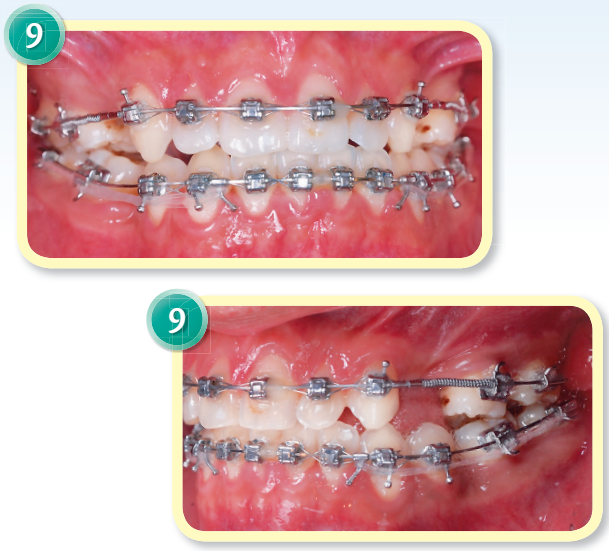

Fig. 15,16:
The overjet and anterior crossbite were corrected and the protrusive guidance was established.

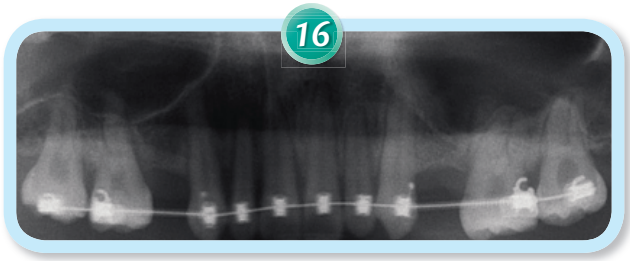

Fig. 17:
The panoramic radiograph was exposed to confirm the roots adjacent to the implant sites were parallel.

Implant Placement

A preoperative CT scan was taken to evaluate alveolar bone volume (*Fig. 18*): 8mm in height x 6mm in width on the right, and 6mm in height x 5mm in width on the left. Since there was insufficient bone volume on both sides, simultaneous maxillary sinus grafting and implant placement was indicated.

Surgical stents were designed for precise implant placement in three dimensions. The implant fixture was positioned 3mm below the future crown

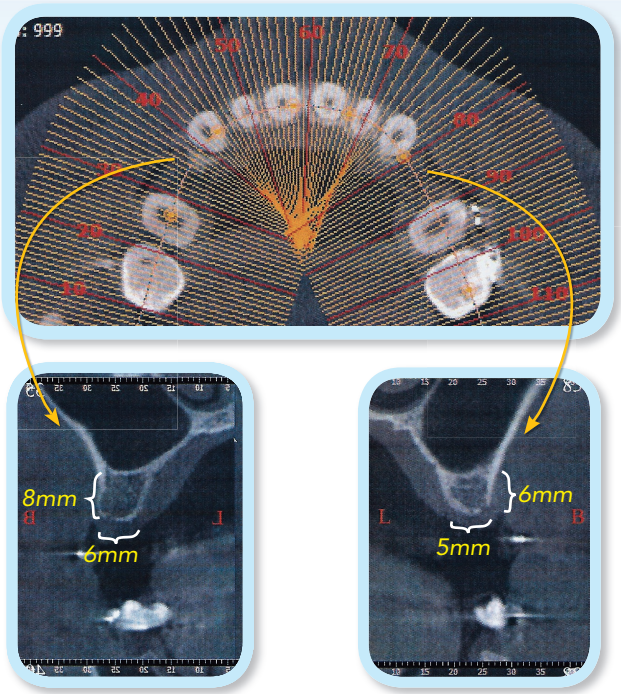

Fig. 18:

The spaces were created for the maxillary first premolar implants. The bone volume at the right is 8mm in height x 6mm in width; at the left is 6mm in height x 5mm in width.

Fig. 19:

Surgical stents were designed for precise implant placement in three dimensions.

margin, with a distance of at least 1.5mm from the adjacent teeth (*Fig. 19*).[2] The 2B-3D rule[2] for dental implant planning, placement and restoration was followed.

In the #12 area, a crestal incision was performed at the palatal line angle with a No.15c scalpel. Sulcular incisions were made on the buccal and palatal of the adjacent teeth for flap reflection. After exposing the bone with full-thickness flaps, the surgical stent was fitted to guide the first lancer drill for the initial osteotomy. The depth of the osteotomy was measured with a periodontal probe (*Fig. 20*). A surgical guide pin was placed, and a periapical X-ray revealed the remaining distance to the sinus floor (*Fig. 21*). An osteotome was used to push the sinus floor axially (*Fig. 22*), and the latter was broken with light strokes from a mallet. The Schneiderian membrane (*sinus membrane*) was then further elevated by the bone graft material (*Bio-Oss® Geistlich Biomaterials*), which was carefully pushed into the sinus cavity (*Fig. 23*).

Then, an implant fixture (*Ø4.1X11.5mm, TwStar® MegaGen® Taiwan*) was installed following the manufacturer's recommended drilling and insertion protocol. The implant achieved adequate primary stability and closing screw was placed. The flap was repositioned and closed with 5-0 nylon sutures (*Fig. 24*).

In the #5 area, the same surgical procedure was performed (*Figs. 25-26*). However, the sinus membrane was perforated accidentally, so it was necessary to perform a lateral window approach to

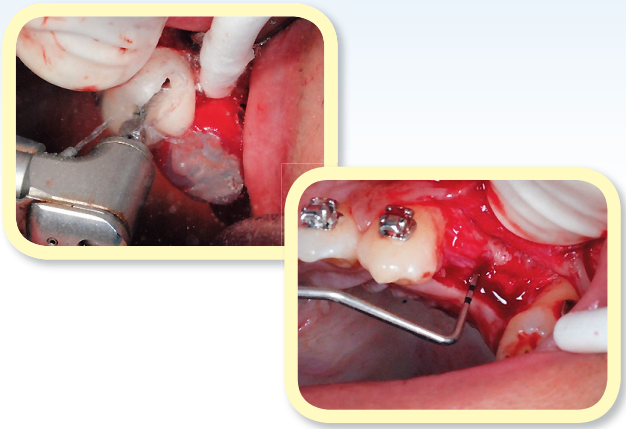

Fig. 20:

The surgical stent was fitted to guide the first lancer drill and the depth of the osteotomy was check with a periodontal probe.

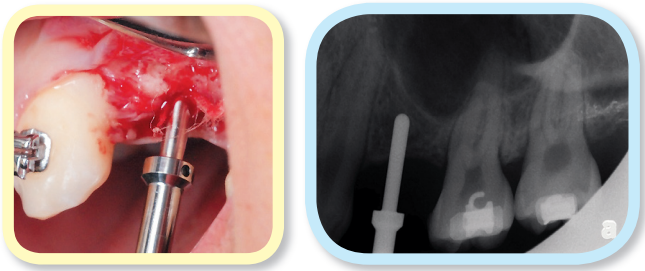

Fig. 21:

The surgical guide pin was place and periapical X-ray was checked to evaluate the remaining from the sinus floor and the direction of the osteotomy.

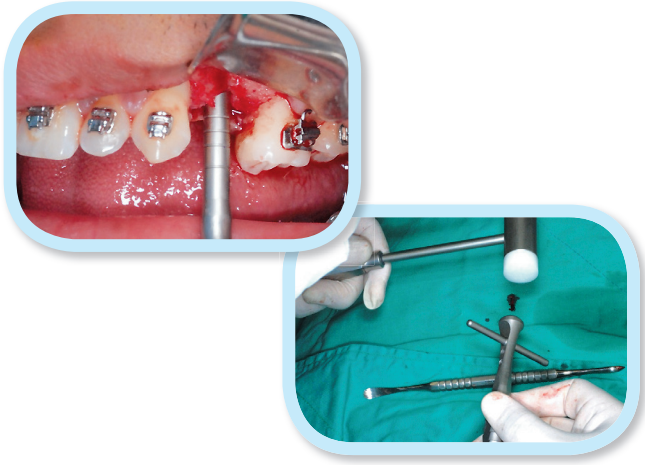

Fig. 22 An osteotome was used to push the sinus floor axially.

Fig. 23:

The sinus membrane was then further elevated by the bone graft material.

repair of the perforation. A buccal-releasing incision was made at the distofacial line angle of the right maxillary canine increase the flap reflation (*Fig. 27*). After the lateral wall of the sinus was exposed, an oval osteotomy was performed with a round bur mounted on a high-speed handpiece. A lateral brushing motion was used to carefully penetrate the sinus wall. The sinus membrane, usually seen as a dark shadow, was approached carefully until it was possible to observe slight movement of the surgical window. The sinus membrane was carefully and completely reflected from the floor and medial wall of the maxillary sinus. The perforated area was patched with a collagen membrane (*CollaTape® Zimmer*)(*Fig. 28*), and the bone graft (*Bio-Oss® Geistlich Biomaterials*) was gently packed into the inferior portion of the sinus cavity (*Fig. 29*). Then, a Ø4.1X8.5mm implant fixture (*TwStar® MegaGen® Taiwan*) was installed in the alveolar ridge osteotomy, and the other collagen membrane (*Lyoplant® Aesculap*) was positioned over the lateral window, extending about 3mm over sound

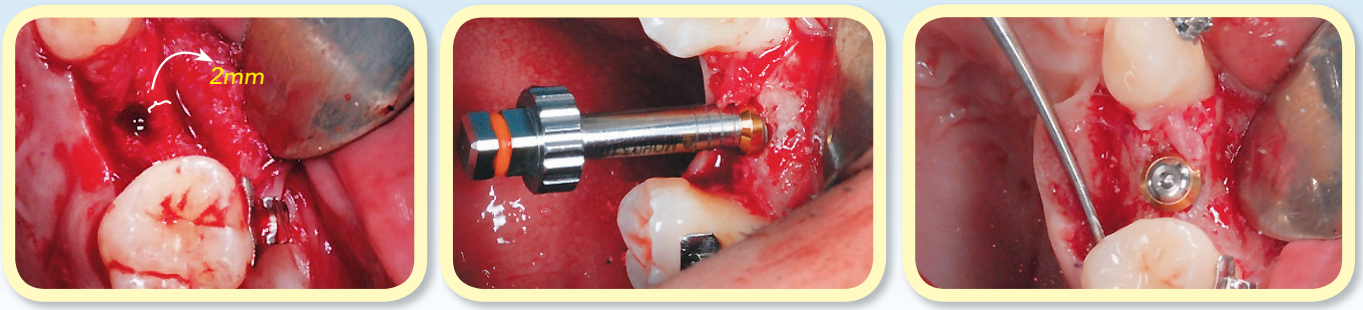

Fig. 24:

The 2mm buccal bone plate was preserved, before implant fixture placement. All the SLA surface of implant fixture was placed into the osteotomy. Then the closing screw was secured.

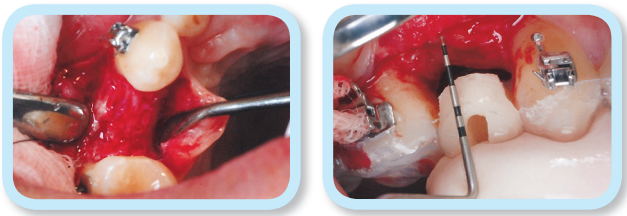

Fig. 25:

The flap was elevated, and the future crown margin to the bone level was measured with a periodontal probe.

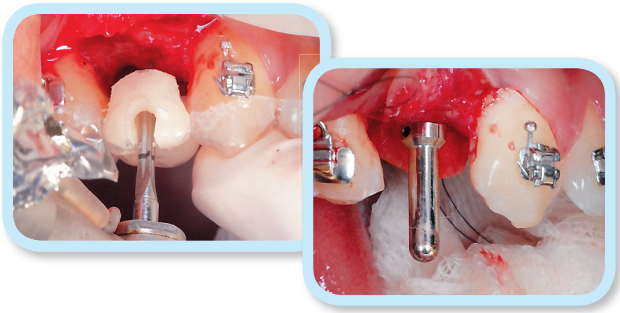

Fig. 26:

The surgical stent was fitted to guide the first lancer drill. After the osteotomy was done, the surgical guide pin was placed and periapical X-ray film was checked.

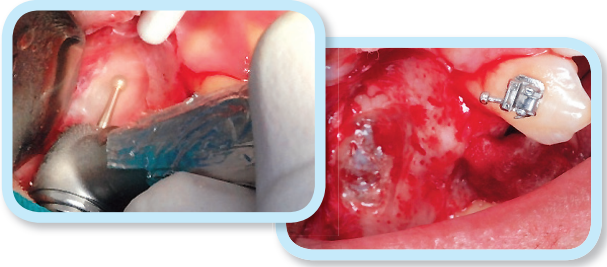

Fig. 27:

The window was made with a round bur, and the Schneiderian membrane was seen as a dark shadow..

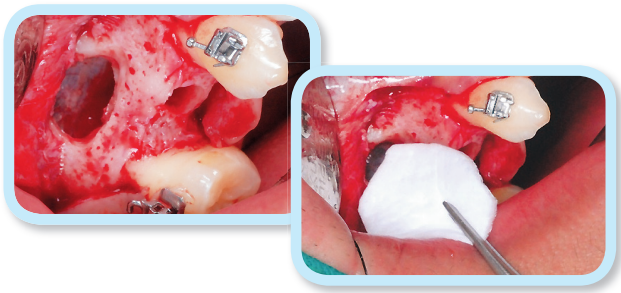

Fig. 28:

The sinus membrane was completely reflected. The perforated area was patched with a collagen membrane.

bone. The flap was repositioned and closed with interrupted 5-0 nylon sutures (*Fig. 30*). Post-operative periapical radiographs were taken to check the position and angulation of the implants, as well as to confirm the integrity of the sinus membranes (*Fig. 31*).

The healing was uneventful, and the sutures were removed in a week (*Fig. 32*). Because vascular ingrowth occurs at a rate of ~1mm per month, graft infiltration with living bone requires several months. After 5 months of healing, the closing screw of maxillary left first premolar implant was partially exposed, indicating that the gingival biotype might be thin (*Fig. 33*). In retrospect, the implant should be positioned deeper.

Fig. 29:

With the collagen membrane patching, the bone graft was then gently packed into the sinus cavity. Then, the Ø4.1X8.5mm implant fixture was installed.

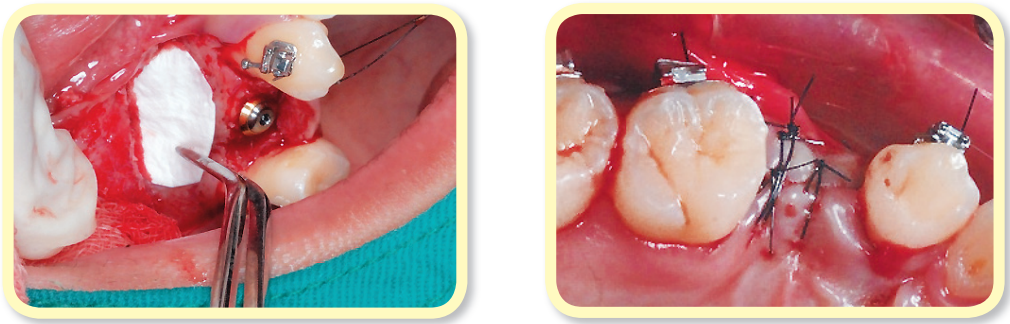

Fig. 30:

The other collagen membrane was positioned over the lateral window, extending about 3 mm over sound bone. The flap was repositioned and sutured.

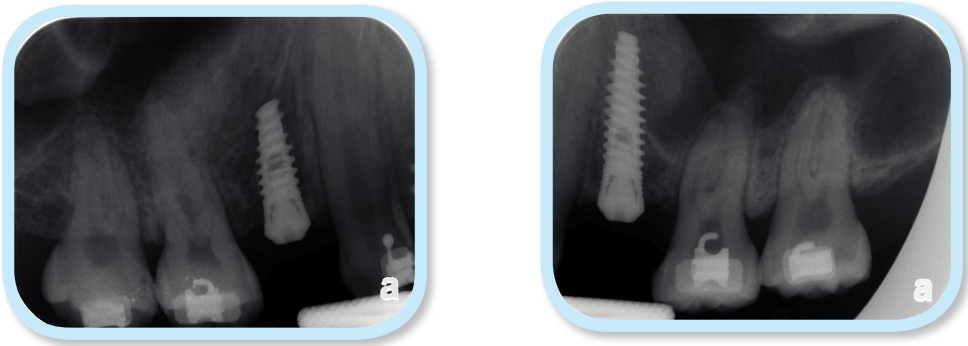

Fig. 31:

Post-operative periapical radiographs were taken to check the position and angulation of the implants, as well as to confirm the integrity of the sinus membranes.

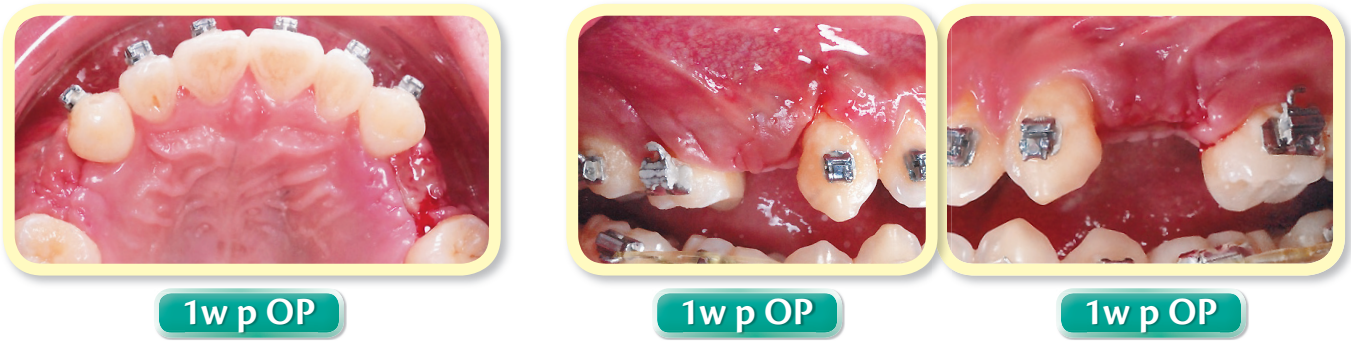

Fig. 32 The healing was uneventful, and the sutures were removed in a week.

The second stage implant surgery was performed according to the classical Brånemark 2 stage, submerged fixture protocol.[3] A No.15c scalpel and diode laser were used to fully uncover the implant fixture. The closing screw was removed and replaced with a gingiva former which would enable the gingival margin to form properly during the healing period and ensure an ideal emergence profile around the future crown (*Fig. 34*).

Orthodontic Finishing Stage

Since the patient's mandibular midline was still 4mm to the left of the facial and maxillary midlines, an unsuccessful effort was made to correct the midline with an elastic (*Bear 1/4", 4.5 oz.*) from the left mandibular canine to the right maxillary canine (*Fig. 35*). In the 32nd month of orthodontic treatment, which included 13 months of implant healing, all brackets were removed. Clear overlay retainers were delivered for both arches, and the patient was scheduled for the implant prosthesis fabrication (*Fig. 36*).

Implant Prosthesis Fabrication

The gingiva formers were removed (*Fig. 37*) and the multi-post abutments (*Ø5.5mm and 2.5mm cuff height*) were tried on for fitting (*Fig. 38*). 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 (*Fig. 39*). The post height of the abutments were reduced to provide two mm of occlusal clearance for the fabrication of the porcelain fused to metal crown (*Fig. 40*). The cuff height of the abutments were also prepared to follow the soft tissue contour, and the buccal thickness of the abutments were reduced as needed.

Fig. 33:

After 5 months of healing, the healing cap of maxillary left first premolar implant was partially exposed.

Fig. 34:

A surgical scalpel and diode laser were used to fully uncover the implant fixture, and the cover screw was removed and replaced with a gingiva former.

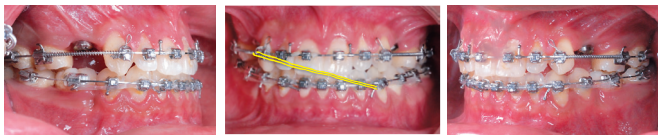

Fig. 35:

An unsuccessful effort was made to correct the midline with an elastic (Bear 1/4", 4.5oz.) from the left mandibular canine to the right maxillary canine

Fig. 36:

After 32 months of active orthodontic treatment, the brackets were all debonded.

Fig. 37: The gingiva formers were removed.

Multi-post

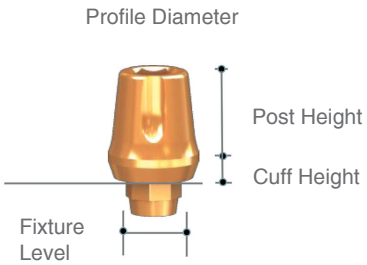

Fig. 38: The profile of multi-post.

Fig. 39: The multi-post was modified.

Before taking an impression, the abutment screws were torqued to 35-N-cm with a screw driver and a torque ratchet (*Fig. 41*). A gingival retraction cord was positioned in the peri-implant sulcus with a packing-placement instrument (*Fig. 42*). A direct impression was obtained with polyvinyl siloxane (*Fig. 43*), and poured with type IV dental stone. The casts were subsequently articulated using appropriate check-

Fig. 40:

The height of the abutments were reduced to provide two mm of occlusal clearance for the fabrication of the porcelain fused to metal crown

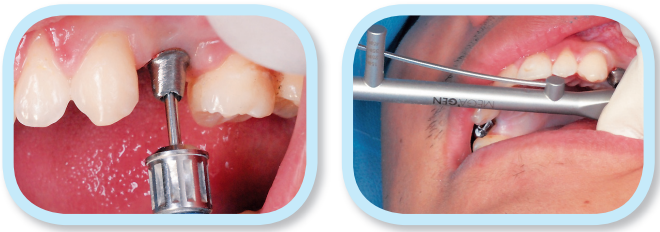

Fig. 41:

Before taking an impression, the abutment screws were torqued to 35-N-cm with a screw driver and a torque ratchet.

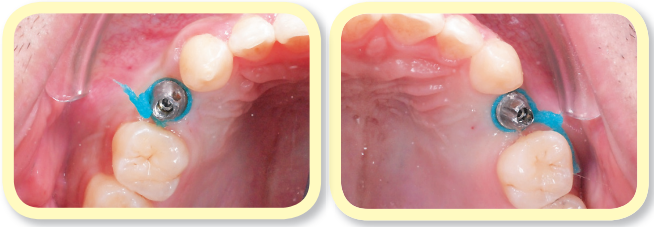

Fig. 42:

Gingival retraction cord was positioned in the peri-implant sulcus with a packing-placement instrument

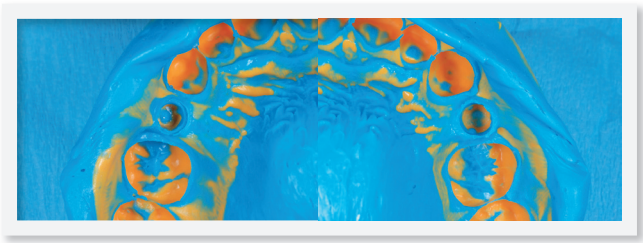

Fig. 43: A direct impression was obtained with polyvinyl siloxane.

bite records. A metal coping was fabricated by the laboratory, and the marginal integrity was verified with a dental explorer. After completion of the final prosthesis (*Fig. 44*), appropriate tightness of the contact area was confirmed with dental floss. After clinical adjustment and verification of the fit and occlusion, the permanent crowns were completed and luted into place with temporary cement . The crown removing lugs on the palatal side were trimmed off a week later (*Fig. 45*).

Fig. 44: The completion of the final prostheses.

Fig. 45: The final prostheses were luted into place.

Results Achieved

Maxilla (*all three planes*):

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

Mandible (*all three planes*):

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

Maxillary Dentition

- A - P: Retracted
- Vertical: Incisors extruded
- Inter-molar / Inter-canine Width: Maintained

Mandibular Dentition

- A - P: Incisors retracted
- Vertical: Maintained
- Inter-molar / Inter-canine Width: Maintained

Facial Esthetics: Maintained

Final Evaluation Of Treatment

The ABO Cast-Radiograph Evaluation (*CRS*) score was 27 points. The major discrepancies[1] were buccolingual inclination (*6 points*) and occlusal relationships (*7 points*)(*Fig. 46*). The facial asymmetry and residual midline discrepancy appeared to be major factors contributing to the compromised final occlusion. Details of the CRS scores are presented in the scoring sheet at the end of this report.

The smile esthetics were substantially improved by closing the interdental spaces, correcting the anterior crossbite, establishing optimal incisal exposure and providing for proper gingival

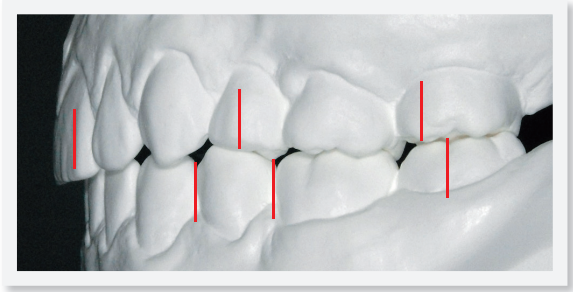

Fig. 46:
The major discrepancies were buccolingual inclination (6 points) and occlusal relationships (7 points).

display. The occlusal function was also improved by obtaining of adequate protrusive guidance and proper occlusal contact in centric occlusion. The missing right and left maxillary first premolars were also restored into occlusion by the implant-supported prostheses.

Overall, there was significant improvement in dental esthetics, smile dynamics and occlusal function. The patient was satisfied with the result.

Discussion

This patient had a genetically related disorder that is deemed oligodontia, because he has at least six missing teeth other than third molars. It is an inheritable disorder that he is likely to pass on to his children. Since the problem is probably common in his family, it is important for the patient to realize that early diagnosis and treatment with orthodontics and temporary anchorage devices is often indicated. Without interceptive orthodontics treatment, oligodontia can result in a severe acquired malocclusions that are difficult and expensive to correct. When oligodontia is diagnosed, the first oligation of the clinician is genetic counseling, which may involve referral to a medical geneticist.

The most obvious treatment plan for a patient with six missing premolars and generalized spacing is preprosthetic orthodontics to prepare the edentulous areas for six implant-supported prostheses (*Fig. 47*). However, the treatment plan for patients with multiple missing teeth should be based on a comprehensive evaluation of the facial profile, smile framework, and occlusion as well as on space requirements. Dr. Sarver's Treatment Optimization[4] approach is an important and useful treatment guideline.

For the present patient, the straight profile and appropriate axial inclination of the maxillary incisors (*U1 to SN angle* 109°) is an important diagnostic consideration favoring space closure in the mandibular arch. The anterior crossbite should be corrected by retracting the mandibular incisors, instead of flaring the maxillary incisors (*Fig. 48*). However, lower incisor axial inclination is within the normal range (*U1 to MP*), so it is important to maintain adequate root-lingual torque to prevent excessive mandibular incisor tipping. Additional factors favoring mandibular arch space closure are the atrophic (*resorbed*) edentulous spaces in the areas of the lower second premolars (*Fig. 49*).

It was not possible to correct the midline deviation with the routine space closure mechanics employed (*Figs. 35-36*). In retrospect, an OrthoBoneScrew® (*OBS*) in the right buccal shelf [5] was indicated

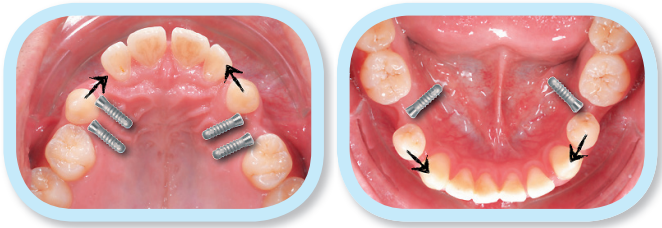

Fig. 47:

The most obvious treatment plan for a patient with six missing premolars and generalized spacing is preprosthetic orthodontics to prepare the edentulous areas for six implant-supported prostheses

Fig. 48:

The straight profile and appropriate axial inclination of the maxillary incisors is an important diagnostic consideration favoring space closure in the mandibular arch.

to provide osseous anchorage to correct the mandibular midline discrepancy (*Fig. 50*). The OBS approach would have considerably improved the occlusal interdigitation (*Figs. 45-46*) and the anterior alignment. In addition, the overjet could have been reduced by adjusting the marginal ridges on the maxillary incisors (*Fig. 51*). Overall, it appears that the use of OBS anchorage would have considerably improved the ABO cast-radiograph score of 27.

When an implant is placed, its position within the bone housing is the major determinant of the outcome. The Taiwan Star system has a 1.2mm smooth collar at the neck. According to the manufacture's handbook,[6] such implant fixtures can be placed as either submerged (*smooth collar in bone*) or non-submerged (*Fig. 52*). Under the present circumstances, the depth of implant placement and the abutment selection significantly impact the final prostheses. If the implant is placed as a submerged fixture, the crown margin should be located on the cuff height of the multi-post abutment (*Fig. 52*). Thus, the biological width can be accommodated by the cuff height of 2.5mm and the implant-abutment connection. On the other hand, if the implant is placed as non-submerged (*exposed*) fixture, the crown margin should be located on the implant platform, leaving the 1.2mm smooth collar for the biological width.

In the #12 area, the implant was placed as a non-submerged fixture. Following the unloaded healing phase, a multi-post abutment was used. Since the crown margin was located on the abutment, there was an unesthetic dark shadow at the gingival margin. In retrospect, a solid abutment would more

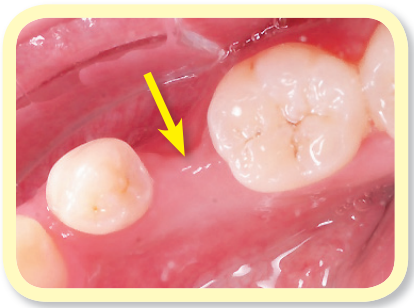

Fig. 49:
The atropic ridge would complicate the dental implant treatment.

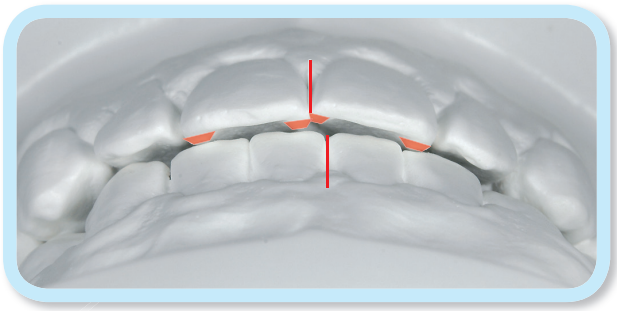

Fig. 51:
The overjet could have been reduced by adjusting the marginal ridges (shown as orange shadows) on the maxillary incisors

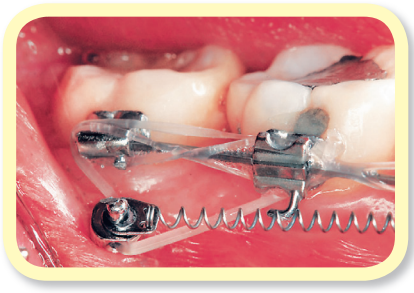

Fig. 50:
The OBS in the buccal shelf was indicated to provide osseous anchorage to correct the mandibular midline discrepancy.

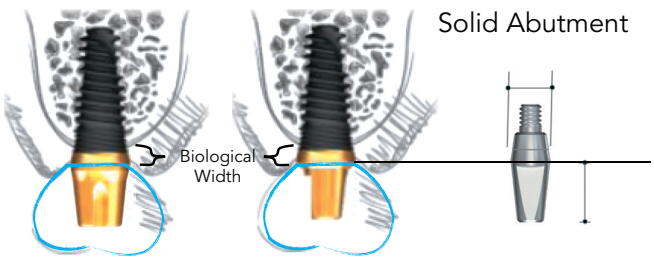

Fig. 52:
The selection of abutment should be different based on different depth that TS implant fixture was placed.

appropriate for a better esthetic result.

There are increasing needs for dental implants in oral rehabilitation, but atrophic edentulous sites are a common problem (*Fig. 54*). The maxillary sinus elevation and grafting technique are effective and predictable surgical procedures for augmenting the available bone volume in the posterior maxilla.[7] There are two common approaches for maxillary sinus elevation: a lateral window (*a modified Caldwell-Luc procedure*),[8,9] and the osteotome technique (*crestal approach*).[10] The choice of the method is primarily dependent on residual bone height, implant length, and amount of bone grafting required.11 Residual bone height is usually the most important factor in determining which augmentation technique that is most appropriate (*Fig. 55*).[1,12]

When the residual bone height is less than 4mm, the lateral window approach is preferred, because it offers a direct view of the sinus and better control of the surgical site. The implants can be placed simultaneously, if there is sufficient residual bone to provide primary stability. Alternatively, the implants can be placed after the graft maturation.

If the residual bone height is 4-5mm, the crestal approach may be indicated to lift the sinus membrane about 3-4mm to place an 8mm implant. The crestal approach is a more conservative surgery, with less post-operative discomfort, that focuses on localized augmentation of the sinus.

A residual bone height of 6-8mm is usually adequate for a short implant (*6-8mm*).[13] Short implants have proved reliable for patients with limited bone availability. The advantage is avoiding a ridge augmentation procedure, but masticatory stress

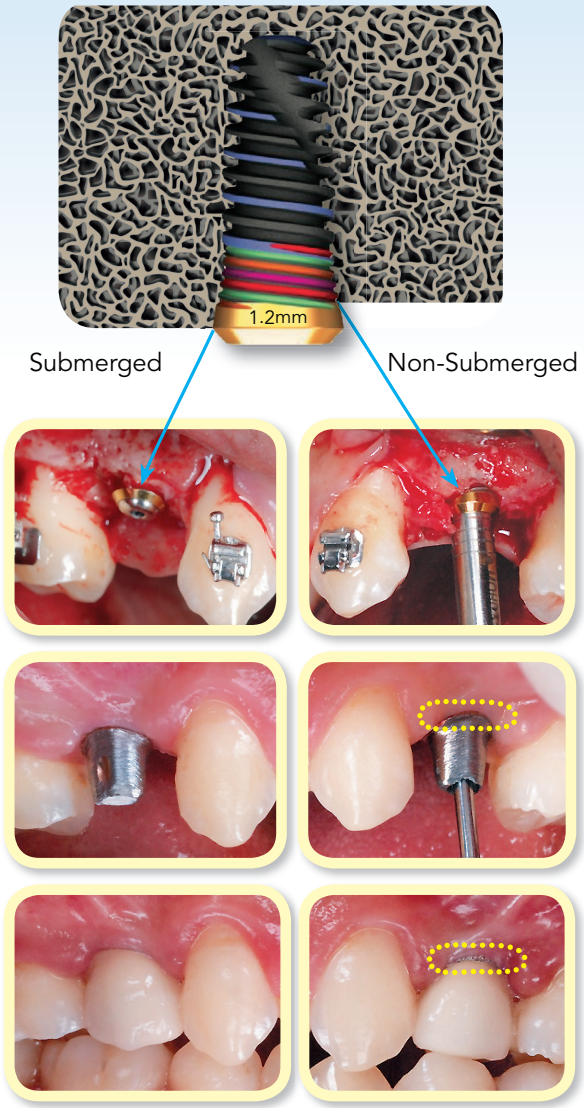

Fig. 53:

The TS implant fixture can be placed as submerged or non-submerged. The depth of the placement and the selection of abutment both impact the result of the final prostheses.

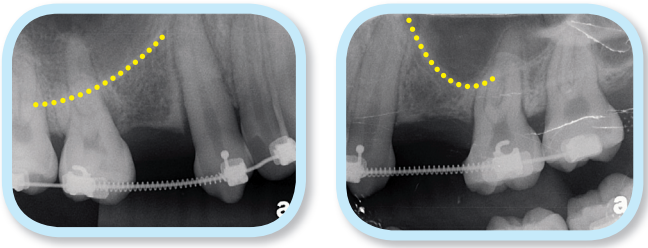

Fig. 54:

Atrophic edentulous sites are a common problemin the rehabilitation of the edentulous posterior maxilla with implant-supported prostheses.

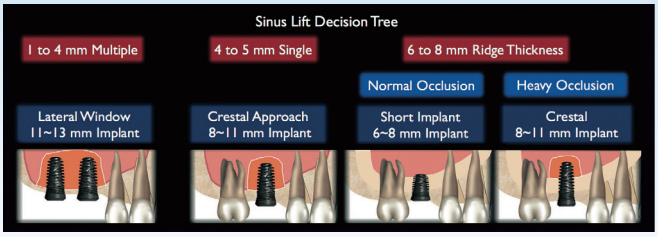

Fig. 55:

The choice of the method is primarily dependent on residual bone height, implant length, and amount of bone grafting required

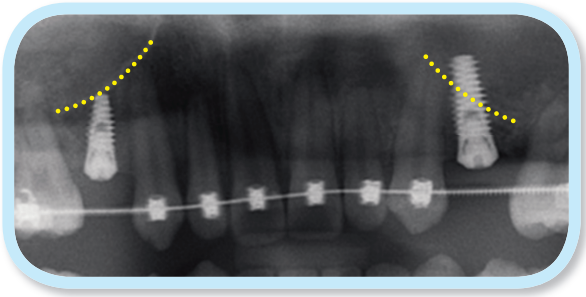

Fig. 56:

In the #12 area, the sinus membrane should have been elevated 3-4mm and a shorter (8 or 9mm) implant could have been used to reduce the chance of sinus membrane perforation

Fig. 57

A drill with a vertical stop could be used to control the depth of drilling and avoid penetrating the floor of the sinus.

must be managed by a shorter implant. Because of this mechanical disadvantage, short implants are often increased in width to increase the surface area of the bone-implant interface.

In light of the above decision-making process, the implant procedure in the #12 area could have been managed more effectively. The sinus membrane should have been elevated 3-4mm and a shorter (*8 or 9mm*) implant could have been used to reduce the chance of sinus membrane perforation (*Fig. 56*).[14,15] The osteotome technique is recommended when more than 6mm of residual bone height is present and an increase of about 3 to 4mm is expected.[15]

In the #5 area, the same osteotome technique resulted in sinus membrane perforation which required a more extensive surgical repair.[16] Sinus membrane perforation is not an absolute indication for aborting an augmentation procedure, but care should be taken during the drilling procedure. A drill with a vertical stop could be used to control the depth of drilling and avoid penetrating the floor of the sinus (*Fig. 57*). In retrospect, since the lateral window was performed in the #5 area, the implant length could have been longer (*~10-12mm*), instead of a short implant (*8.5mm*). The longer implants would have provided a long-term mechanical advantage for resisting functional stress.

Conclusion

Generally, treatment of oligodontia, six or more missing teeth, is a challenging restorative task.[17] To optimize both esthetic and functional outcomes, interdisciplinary management with orthodontics, implants, and prostheses is commonly required. For maximal patient benefit, an ordered diagnostic and treatment planning process is indicated:

Diagnosis should include a careful history of this familial trait. The patient may have family members who could benefit from interceptive orthodontics treatment.

Treatment planning is based on the facial profile and occlusion. For acquired malocclusions, space management may require orthodontics. Modest alignment problems can be restored with implants and prostheses. Implant site development with orthodontics is often a viable option.[17]

Orthodontics treatment is used to consolidate space and improve the occlusion to an acceptable level. Dental implants are placed in edentulous spaces, allowed to heal, and the gingival collar is developed, while the orthodontics is completed. After the fixed appliances are removed, abutments are fitted, prostheses fabricated, and the occlusion is restored.

When interdisciplinary "*ortho-implant-pros*" treatment is necessary, effective coordination is absolutely essential and is always challenging.

The result of the present case is not perfect; nevertheless, the report is still valuable information for most clinicians. Carefully analyzing the results provides an opportunity to improve methodology and develop a more comprehensive treatment philosophy.

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Discrepancy Index Worksheet

TOTAL D.I. SCORE 44

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 = 17

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 = 2

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. =	2
Missing teeth (except 3rd molars)	_____ x 1 pts. =	_____
Missing teeth, congenital	6 x 2 pts. =	12
Spacing (4 or more, per arch)	2 x 2 pts. =	4
Spacing (Mx cent. diastema ≥ 2mm)	@ 2 pts. =	_____
Tooth transposition	_____ x 2 pts. =	_____
Skeletal asymmetry (nonsurgical tx)	@ 3 pts. =	_____
Addl. treatment complexities	_____ x 2 pts. =	_____

Identify:

Total = 18

IMPLANT SITE

Lip line : Low (0 pt), Medium (1 pt), High (2 pts) = 0

Gingival biotype : Low-scalloped, thick (0 pt), Medium-scalloped, medium-thick (1 pt), High-scalloped, thin (2 pts) = 2

Shape of tooth crowns : Rectangular (0 pt), Triangular (2 pts) = 2

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) = 0

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) = 1

Soft tissue anatomy : Intact (0 pt), Defective (2 pts) = 0

Infection at implant site : None (0 pt), Chronic (1 pt), Acute(2 pts) = 0

Total = 5

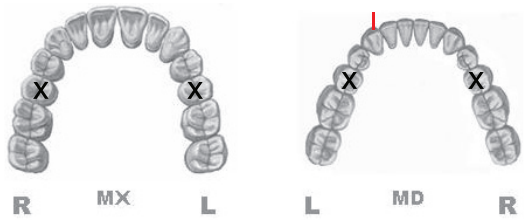
Cast-Radiograph Evaluation

Case # Patient

Total C-R Eval Score: 27

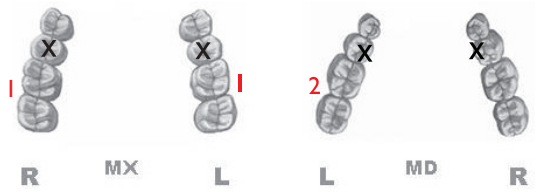
Alignment/Rotations

1



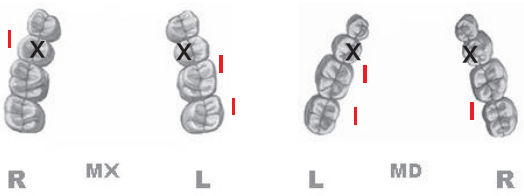
Marginal Ridges

4



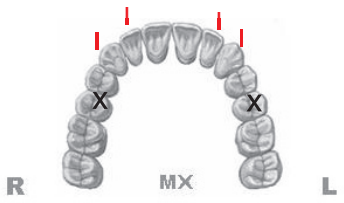
Buccolingual Inclination

6



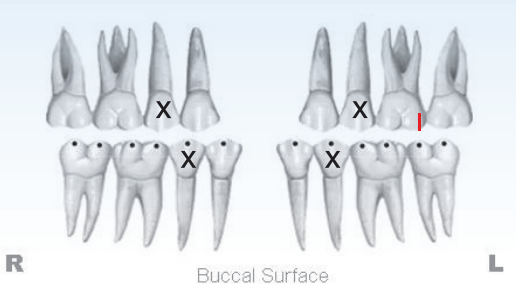
Overjet

4



Occlusal Contacts

2

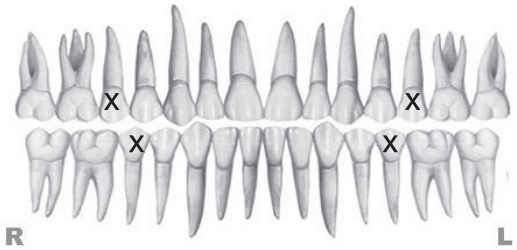


Occlusal Relationships

7

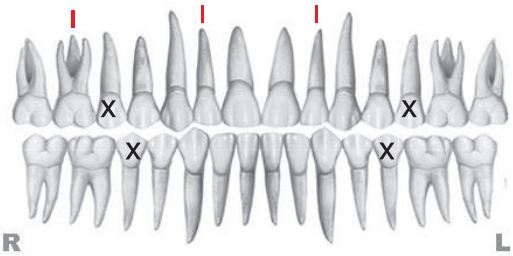
Interproximal Contacts

0



Root Angulation

3



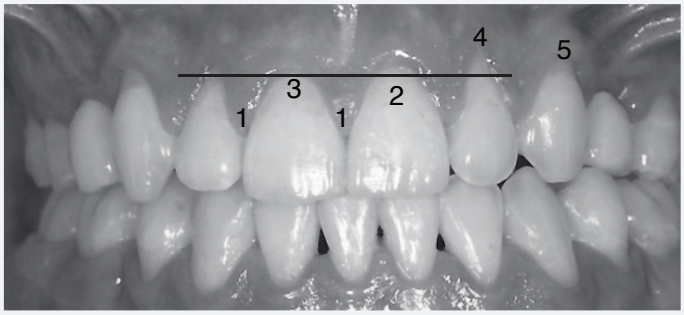
INSTRUCTIONS: Place score beside each deficient tooth and enter total score for each parameter in the white box. Mark extracted teeth with "X". Second molars should be in occlusion.

IBOI Pink & White Esthetic Score

Total Score: = 9

1. Pink Esthetic Score

Total = 4

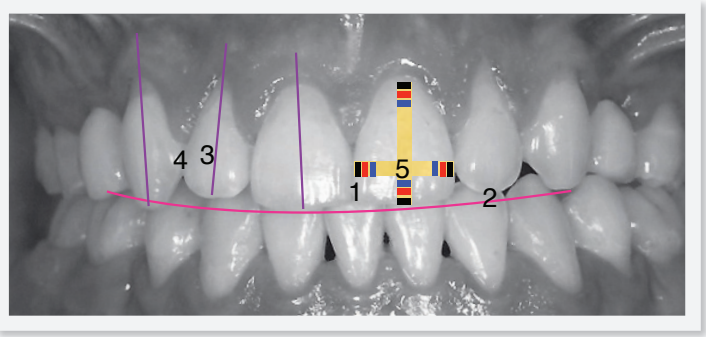


1. M & D Papillae	0	1	2
2. Keratinized Gingiva	0	1	2
3. Curvature of Gingival Margin	0	1	2
4. Level of Gingival Margin	0	1	2
5. Root Convexity (Torque)	0	1	2
6. Scar Formation	0	1	2

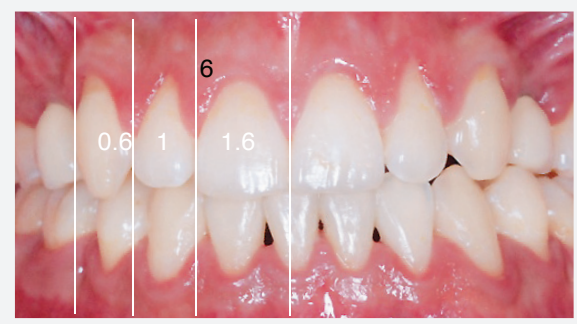
1. M & D Papillae	0	1	(2)
2. Keratinized Gingiva	(0)	1	2
3. Curvature of Gingival Margin	(0)	1	2
4. Level of Gingival Margin	(0)	1	2
5. Root Convexity (Torque)	0	(1)	2
6. Scar Formation	(0)	1	2

2. White Esthetic Score (for Micro-esthetics)

Total = 5



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	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	(0)	1	2
6. Tooth to Tooth Proportion	(0)	1	2

IBOI Pink & White Esthetic Score

1. Pink Esthetic Score

Total = 1

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 = 1

1. Tooth Form	(0)	1	2
2. Mesial & Distal Outline	(0)	1	2
3. Crown Margin	(0)	1	2
4. Translucency (Incisal third)	0	(1)	2
5. Hue & Value (Middle Third)	(0)	1	2
6. Tooth Proportion	(0)	1	2

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

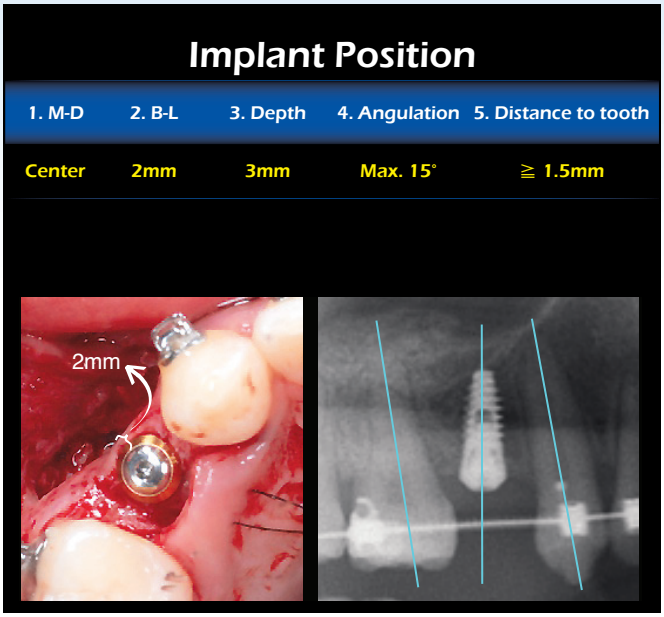
2. White Esthetic Score (for Micro-esthetics)

Total = 2

1. Tooth Form	(0)	1	2
2. Mesial & Distal Outline	(0)	1	2
3. Crown Margin	0	(1)	2
4. Translucency (Incisal third)	(0)	1	2
5. Hue & Value (Middle Third)	(0)	1	2
6. Tooth Proportion	0	(1)	2

IBOI Implant-Abutment Transition & Position Analysis

3. Implant Position



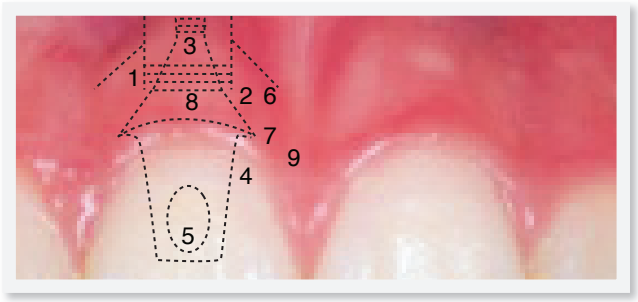
Total = 2

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

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

Total = 2

4. Abutment transition Contour



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

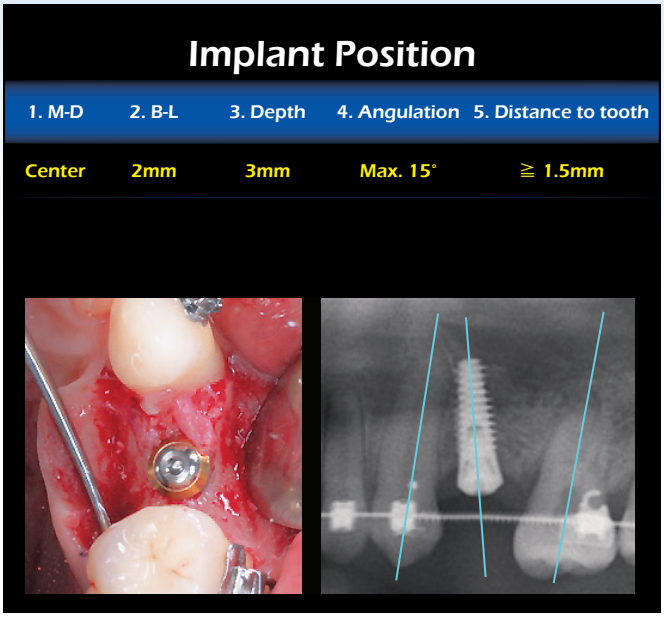
1. Fixture Cervical Design	N	Y			
2. Platform Switch N Y	N	Y			
3. I-A Connection Type	E	I			
4. Abutment Selection	S	C			
5. Screw Hole Position	P	B			
6. Marginal Bone Loss	N	Y	0	1	2
7. Modified Gingival Contour	N	Y	0	1	2
8. Gingival Height	N	Y	0	1	2
9. Crown margin fitness	N	Y	0	1	2

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

IBOI Implant-Abutment Transition & Position Analysis

3. Implant Position

Total = 2

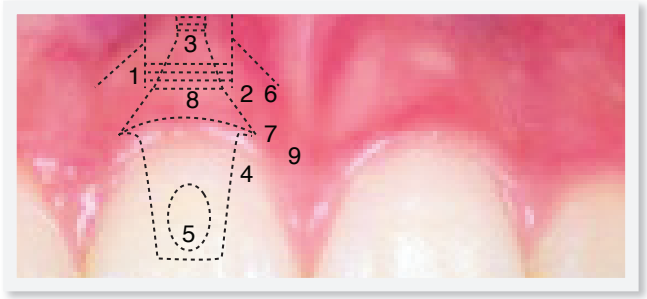


1. M & D (Center)	0	1	2
2. B & L (Buccal 2 mm)	0	1	2
3. Depth (3 mm)	0	1	2
4. Angulation (Max. 15°)	0	1	2
5. Distance to Adjacent Anatomy	0	1	2

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

Total = 2

4. Abutment transition Contour



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

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

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