

Congenital Absence of Maxillary Second Premolars: Orthodontics, Sinus Lift Bone Graft, and Implant-Supported Prosthesis

Abstract

History: Congenital absence of maxillary second premolars is a familial trait with a prevalence of about 1.5% worldwide.

Diagnosis: A 15-year-11-month old male presented with a chief complaint (CC) of unattractive smile due to irregular teeth and spacing. Both maxillary second premolars were missing. The upper right second deciduous molar was retained, but there was a partially-closed edentulous space on the left side. Clinical examination revealed a bilateral Class I molar relationship, lingually tipped upper and lower incisors (U1-SN 93.5°, L1-MP 85°), upper right canine crossbite, as well as spaces mesial and distal to the lower left canine (LL3). The discrepancy index (DI) was 17.

Treatment: Align the dentition, open space for an implant-supported prosthesis (ISP) to restore the upper left second premolar (UL5). Decrease the width of the upper right primary second premolar to 7mm and retain it for as long as possible. Preprosthetic orthodontics treatment duration was 20 months. Implant placement was delayed for 7 months for completion of adolescent facial growth. The UR5 area implant was placed with a simultaneous sinus elevation graft. After a 5 months healing phase, the implant was uncovered, and soft tissue was formed for 2 months with a healing cap. The abutment was placed and adjusted to achieve 2mm of interocclusal clearance. The final crown was delivered 2 weeks later. Interdisciplinary treatment duration including the growth completion delay was 28 months.

Results: The dentition was aligned and all spaces were closed except for the UL5 edentulous site that was prepared for an ISP. Following completion of the ISP to restore the UL5, the overall treatment was excellent, as evidenced by a Cast Radiograph Evaluation (CRE) score of 17, and dental esthetics pink and white (P&W) score of 3. (*J Digital Orthod* 2019;53:30-50)

Key words:

Interdisciplinary treatment, adolescent treatment, congenitally missing maxillary second premolar, implant placement, 2B-3D rule, sinus lift, osteotome, bone augmentation

Introduction

Dental nomenclature for this report is a Palmer notation: upper right (UR), upper left (UL), lower right (LR), and lower left (LL) quadrants. Teeth in each quadrant are numbered 1-8 from the midline. Other than third molars, congenitally missing maxillary second premolars (U5s) are the second most common dental agenesis, exceeded by the mandibular second premolars (L5s), and followed by maxillary lateral incisors (L2s).¹ Long-term absence of an U5 can lead to an atrophic ridge and maxillary sinus pneumatization (*enlargement*). Bone resorption superior and inferior to the osseous site results in inadequate bone height to accommodate an implant. Maxillary sinus elevation is a common method for enhancing an inadequate site to achieve longterm stability of an ISPs.²

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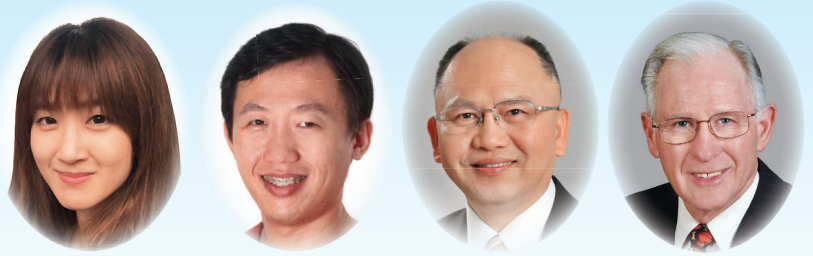
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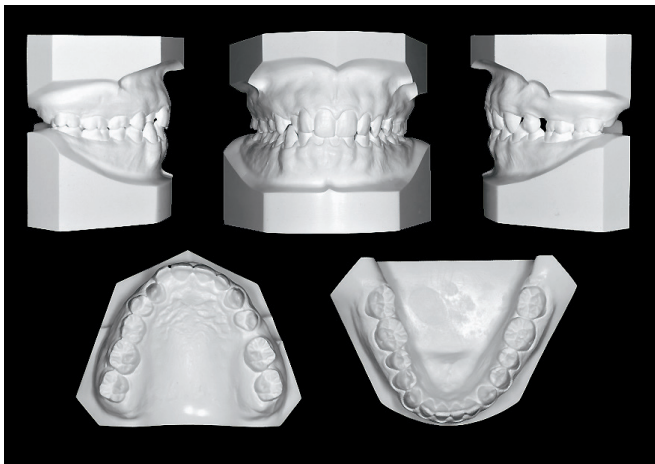
Congenitally missing teeth are frequently encountered in young patients, but there is general agreement that implant placement should be postponed until after the adolescent growth spurt is complete. Common methods for estimating remaining growth are radiographic maturation of the hand wrist³ and cervical vertebrae⁴ areas. It is important to determine that adolescent growth is over or nearly so before placing dental implants in esthetically sensitive areas.



■ Fig. 1: Pre-treatment facial and intraoral photographs

Diagnosis and Etiology

A 15-year-11-month old male sought consultation for his irregular teeth and interdental spaces (Figs. 1-4). There is a history of congenitally missing teeth in the family.¹ Extraoral evaluation showed facial symmetry, and a straight profile. Intraoral buccal relationships were a bilateral Class I, but both arches were narrow. There was palatal crossbite of the UR3, a retained deciduous upper right second molar, a missing UL5, and spaces in the left anterior portion of the lower arch. The UL4 was rotated mesial-out and tipped into the edentulous UL5 space. The lower midline was shifted to the right side about 3mm. Pre-treatment cephalometrics revealed a skeletal Class I relationship ($SNA\ 81.5^\circ$, $SNB\ 80.5^\circ$, $ANB\ 1^\circ$), linguo-tilted maxillary and mandibular incisors ($U1-SN$



■ Fig. 2: Pre-treatment dental models (casts)

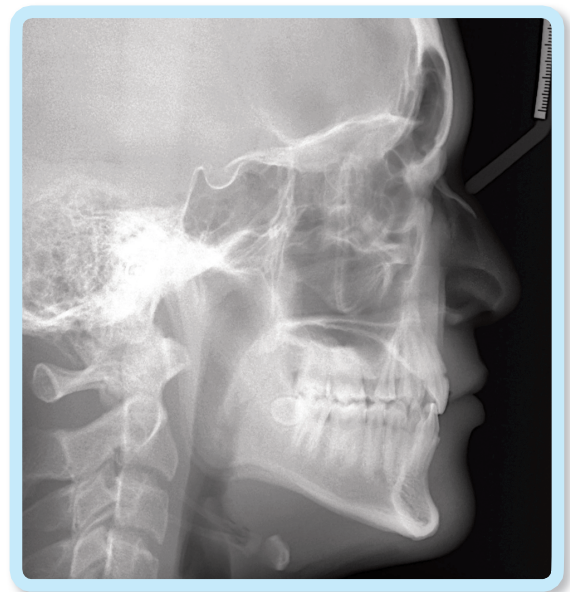


■ Fig. 3: Smile evaluation in the frontal view shows excessive buccal corridors.



■ Fig. 4: **Left:** Decreased axial inclination is noted for the upper and lower incisors. **Right:** Frontal view of the lower anterior spacing and irregularity.

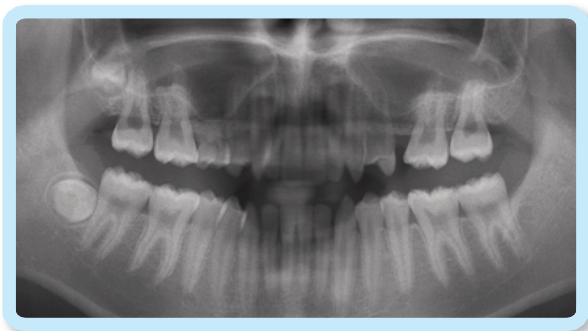
93.5° , $L1-MP\ 85^\circ$), and retrusive upper and lower lips ($-5.5mm/-3.5mm$ to the E-Line) (Fig. 5 & Table 1). The panoramic radiograph showed multiple missing teeth: UR5, UL5, UL8 and LL8. The ridge in the missing UL5 area was atrophic and the associated maxillary sinus was enlarged (Fig. 6). Temporomandibular joint (TMJ) radiographs (Fig. 7) were within normal limits (WNL), and there were no signs or symptoms of temporomandibular disorder (TMD). The discrepancy index (DI) was 17 points including 4 supplemental points for implant site complexity.⁵ For details refer to the first worksheet at the end of this report.



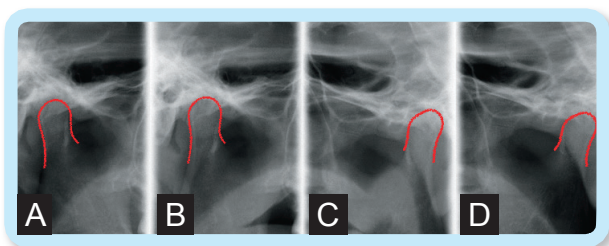
■ Fig. 5: Pre-treatment lateral cephalometric radiograph

CEPHALOMETRIC SUMMARY			
SKELETAL ANALYSIS			
	PRE-Tx	POST-Tx	DIFF.
SNA°	81.5°	82°	0.5°
SNB°	80.5°	81°	0.5°
ANB°	1°	1°	0°
SN-MP°	27.5°	29°	1.5°
FMA°	20.5°	22°	1.5°
DENTAL ANALYSIS			
U1 To NA mm	2 mm	1.5 mm	0.5 mm
U1 To SN°	93.5°	98°	4.5°
L1 To NB mm	0.5 mm	1.5 mm	1 mm
L1 To MP°	85°	84°	1°
FACIAL ANALYSIS			
E-LINE UL	-5.5 mm	-7 mm	1.5 mm
E-LINE LL	-3.5 mm	-5.5 mm	2 mm
%FH: Na-ANS-Gn	58%	58%	0%
Convexity: G-Sn-Pg'	1°	0.5°	0.5°

■ Table 1: Cephalometric summary



■ Fig. 6: Pre-treatment panoramic radiograph



■ Fig. 7: Pre-treatment TMJ radiographs are transcranial views of the right side open (A) and closed (B), as well as the left side open (C) and closed (D).

Treatment Objectives

1. Increase the axial inclination of the incisors
2. Relieve maxillary crowding
3. Maintain Class I occlusion
4. Maintain a harmonious straight profile
5. Prepare the UL5 area as an implant site

Treatment Alternatives

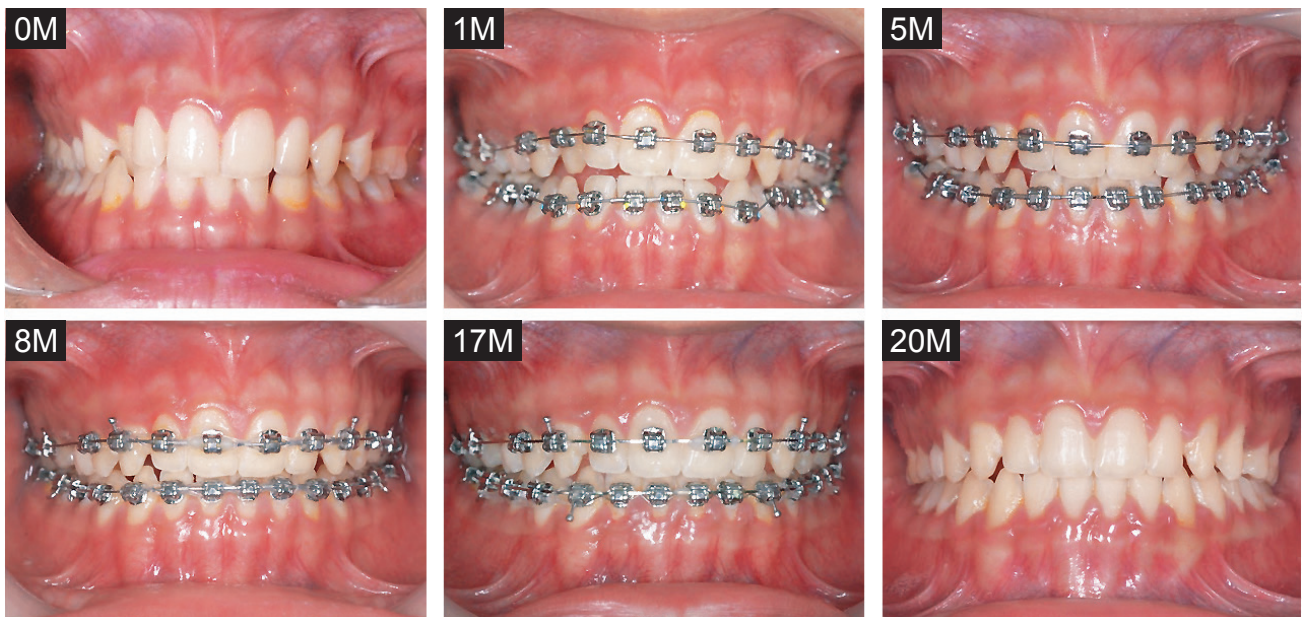
An alternate option was to extract the retained primary molar and close the bilateral U5 spaces to achieve Class II molar and Class I canine relationships. The distinct advantage for this approach is avoiding restorative procedures, which has both immediate and longterm implications. Two ISPs will be required at some point due to the limited longevity of the UR primary second molar. All prosthetic procedures require substantial maintenance over a life expectancy of >70 years. In addition to considerable expense, patients experience inconvenience and some degree of compromised esthetics and function. In retrospect, closure of the U5 spaces without compromising the lip profile was a viable option because adequate overbite (Fig. 5) was available to provide anchorage to protract the maxillary buccal segments to close the U5 spaces without retracting the incisors.⁶ In addition, the sagittal anchorage could be supported by applying lingual root torque to the lower incisors (Table 1). Although this treatment alternative is the most cost-effective option for managing the present malocclusion, the use of overbite and lower incisor torque for sagittal anchorage are sophisticated biomechanics concept, that is not obvious to a lay person. The patient was concerned about avoiding a dished-in profile, so an ISP to restore the UL5 was

a lower risk choice from his perspective because decreased lip protrusion was highly undesirable.

Treatment Progress

A fixed 0.022-in slot Damon Q® bracket system (Ormco, Glendora, CA) was used with archwires and accessories produced by the same manufacturer (Fig. 8). Bracket torque selection for anterior teeth was standard for both arches. In the 1st month of the treatment, the upper arch was bonded except for the UR second deciduous molar, which remained unbonded throughout treatment (Fig. 9). UL5 implant site development was initiated with a compressed coil spring between the UL4 and UL6 (Figs. 10 and 11). Bite turbos composed of glass ionomer cement (GC America, Alsip IL) were bonded on the occlusal surface of LR6 and LL6 to prevent bracket interference and facilitate UR3 crossbite correction

(Fig. 9). One month later (2M), a corresponding series of brackets was bonded on the lower arch, and the initial archwire was a 0.014-in copper-nickel-titanium (CuNiTi). After 3 months of leveling and alignment (5M), the crossbite was resolved (Fig. 9). Two anterior bite turbos were constructed on the palatal surfaces of upper central incisors to open the bite and serve as a guide planes for the lower incisors (8M in Fig. 11). L-type Class II elastics (Parrot 5/16-in, 2-oz) from the upper canines to the lower 1st and 2nd molars were used bilaterally to correct the sagittal discrepancy, and to extrude the mandibular posterior teeth. The upper and lower archwires were changed to 0.018-in CuNiTi and 0.014x0.025-in CuNiTi, respectively. In the 7th month of treatment, the maxillary archwire was changed to 0.017x0.025-in titanium-molybdenum-alloy (TMA). An open coil spring was used to retain the implant space. Elastomeric chains were applied to consolidate both arches. A 0.019x0.025 pre-Q NiTi

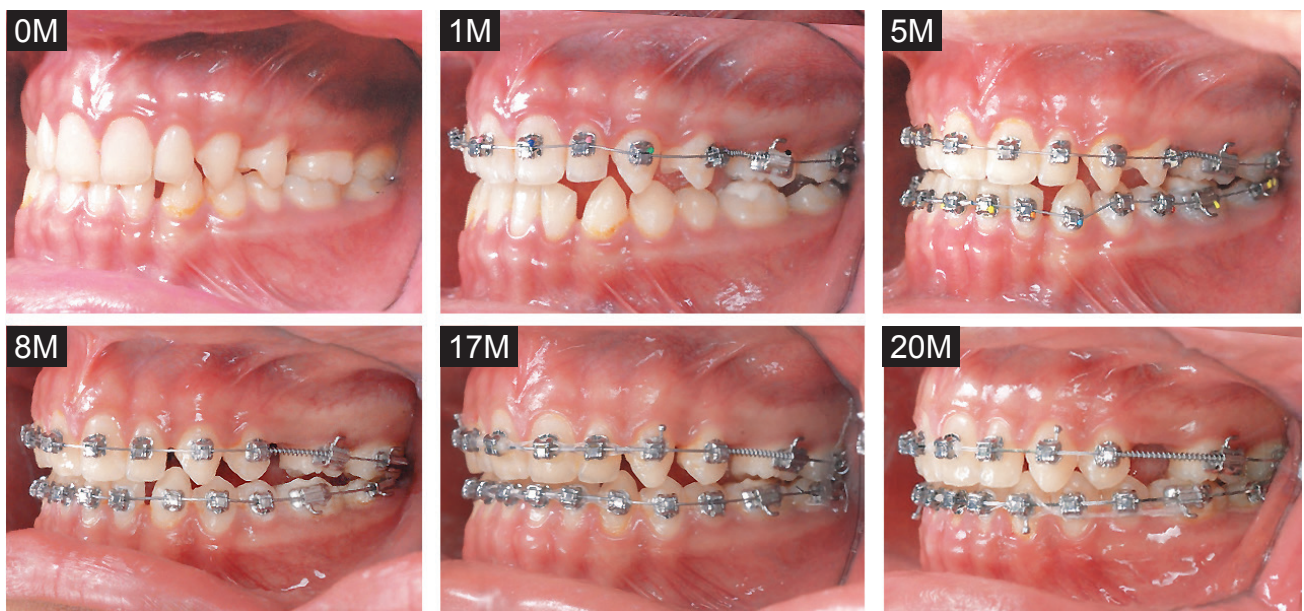


■ Fig. 8:

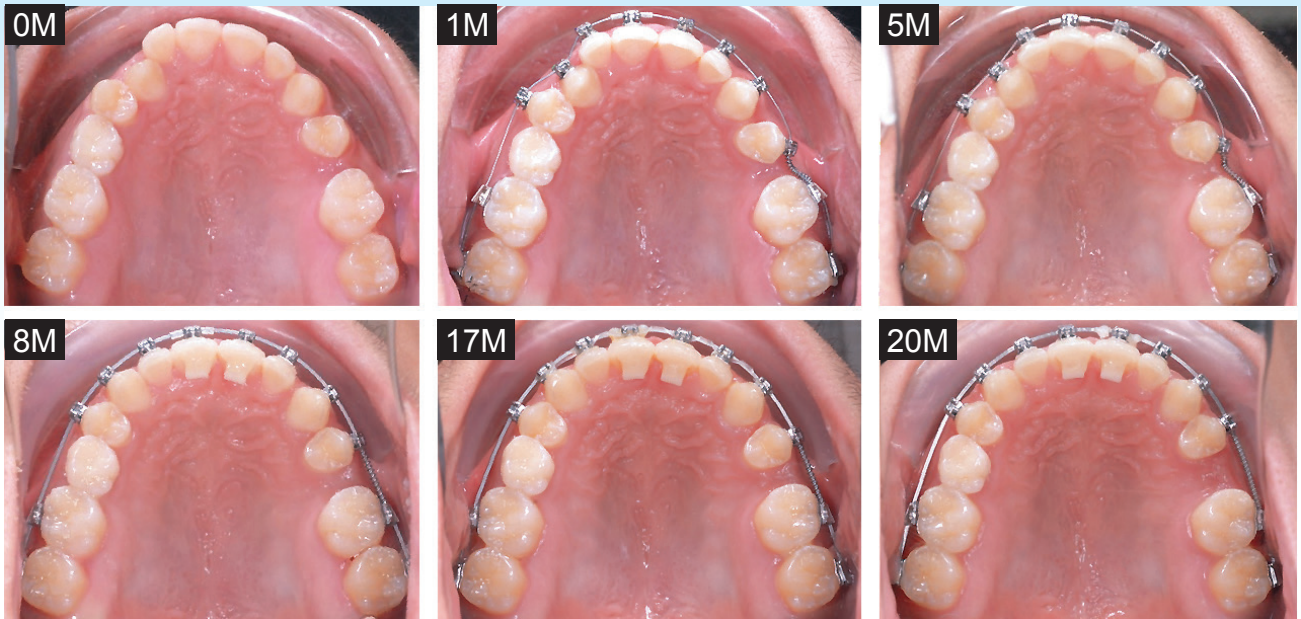
A progressive series of maxillary frontal views show treatment progress from start (0M) to the twenty months (20M) finish.



■ **Fig. 9:**
 A progressive series of right buccal views from the start (0M) to twenty months (20M) document alignment of both arches. Note a bite turbo on the occlusal surface of the LR6 was used to facilitate correction of the UR3 crossbite. There was no bracket bonded on the maxillary deciduous second molar. See text for details.



■ **Fig. 10:**
 A progressive series of left buccal views from the start (0M) to twenty months (20M) document alignment of both arches. See text for details.

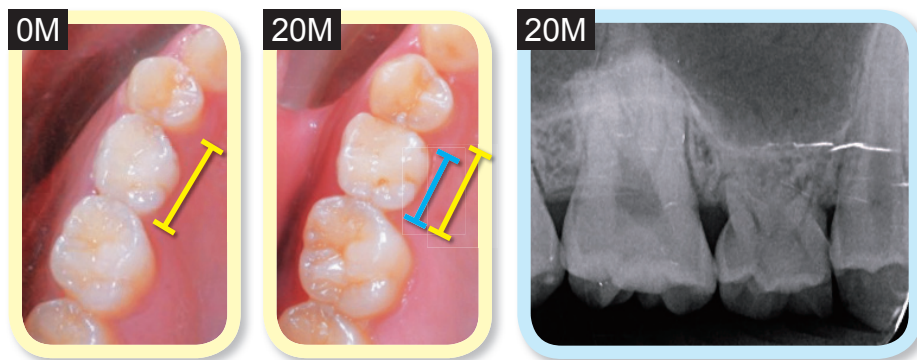


■ Fig. 11:

A progressive series of maxillary occlusal views from the start (0M) to twenty months (20M) document alignment. Two anterior bite turbos were constructed on the palatal surfaces of upper central incisors to open the bite and serve as guide planes for the lower incisors. See text for details.

wire was used for upper incisor lingual root torque, and a 0.017x0.025-in TMA was used in the lower arch. In the 14th month, both arches were changed to 0.016x0.025-in stainless steel. L-type Class II elastics (Fox 1/4-in, 3.5-oz) were applied bilaterally from the upper canines to the lower 1st and 2nd molars. In the last 2 months of treatment, the lower midline shifted to the right about 1mm (Fig. 8) with a L-type Class II elastic (Fox 1/4-in, 3.5-oz) applied

to the right side. The UR deciduous second molar was reduced to 7mm in the mesiodistal dimension to hold space for an ISP to restore the UR5 when the deciduous molar exfoliates (Fig. 12). In the 20th month, the lower arch space was closed, maxillary incisor axial inclinations were corrected, and the length of the UL5 implant site was increased from 3 to 7mm. After 20 months of active treatment, all fixed appliances were removed and interim records were obtained (Figs. 13-17).

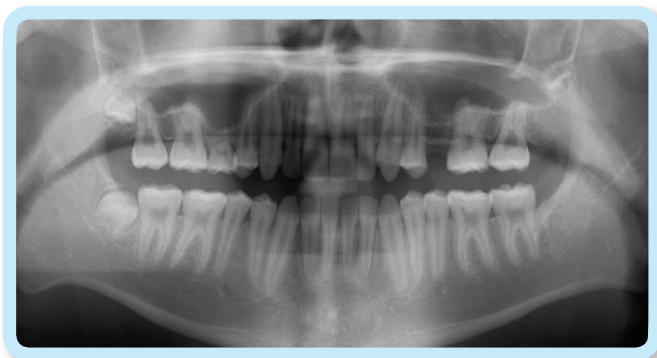


■ Fig. 12:

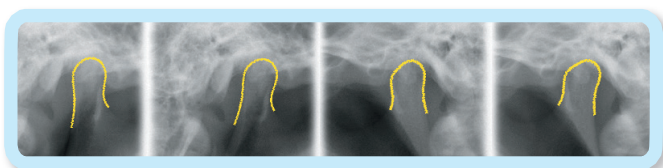
Left: At the start of treatment (0M) the mesio-distal width of the retained deciduous molar is 10mm as shown with a yellow bar.
Central: At twenty months (20M) the deciduous molar width was reduced to 7mm as shown by the blue bar in comparison to the original width (yellow bar).
Right: A periapical radiograph exposed at 20M shows the reduced width of the deciduous molar.



■ Fig. 13: Post-treatment facial and intraoral photographs



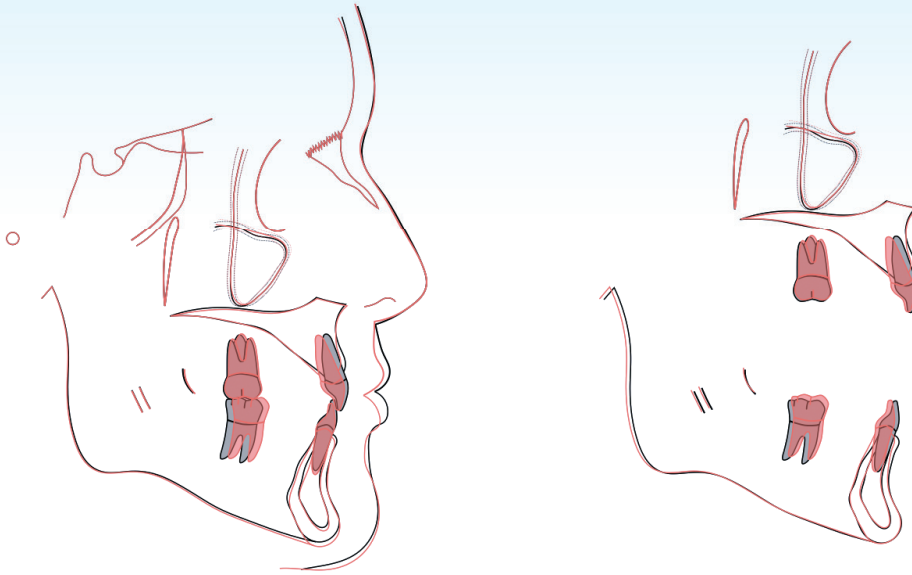
■ Fig. 14: Post-treatment panoramic radiograph



■ Fig. 15:
Post-treatment TMJ radiographs correspond to the pretreatment TMJ views in Figure 7. All morphology is WNL.



■ Fig. 16: Post-treatment lateral cephalometric radiograph



■ Fig. 17:

Superimposed cephalometric tracings showing dentofacial changes over 20 months of treatment (red) compared to the pre-treatment position (black). See text for interpretation and treatment details.

Retention

Upper and lower clear overlay retainers were delivered for both arches, but no fixed retainers were deemed necessary. The patient was instructed to wear them full time for the first 6 months and nights only thereafter. Instructions were provided for home hygiene as well as for maintenance of the retainers.

Treatment Results

After 20 months of active orthodontic treatment, all spacings were closed except the 7mm long UL5 implant site. The UR3 crossbite and dental midline discrepancy were corrected. The patient was satisfied with the interim result, and was looking forward to the ISP. The post-treatment photographs are documented in Fig. 13. The post-treatment panoramic film (Fig. 14) shows some

minor axial inclination problems (LL3, LR3, and LR5) that were not clinically significant. Post-treatment TMJ radiographs document both condylar heads are symmetrical and well positioned in the fossa (Fig. 15). The superimposed cephalometric tracing revealed that upper and lower incisor torque (axial inclinations) were acceptable (Figs. 16 and 17). Maxillary incisor inclination was increased 4.5 degrees, but the mandibular incisor inclination was increased only 1 degree (Table 1). Slight facial growth was noted as evidenced by a 1mm increase in the length of the mandible (Fig. 17). The mandibular plane angle was increased 1.5 degrees, consistent with the application of Class II elastics. More retrusive upper and lower lips contributed to a more concave profile. These results were disappointing but still acceptable for a male patient (Figs. 16 and 17). The American Board of Orthodontics (ABO) cast

radiograph evaluation (CRE) score was 17 points, as shown in the supplementary CRE worksheet.⁷ The major residual discrepancies were marginal ridges (4), overjet (4), and occlusal contacts (3). Pink and white dental esthetics score was 3 points as detailed in the worksheet at the end of this case report. Discrepancies were incisal curve, contact area, and tooth proportion.⁸

Implant-Supported Prosthesis

Preoperative CBCT imaging assessed the alveolar bone volume at the UL5 site. The edentulous ridge was 10mm wide, but the vertical bone height (depth) was only 5mm (Figs. 18 and 19). The decreased depth of the implant site was due to extensive surface resorption on the atrophic periosteal ridge and enlargement of the maxillary sinus. Consulting the sinus lift decision making tree (Fig. 20) indicated a crestal approach with a standard length implant was appropriate. However, a sinus lift procedure was indicated to increase the osseous depth of the

implant site.⁹ Under local anesthesia a crestal incision was performed and a full thickness mucoperiosteal flap was reflected. The first lancer drill was positioned at the center of the edentulous ridge and 3mm palatal to the buccal plate. The drill then penetrated to a depth of 5mm and a surgical guide pin was placed in the osteotomy. A periapical X-ray was exposed to check the mesiodistal angulation and ensure there was no penetration of the sinus floor.

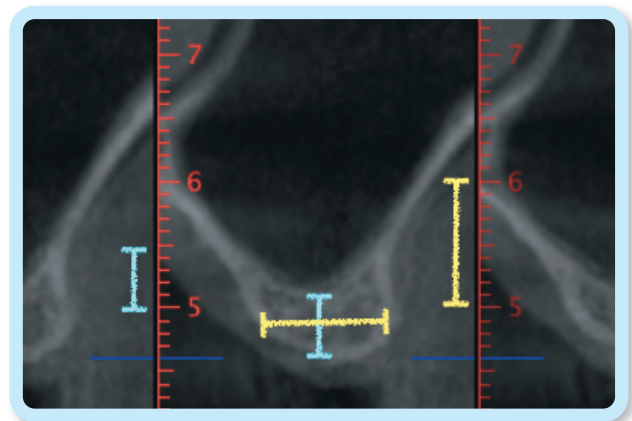


Fig. 19: A frontal CBCT cut through the UL5 implant site shows adequate ridge width (10mm, yellow line) but there is insufficient depth (5mm, blue line) for a 4x9mm implant.

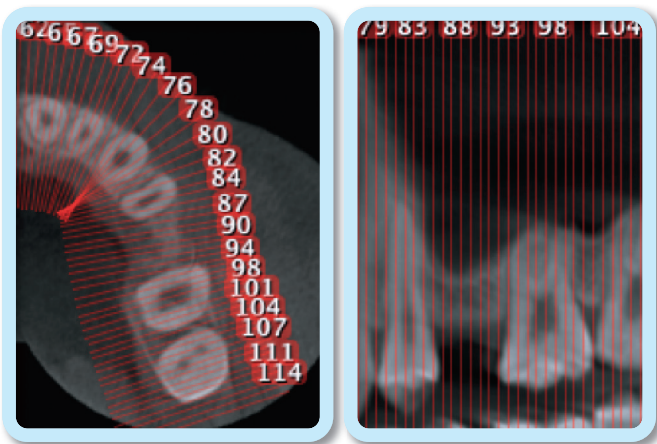


Fig. 18: A CBCT scan was used to evaluate the available bone at the implant site. Left: horizontal view of the maxilla with the scan cuts individually numbered. Right: midsagittal cut through the UL5 implant site.

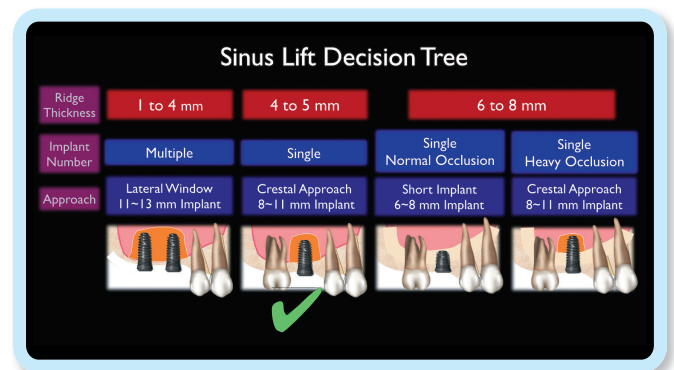
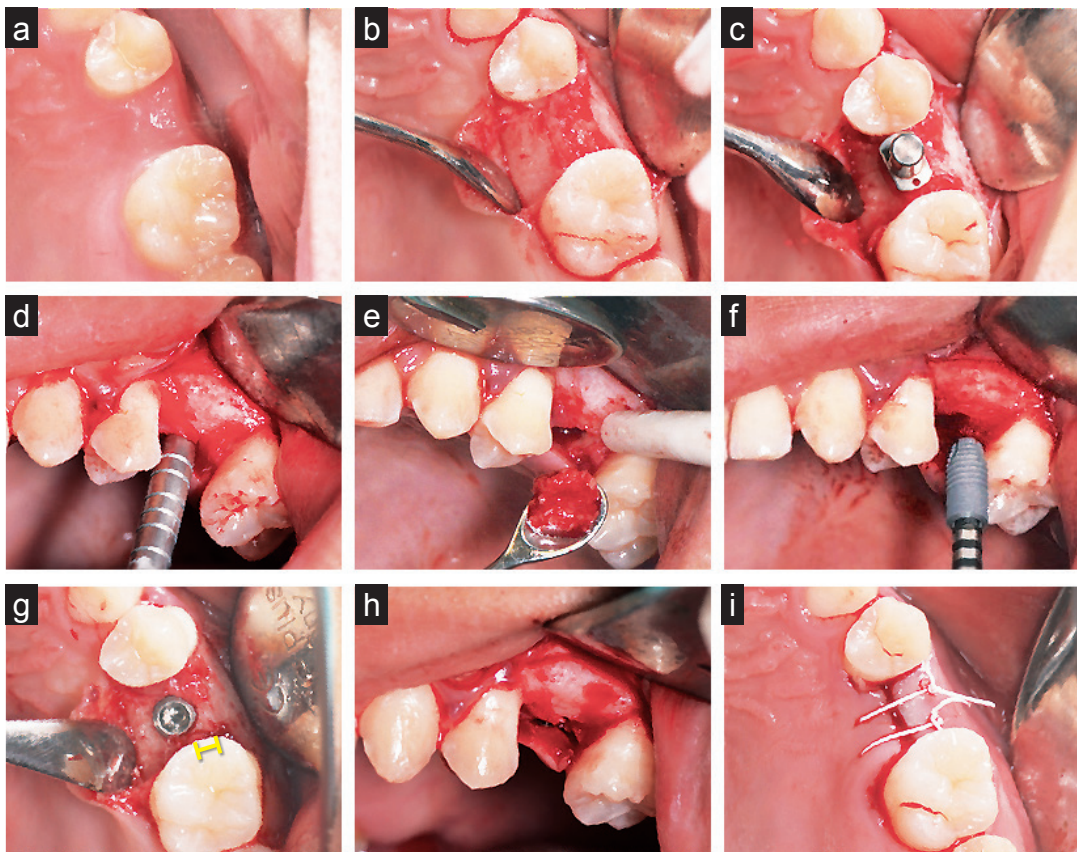


Fig. 20: The Sinus Lift Decision Tree devised by Dr. Homa Zadeh shows the preferred surgical procedure and implant size according to alveolar bone thickness inferior to the sinus, and the expected occlusal load (Normal or Heavy).

An osteotome was used to gently elevate the sinus floor and the overlying Schneiderian membrane.¹⁰ Freeze-dried bone allograft (FDBA) produced by Maxxeus Dental, Kettering OH (USA) was gently packed into the space prepared by the sinus elevation procedure. An implant fixture (4x9mm OsseoSpeed™ TX, Dentsply International, York, PA) was installed according to the manufacturer's instructions and a cover screw was placed. The soft tissue flap was repositioned and closed with interrupted 4-0 Gore-Tex® (Flagstaff, AZ) sutures (Fig. 21). A photograph (Fig. 21g) shows that the buccal bone thickness was >2mm which is ideal for the long-term success of the implant-supported prosthesis.¹¹ The prosthetic sequence for forming the soft tissue, placing an abutment, and delivering the implant-implant-retained crown is illustrated in Fig. 22. A periapical radiograph series shows the surgical and prosthetic sequence including the final radiograph documenting

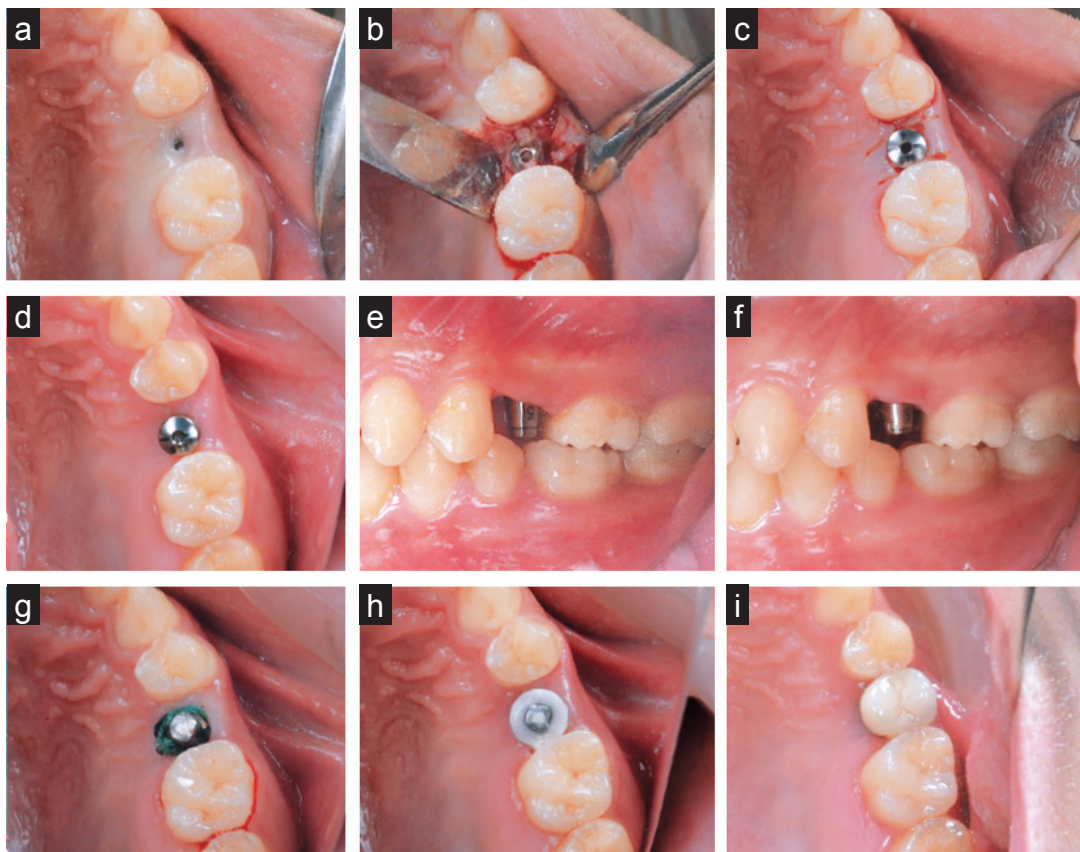


■ Fig. 21:

Steps involved in the placement of the implant are illustrated as follows: (a) UL5 edentulous site was prepared as a 7mm long implant space, (b) mid-crestal and sulcular incisions were performed for flap reflection, (c) a guide pin was placed to check axial direction and the depth of the initial osteotomy, (d) an osteotome is inserted into the osteotomy for sinus floor elevation, (e) freeze-dried bone augmentation (FDBA) material was packed into the osteotomy, (f) a 4x9mm implant fixture was inserted, (g) occlusal view of implant fixture and osseous ridge with a yellow bar showing the buccal bone thickness is >2mm, (h) buccal view of the osseous ridge with completely submerged implant fixture, (i) the flap was sutured with direct loop interrupted 4-0 GORE-TEX® sutures. See text for details.

the fit of the final prosthesis (Fig. 23). The post-surgical panoramic radiograph confirmed the accuracy of implant position and the integrity of the sinus membrane (Fig. 24).

After a 5-month osseointegration healing period, second stage surgery was performed to place a healing abutment ($\text{Ø}4.5\text{mm} \times H4.0\text{mm}$), and a periapical X-ray was taken to make sure the healing abutment was seated in the correct position. Following 2 months of soft tissue maturation, the healing abutment was replaced with a direct abutment ($\text{Ø}5.0\text{mm}$, 2.5mm height, 2.0mm cuff height). However, there was an insufficient occlusal clearance for porcelain-fused-to-metal crown fabrication, so a 1.0mm cuff height direct abutment was selected to replace the previous one for prosthesis fabrication. The abutment was trimmed

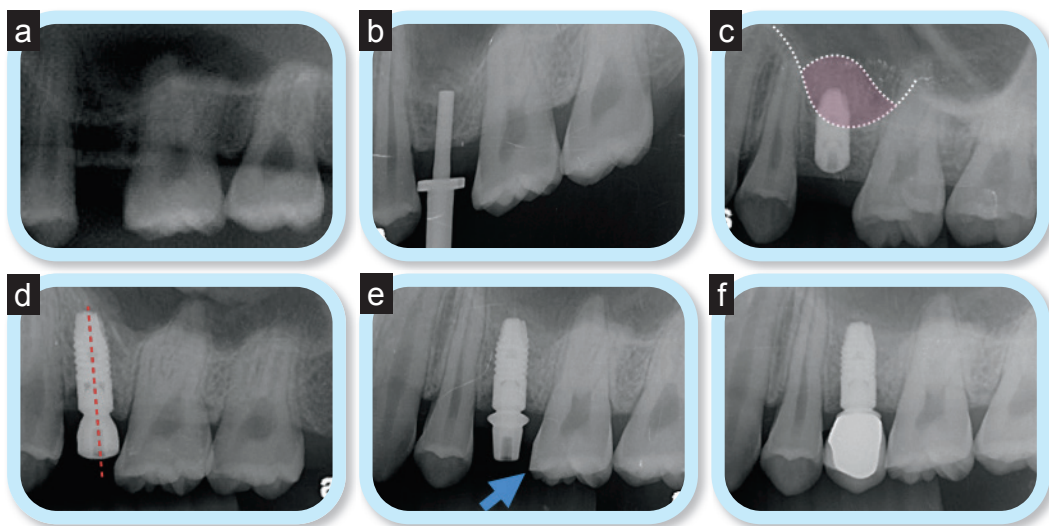


■ Fig. 22:

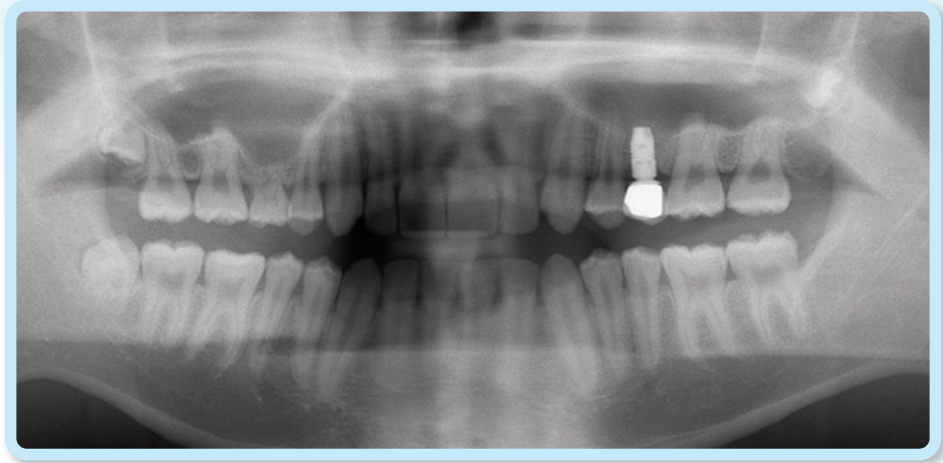
A panel of intraoral photographs show the prosthesis fabrication procedure 5 months after implant placement: (a) cover screw exposure was noted, (b) flap reflection for second stage surgery, (c) healing abutment was placed, and the flaps were repositioned and sutured, (d) after 2 months of soft tissue maturation, (e) direct abutment was installed, (f) the abutment was trimmed to obtain $\sim 1.5\text{mm}$ occlusal clearance, (g) a double cord gingival retraction technique was used to make a direct impression, (h) a Tony Cap was used as a substitute for provisional crowns and for soft tissue modeling, and (i) a PFM crown was delivered and luted with temporary cement 2 weeks later. See text for details.

extraorally with a diamond bur. A torque ratchet was applied at 25 N-cm to seat and secure the abutment in the planned position. The inter-occlusal clearance for the post was increased to ~1.5mm for porcelain fused to metal crown fabrication. Before the impression, UL6 mesial surface enamel-plasty was performed to eliminate the undercut that blocked the insertion path of the crown, and to create an ideal contour of contact area. A double cord gingival retraction technique compressed the soft tissue to expose the abutment margin. A direct impression was made with polyvinyl siloxane impression material while the thin compression cord was left in the gingival sulcus. The prepared abutment was then covered by a Tony Cap (*Alliance, Taiwan*), a device that substitutes for a temporary crown relative to soft tissue modeling.

The impression was poured in type IV dental stone, and the cast was mounted on an articulator with a silicon bite record. A porcelain fused to metal crown was fabricated and delivered 2 weeks later. After checking the tightness of the contact area with dental floss and the margin integrity with a dental explorer, the permanent crown was luted with temporary cement (*Fig. 22*). Periapical radiographs from different angles were exposed to ensure the marginal fit of the restoration (*Fig. 23*). New upper and lower clear retainers were prepared after the prosthesis was delivered. Post-treatment records document the final result (*Figs. 25 and 26*).



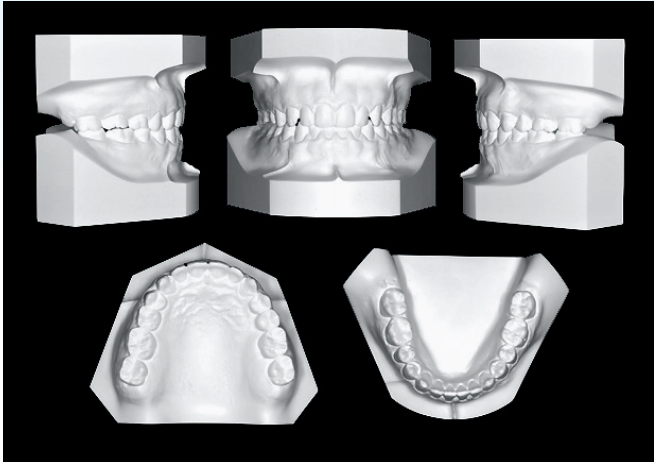
■ **Fig. 23:** A series of periapical radiographs document the implant procedure: (a) initial ridge depth, (b) a guide pin shows the insertion path and orientation of the osteotomy, (c) the bone-grafted area superior to the sinus floor is delineated with a white dotted line and shaded in pink, (d) the implant orientation and healing abutment position is shown with a red dashed line, and the fixture was repositioned distally, (e) the direct abutment is shown along with the mesial reduction of the UR6 (blue arrow) that was required to accommodate a crown, and (f) the marginal fit of the restoration.



■ Fig. 24: Post-treatment panoramic radiograph after delivery of the ISP.



■ Fig. 25: Post-treatment facial and intraoral photographs after delivery of the ISP.



■ Fig. 26:
Post-treatment dental models (casts) after delivery of the ISP.

Discussion

Sinus lift and implant placement

CBCT imaging was used to assess the implant site (Figs. 18 and 19). Since the bone height (*depth*) was insufficient (5mm), the sinus lift decision tree was utilized to decide on an appropriate approach for a single implant placement (Fig. 20). The UL5 implant placement surgery with sinus lift (Fig. 21) was followed in 5 months by the prosthesis construction and crown placement (Fig. 22). The radiographic documentation is shown in Figs. 23 and 24. Details for the ISP will be detailed in a following section. Maxillary sinus elevation and grafting are predictable surgical procedures for augmenting an atrophic posterior maxillary implant site. There are two common approaches for maxillary sinus elevation: 1. lateral window (*modified Caldwell-Luc procedure*), and 2. osteotome sinus floor fracture technique (*crestal approach*). The choice of the method depends

on the residual bone height, implant length, and amount of grafting required.¹² According to the sinus lift decision making tree (Fig. 20), a 4-5mm ridge thickness (*depth*) is suitable for an osteotomy sinus lift technique prior to installing a 8-11mm implant.¹³ The current patient had 5mm ridge thickness, so a 9mm implant was indicated for a crestal approach augmented with a sinus lift procedure. Post-operative radiographic examination revealed the implant fixture is distally inclined and is too close to the adjacent UL6. When the plant was uncovered, it was evident it was too superficial.¹⁴ According to the 2B-3D rule,^{11,14} the implant head should be 3mm apical to the future margin position of the prosthesis for development of a desirable emergence profile, esthetics, and biological width around the implant.⁹ Inserting the implant fixture to the bone level provides adequate height for biological width development, but if the interocclusal clearance is inadequate, the abutment must be trimmed or replaced with a shorter abutment. Under these circumstances, the peri-implant bone resorbs apically at least 1mm to re-establish an ideal biological width. In the long term, gingival recession around the implant may be a problem so a 2.0mm cuff height direct abutment is a better choice to achieve an optimal biologic width to resist recession.

Delayed primary tooth extraction

If the patient is missing a posterior tooth such as a second premolar, it is best to delay the primary tooth extraction as long as possible to enhance preservation of the ridge for a subsequent ISP. It has been documented that extraction of a primary tooth

three years prior to implant placement leads to a reduction of approximately 25% in ridge thickness.¹⁵ Most of this loss occurs on the buccal surface of the ridge, and if the resorption is extensive, implant placement may be compromised.¹⁶ It is advisable to reduce the mesio-distal dimension of the primary molar so that is the same size as a missing second premolar.¹⁷ A primary second molar may retain the space for many years, preserving the alveolar ridge for an eventual implant placement (Fig. 14).

Timing of implant placement in growing patient

Congenitally missing teeth are frequently encountered in children. Placing an integrated implant in a growing patient is problematic because the ISP behaves as an ankylosed tooth. When there is a growth-related increase in the vertical dimension of occlusion, natural teeth will extrude to maintain optimal occlusion, leaving an ISP in its original position. The ISP becomes submerged relative to the adjacent teeth resulting in occlusal and gingival irregularity. The apex of a submerged maxillary implant can eventually penetrate the sinus or nasal cavity as the airway expands. Also opposing teeth can super erupt creating substantial occlusal and gingival irregularity which is manifest as esthetic and functional compromise. Replacing the crown of a submerged implant results in excessive length of the crown that compromises esthetics and the crown-to-implant ratio.^{18,19} Another long-term complication is opening of contacts between the ISP and adjacent natural teeth.^{20,21}

The timing for implant placement in growing

patients is best delayed until adolescent facial growth is completed or nearly so. No reliable indicator is available to determine when growth has ended. The time-honored clinical approach is to expose cephalometric radiographs at 6 month intervals and superimpose the tracings. If no appreciable change occurs over the period of 1 year, facial growth is probably complete.²² However, growth of the craniofacial skeleton is a slow continuous process that continues over a lifetime, but the rate is very slow after the age of about 20 years. Fudalej et al.¹⁹ assessed maxillary central incisor and first molar (U6) extrusion following puberty. In males, U6s erupted 2.5mm before age 15, 1.1mm from 15-18 years, and only 0.5mm from 18 to 50 years.¹⁹ Dental esthetics are negatively affected by a submerged ISP because of irregular incisal edges and gingival margins in the esthetic zone. Evian et al.²³ reported passive eruption continues throughout the teen-age years, but Volchansky and Cleaton-Jones²⁴ found that passive eruption was still not complete at age 20 years. Overall, it is best to plan on some passive eruption even in adults, but it is important to avoid orthodontic intrusion when preparing an implant site because relapse may intensify the submersion effect.²⁵

For the present patient, preprosthetic orthodontic treatment was complete at 17y7m, but the delivery of the ISP was delayed until the age of 18y2m. This approach takes advantage of the greatly diminished facial growth after the age of 18 years.^{19,23-24} Some passive eruption is expected longterm, but the UL5 region is not a sensitive esthetic area. A modest amount of gingival recession, as well as passive

eruption by adjacent and opposing teeth will probably be acceptable. Despite the possibility of negative outcomes longterm, the patient chose to have the ISP placed as soon as possible after the completion of orthodontic treatment. In consultation with the clinicians, 18y2m was deemed appropriate because the risk of serious longterm complications was minimal.

Conclusions

Partially edentulous growing patients are esthetic and functional challenges longterm. Combining orthodontics and implant prosthetic procedures requires extensive interdisciplinary collaboration. Orthodontic preparation of implant sites is crucial for success in placing fixtures. Atrophic edentulous sites require bone augmentation and/or a sinus lift procedure. The timing an ISP must be chosen with respect to the prospect for follow-up facial growth. ISPs behave like ankylosed teeth, so they must be monitored longterm for submergence and gingival recession.

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Discrepancy Index Worksheet

TOTAL D.I. SCORE = 17

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 = **3**

Total = 3

OVERBITE

- 0 – 3 mm. = 0 pts.
- 3.1 – 5 mm. = 2 pts.
- 5.1 – 7 mm. = 3 pts. **6mm**
- Impinging (100%) = 5 pts.

Total = 3

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 = 1

OCCLUSION

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

Total = 0

2mm (upper)

LINGUAL POSTERIOR X-BITE

1 pt. per tooth Total = 0

BUCCAL POSTERIOR X-BITE

2 pts. per tooth Total = 0

CEPHALOMETRICS (See Instructions)

ANB $\geq 6^\circ$ or $\leq -2^\circ$ = 4 pts.

Each degree $< -2^\circ$ _____ x 1 pt. = _____

Each degree $> 6^\circ$ _____ x 1 pt. = _____

SN-MP

$\geq 38^\circ$ = 2 pts.

Each degree $> 38^\circ$ _____ x 2 pts. = _____

$\leq 26^\circ$ = 1 pt.

Each degree $< 26^\circ$ _____ x 1 pt. = _____

1 to MP $\geq 99^\circ$ = 1 pt.

Each degree $> 99^\circ$ _____ 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 ($\geq 3mm$) _____ @ 2 pts. = **2**
- Missing teeth (except 3rd molars) _____ x 1 pt. = _____
- Missing teeth, congenital **2** x 2 pts. = **4**
- Spacing (4 or more, per arch) _____ x 2 pts. = _____
- Spacing (Mx cent. diastema $\geq 2mm$) _____ @ 2 pts. = _____
- Tooth transposition _____ x 2 pts. = _____
- Skeletal asymmetry (nonsurgical tx) _____ @ 3 pts. = _____
- Addl. treatment complexities _____ x 2 pts. = _____

Identify:

Total = 6

IMPLANT SITE

- Lip line : Low (0 pt), Medium (1 pt), High (2 pts) =_ **1**
- 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) =_
- Bone level at adjacent teeth : ≤ 5 mm to contact point (0 pt), 5.5 to 6.5 mm to
contact point (1 pt), $\geq 7mm$ 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) =_ **1**
- Soft tissue anatomy : Intact (0 pt), Defective (2 pts) =_
- Infection at implant site : None (0 pt), Chronic (1 pt), Acute(2 pts) =_

Total = 4

Cast-Radiograph Evaluation

Case # Patient

Total Score: **17**

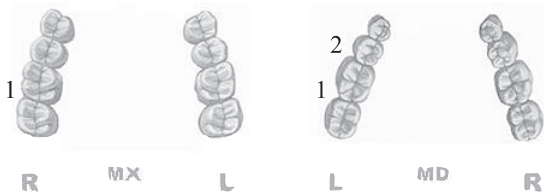
Alignment/Rotations

2



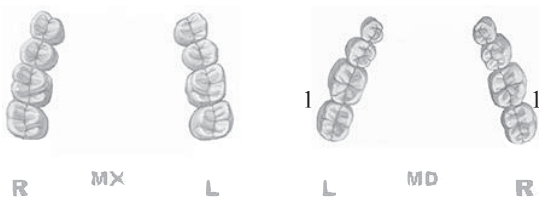
Marginal Ridges

4



Buccolingual Inclination

2



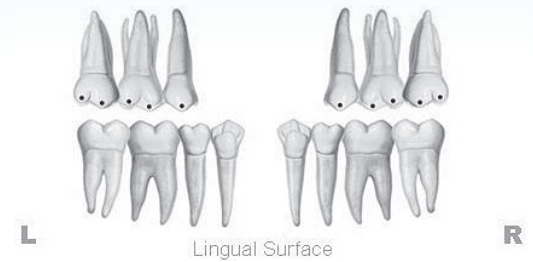
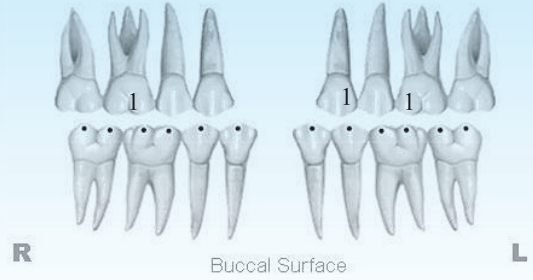
Overjet

4



Occlusal Contacts

3



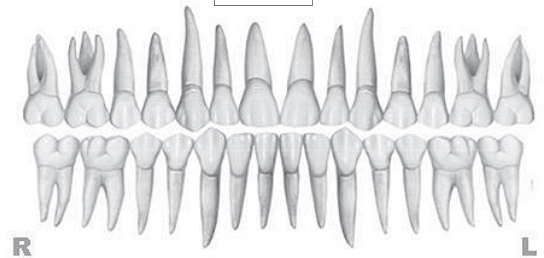
Occlusal Relationships

1



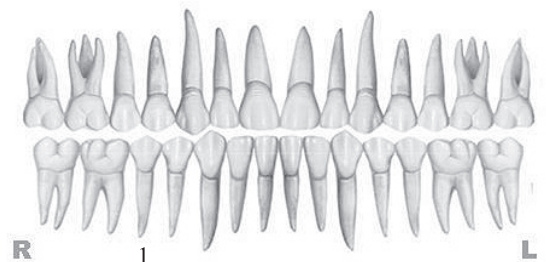
Interproximal Contacts

0



Root Angulation

1

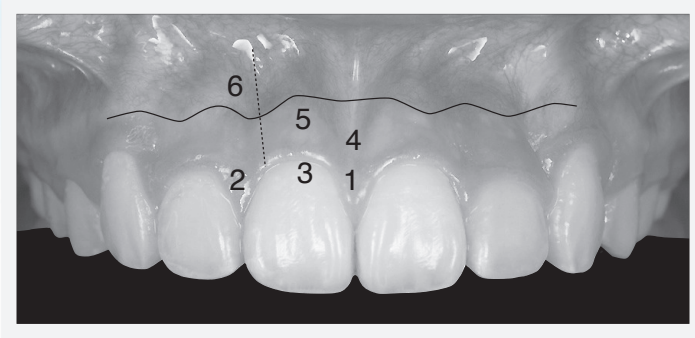


INSTRUCTIONS: Place score beside each deficient tooth and enter total score for each parameter in the white box. Mark extracted teeth with "X". Second molars should be in occlusion.

IBOI Pink & White Esthetic Score

Total Score: = 3

1. Pink Esthetic Score

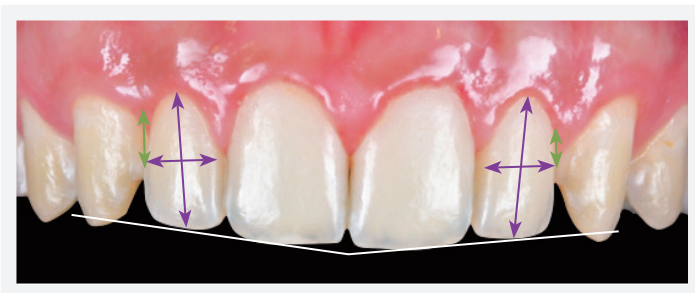
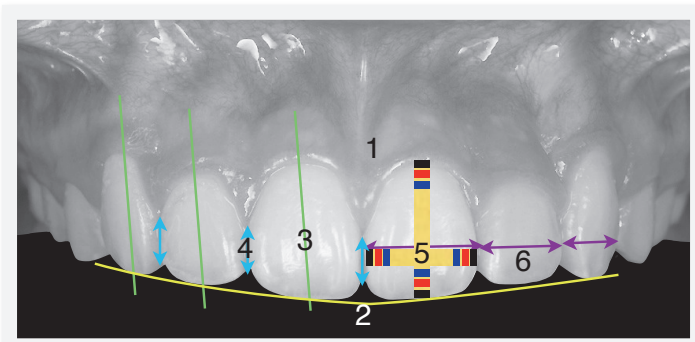


1. M & D Papillae	0	1	2
2. Keratinized Gingiva	0	1	2
3. Curvature of Gingival Margin	0	1	2
4. Level of Gingival Margin	0	1	2
5. Root Convexity (Torque)	0	1	2
6. Scar Formation	0	1	2

Total = 0

1. M & D Papilla	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)



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

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