

How would you treat this malocclusion?

Pretreatment

Case C.F., 10 years, 4 months

A video of this case can be found at www.pcsortho.org/case-reports/

Diagnosis and Etiology

C.F. presented at the age of 10 years, 4 months with a chief complaint of missing teeth and crowding. The patient required dental clearance at the time because of the presence of caries and was placed on a recall list for periodic follow-up.

Extraoral and Intraoral Findings

The patient has a mesocephalic facial type with symmetrical facial fifths and asymmetrical facial thirds with a long lower third. The patient has a convex facial profile, an obtuse nasolabial angle and labiomental fold, and slightly protrusive upper and lower lips with mentalis strain on repose. Upon smiling, the patient shows 100% incisor display, adequate buccal corridors, an upper midline shifted 1 mm to the left, and a lower midline coincident to the facial midline (Figure 1).

Intraorally, she has bilateral Class I molar and canine relationships, a 50% overbite, and a normal overjet. The maxillary arch is ovoid, and the mandibular arch is square-shaped; both arches are transversely constricted. The patient is in late mixed dentition with upper right and lower E's retained, mild maxillary crowding, and moderate mandibular crowding (Figure 1).

Radiographic Findings

The pretreatment panoramic radiograph revealed congenital absence of the mandibular second premolars. The retained mandibular primary teeth Es had no signs of ankylosis. The succedaneous tooth UR5 had incomplete root formation and asymmetric, delayed eruption. The maxillary and mandibular third molars were developing, the sinuses appeared within normal limits, and the condyles were within normal limits with no beaking and adequate cortication (Figure 2).

The cephalometric analysis indicates a skeletal Class II pattern ($ANB = 5.0$) and a normovergent growth pattern ($SN-MP = 33.6^\circ$). The maxillary incisors are proclined ($U1-SN = 110.6^\circ$), and the mandibular incisors are upright ($IMPA = 84.2^\circ$). Both upper and lower lips are protrusive to the E-line, -0.6 mm and -4.5 mm, respectively (Table 1). The ABO discrepancy index score for this case is 14 (Figure 3).



Figure 1. Pretreatment intraoral and extraoral photographs (C.F., 10 years, 4 months)



Figure 2. Pretreatment panoramic radiograph and lateral cephalogram (C.F., 10 years, 4 months)

Treatment Objectives

Treatment objectives for this case involved the following:

- Maintain Class I canine relationship
- Obtain Class III molar relationship
- Maintain the inclination of the mandibular incisors
- Reduce upper incisor proclination
- Protract the L6s and L7s and close L5 spaces bilaterally

Table 1. Comparison of Pretreatment and Posttreatment Cephalometric Measurements

Cephalometric Measurement	Norm	Pretreatment	Posttreatment
SNA (°)	82.0	91.7	90.7
SNB (°)	80.9	86.7	86.3
ANB (°)	1.6	5.0	4.4
SN-MP (°)	32.9	33.6	35.4
U1-SN (°)	103.1	110.6	105.9
IMPA (°)	95.0	84.2	84.6
Wits (mm)	-1.0	-2.1	-2.0
Lower lip to E-plane (mm)	-2.0	-0.6	-0.1
Upper lip to E-plane (mm)	-8.0	-4.5	-2.9
Nasolabial angle (°)	102.0	118.3	116.2

- Obtain coincident maxillary and mandibular midlines
- Maintain maxillary incisor display
- Maintain adequate overbite and overjet
- Coordinate upper and lower arches

Treatment Alternatives

Overall, five treatment plans were prepared and presented to the patient and family. The first option involved maxillary expansion, extraction of the lower primary second molars (Es), and space closure by molar protraction using temporary anchorage devices (TADs) and fixed orthodontic appliances. The second option included maxillary expansion, extraction of the lower Es, and maintenance of the L5 spaces for future implant placement. The third option was a nonextraction plan: retain the lower Es, proceed with leveling and aligning, and perform interproximal reduction as needed. The fourth option was an extraction combination treatment, involving clear aligner therapy for the upper arch after rapid palatal expansion, extraction of the lower Es, and space closure using TADs and fixed orthodontic appliances. The fifth option was a nonextraction combination treatment, involving clear aligner therapy and rapid palatal expansion in the upper arch and fixed orthodontic appliances in the lower arch, maintaining the lower Es.

Treatment Plan

The patient and family ultimately elected to proceed with the fourth treatment option. Treatment begins with placement of a maxillary

EXAM YEAR	ABO DISCREPANCY INDEX
ABO ID #	CASE#
PATIENT	C.F.
TOTAL D.I. SCORE 14	
<i>For mm measures, round up to the next full mm. Examiners will verify measurements in each category.</i>	
OVERJET ≥ 0 to < 1 mm (edge-to-edge) = 1 pt ≥ 1 to ≤ 3 mm = 0 pts > 3 to ≤ 5 mm = 2 pts > 5 to ≤ 7 mm = 3 pts > 7 to ≤ 9 mm = 4 pts > 9 mm = 5 pts Negative Overjet (x-bite): 1 pt per mm per tooth Total 0	LINGUAL POSTERIOR X-BITE > 0 mm, 1 pt per tooth Total 0
OVERBITE > 1 to ≤ 3 mm = 0 pts > 3 to ≤ 5 mm = 2 pts > 5 to ≤ 7 mm = 3 pts Impinging (100%) = 5 pts Total 2	BUCCAL POSTERIOR X-BITE > 0 mm, 2 pts per tooth Total 0
ANTERIOR OPEN BITE 0 mm (edge-to-edge), 1 pt per tooth then 1 pt per mm per tooth Total 0	CEPHALOMETRICS (See Instructions) ANB ≥ 6° or ≤ -2° @4pts = ____ Each full degree > 6° ____ x 1 pt = ____ Each full degree < -2° ____ x 1 pt = ____ SN-MP ≥ 38° @2pts = ____ Each full degree > 38° ____ x 2 pts = ____ ≤ 26° @1pt = ____ Each full degree < 26° ____ x 1 pt = ____ I to MP ≥ 99° @1pt = ____ Each full degree > 99° ____ x 1 pt = ____ Total 0
LATERAL OPEN BITE ≥ 0.5 mm, 2 pts per mm per tooth Total 0	OTHER (See Instructions) Supernumerary teeth ____ x 1 pt = ____ Ankylosis of permanent teeth ____ x 2 pts = ____ Anomalous morphology ____ x 2 pts = ____ Impaction (except 3rd molars) ____ x 2 pts = ____ Midline discrepancy (≥3 mm) @ 2 pts = ____ 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 ≥ 2 mm) @ 2 pts = ____ Tooth transposition ____ x 2 pts = ____ Skeletal asymmetry (nonsurgical tx) @ 3 pts = ____ Addl. treatment complexities 2 x 2 pts = 4 Identify: Bottom discrepancy Controlling IMPA Total Other 8
CROWDING (only one arch) ≥ 0 to ≤ 1 mm = 0 pts > 1 to ≤ 3 mm = 1 pts > 3 to ≤ 5 mm = 2 pts > 5 to ≤ 7 mm = 4 pts > 7 mm = 7 pts Total 4	
OCCUSAL RELATIONSHIP Class I to End On = 0 pts End-to-End 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 additional ____ pts Total 0	

Figure 3. ABO discrepancy index score

rapid palatal expander (RPE) and bonding of the mandibular teeth for initial leveling and alignment followed by extraction of the lower Es. TADs are placed between the lower canines and first premolars for indirect anchorage, enabling space closure through protraction of the mandibular molars. Invisalign therapy for the maxillary arch will begin once sufficient expansion has been achieved and the RPE is removed.

Treatment Progress

Treatment began with the delivery of a Hyrax appliance and bonding of the mandibular 7-7. At this time, a referral was provided to extract the lower Es. Initial leveling and alignment of the mandibular arch were performed using a sequence of archwires, starting with a 0.014" nickel titanium (NiTi) wire and followed by 0.016" NiTi, 0.018" NiTi, then 0.020" × 0.020" NiTi. The retained lower Es were excluded from bonding, and their interbracket spaces were maintained with a closed coil spring (Figure 4).

Following the extraction of the lower Es, bracket repositioning was performed based on a progress panoramic radiograph to diverge the roots of the lower canines and first premolars in preparation for TAD placement. Two TADs (1.6 × 6 mm and 1.6 × 8 mm) were placed bilaterally between L3s and L4s and were engaged to L3s for indirect anchorage. The mandibular 4-4 were co-ligated with stainless steel



Figure 4. Intraoral progress photographs: one year into treatment

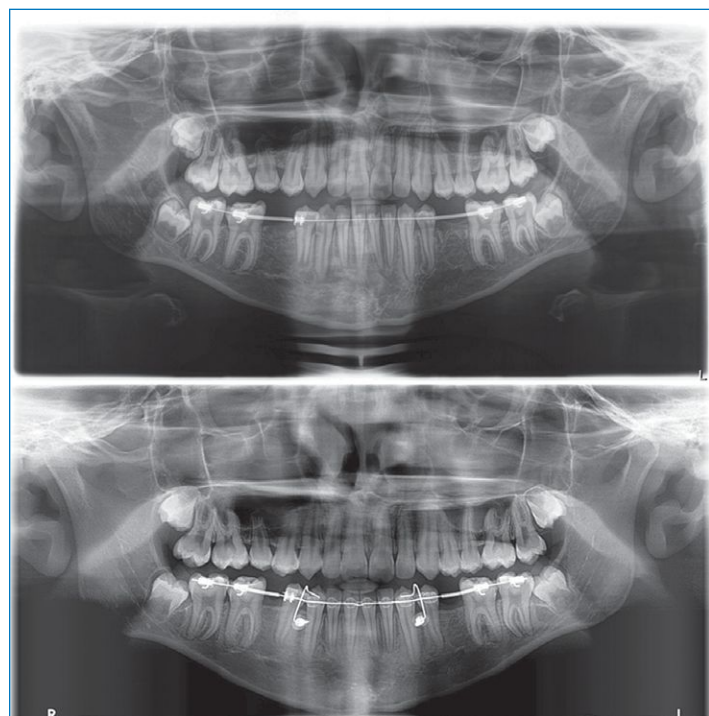


Figure 5. Progress panoramic radiographs. Top: after one year, one month of treatment, lower Es were extracted; bottom: two years, three months into treatment

ligature ties, and posterior protraction was initiated by using power chains from L7 to L7 on a 0.019" × 0.025" stainless steel (SS) archwire (Figures 5–8). The protraction phase lasted approximately 23 months. Near the end of space closure, the lower third molars erupted into the occlusal plane and were brought into alignment.

By the 32nd month of treatment, lower E spaces were fully closed, TADs were removed, and a reverse curve of Spee and arch expansion were incorporated into the 0.019" × 0.025" SS mandibular archwire. To further improve mandibular arch expansion and arch coordination, a maxillary arch form of 0.019" × 0.025" NiTi was placed in the mandibular arch with a light power chain. Class II elastics were used to achieve a Class I canine relationship.

In the upper arch, the Hyrax appliance was removed after completing approximately 28 turns, after which the patient was scanned for maxillary Invisalign treatment. The Invisalign treatment for the



Figure 6. Intraoral progress photographs, two years, six months into treatment



Figure 7. Intraoral progress photographs showing continued protraction (three years, three months into treatment)

maxillary arch involved a total of 40 aligners, four scans, and Class II elastics with the fourth set of Invisalign aligners. Retention was achieved with a maxillary Essix retainer and a mandibular lingual fixed 3-3 retainer.

Treatment Results

Case C.F., 14 years, 9 months

Overall, the patient's chief concern was addressed, resulting in a favorable treatment outcome. The total treatment time was four years, five months. Final occlusion resulted in bilateral Class III molar and Class

I canine relationships. The congenitally missing mandibular second premolars were replaced with natural dentition, the proclination of upper incisors was reduced, and the inclination of lower incisors was maintained. Final records indicate correction of maxillary and mandibular crowding, mentalis strain, dental midlines, and preservation of the incisor display (Figure 9).

The posttreatment radiographic records revealed adequate root parallelism and no signs of root resorption. Cephalometric measurements indicated improvement in U1-SN (110.6° pretreatment, 105.9° posttreatment) and stable IMPA (84.2° pretreatment, 84.6° posttreatment) (Figure 10 and Table 1).



Figure 8. Progress panoramic radiograph: three years, six months into treatment

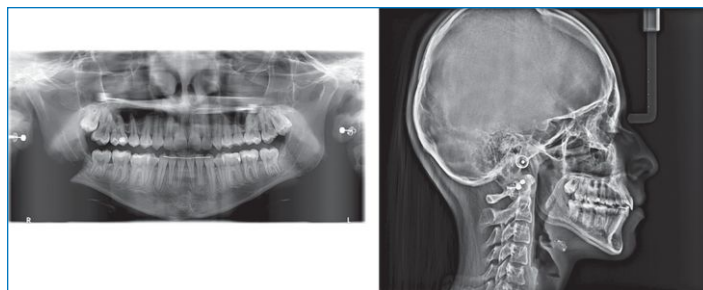


Figure 10. Posttreatment panoramic radiograph (left) and lateral cephalogram (right) (C.F., 14 years, 9 months)

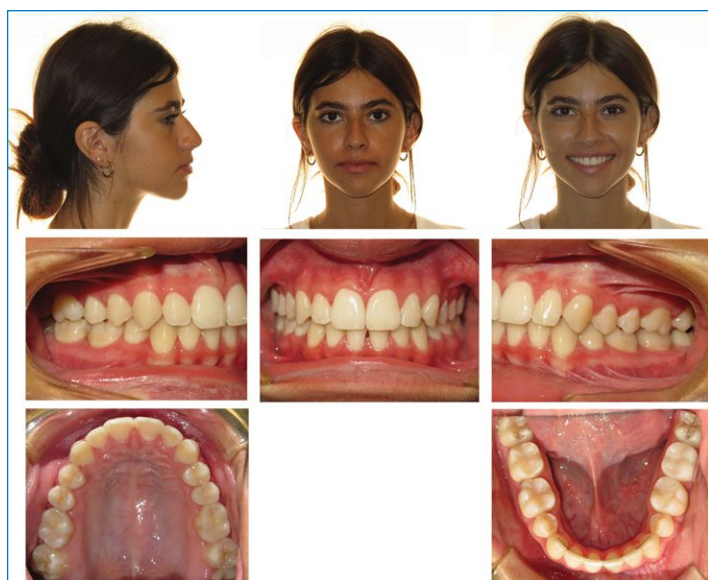


Figure 9. Posttreatment facial and intraoral photos (C.F., 14 years, 9 months)

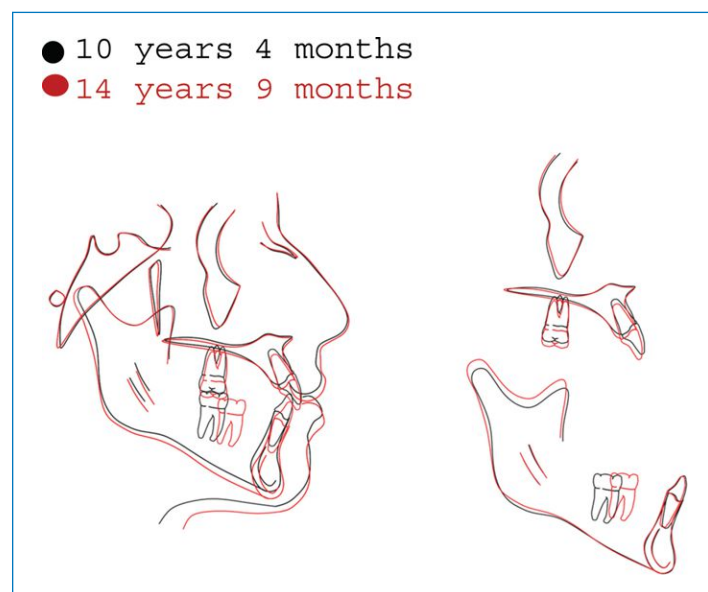


Figure 11. Superimpositions: black, pretreatment; red, posttreatment

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For electronic submission requirement –
use ABO Case Report Work File (pdf).

ABO Cast-Radiograph Evaluation

Case # Patient C.F.

Total C-R Eval Score: 9

Alignment/Rotations

2

Marginal Ridges

2

Buccolingual Inclination

Overjet

Occlusal Contacts

Occlusal Relationships

Interproximal Contacts

Root Angulation

5

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.

Figure 12. ABO cast radiograph evaluation score

Indirect anchorage mechanics with bilateral interradianal TADs made it possible to achieve a well-managed anchorage control and maintenance of incisor mandibular plane angle during the protraction of lower molars. Proper positioning of the lower third molars prevented supraeruption of upper second molars (Figure 11 and Table 1). The



Figure 13. Facial and intraoral photos after ten months of retention

ABO cast-radiograph evaluation score was 9 (Figure 12). The ten-month retention records revealed the stable occlusion (Figure 13).

This case highlights the advantages of a combination therapy approach, utilizing clear aligner treatment for the maxillary arch and fixed appliances for the mandibular arch. Clear aligners offered aesthetic and hygienic benefits in the upper arch, especially during adolescence, and fixed appliances in the lower arch allowed for efficient space closure and anchorage control with TADs necessary for molar protraction.

Treatment was prolonged because of missed appointments, closure of 20 mm of space in the lower arch, and uprighting and alignment of lower third molars. Despite the prolonged treatment, decalcification and external root resorption were unremarkable. This prolonged orthodontic treatment will save the patient significant expenses and time over her lifetime, given that the need for dental implant replacement of the congenitally absent lower premolars has been eliminated.

Clinicians' Biographies



Dr. Susan Kim

Dr. Susan Kim is currently a second-year orthodontic resident in the Postgraduate Orthodontic Program at the A. T. Still University, Arizona School of Dentistry & Oral Health, Mesa, AZ. She received her DDS degree from UT Health San Antonio, San Antonio, TX.



Dr. Seuss Kasssieh

Dr. Seuss Kasssieh received his BS and DDS degrees from the University of Iowa and his MS degree in orthodontics from Baylor College of Dentistry, Dallas, TX. For the last 29 years, he has been in private practice in Scottsdale and Paradise Valley, AZ. He is the past president of the Southwest Component of the Edward H. Angle Society and past president of the Arizona Orthodontic Association. He is a Diplomate of the ABO and serves the College of Diplomates of the

ABO as an advocate for Board certification at the A. T. Still University, Arizona School of Dentistry & Oral Health, Mesa, AZ in the Postgraduate Orthodontic Program, where he has been a parttime adjunct faculty member for 17 years. His educational seminars focus on evidence-based orthodontic treatment and contemporary orthodontic therapies. He also reviews the current ABO-recommended literature and prepares the residents for their written and clinical ABO examinations.

Editor's Comments

The editor appreciates the authors for sharing this well-treated case with our readers. When presenting the space-closure option for cases with missing mandibular second premolars, it is imperative to inform the patient and parents of the potential for extended treatment time, the risk of TAD failure, and the need for reinsertion.

Call for Submitting Cases



Dr. Zhang, editor of the *PCSO Bulletin* Case Report column, sincerely invites you to send your case—either well treated or failed for any reason(s)—to be featured in an upcoming issue. This column welcomes any cases that cannot easily be found in orthodontic textbooks and for which there is an element of uniqueness regarding the malocclusion itself or the treatment. The editor also welcomes any comments or feedback on the published cases, preferably the Case Report featured in the most recent issue. If you have questions about submitting your case or sending your comments, please contact me at xingzhongzhang@atsu.edu.

Thank you,
John (Xingzhong) Zhang, DDS, MSD, PhD
Mesa, AZ