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CASE REPORT

Surgical-Invisalign Treatment of a Patient with Class III Malocclusion and Multiple Missing Teeth

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Recent advances in the Invisalign* technique¹—particularly attachment designs that improve three-dimensional control of tooth movement—have resulted in new treatment strategies for patients who need orthognathic surgery.²⁻⁵ The Invisalign ClinCheck* can be used for diagnosis, visualization of treatment results, and sharing of information with the patient and dental colleagues throughout treatment.

Boyd has described the successful use of the Invisalign sys-

tem with fixed appliances in the pre- and postsurgical treatment of two Class III patients.⁶ The following case shows a Class III patient who was prepared for surgery with the Invisalign system alone.

Diagnosis and Treatment Plan

A 17-year-old female presented with the complaints of a protruding jaw and multiple missing teeth (Fig. 1A). Initial exami-

nation showed a Class III malocclusion with -5mm overjet and anterior open bite. Both upper lateral incisors, all four second premolars, and all four third molars were missing; the upper lateral incisors had been replaced by ceramic crowns connected to the contiguous teeth. The lower arch had a supernumerary incisor and retained deciduous second molars. An internal derangement

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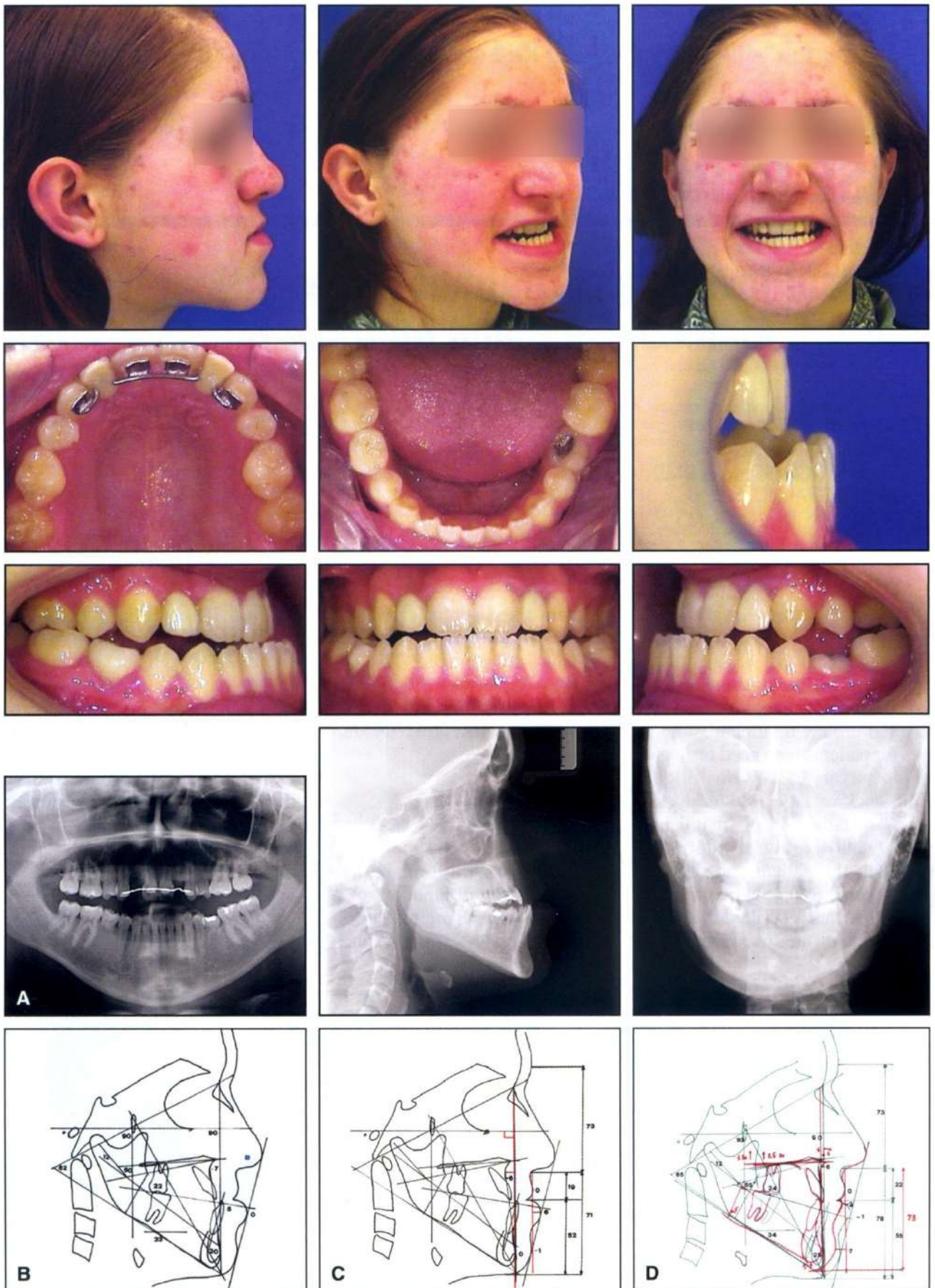


Fig. 1 A. 17-year-old female patient with Class III malocclusion and multiple missing teeth. B. Initial Ricketts analysis. C. Ricketts analysis plus skeletal evaluation by McNamara analysis, soft-tissue evaluation by subnasal line, and vertical evaluation by Holdaway analysis. D. Visual treatment objectives.

TABLE 1
CEPHALOMETRIC DATA

	Norm	Pretreatment	Post-Treatment
Facial axis	90 ± 3°	90°	83°
Facial depth	87 ± 3°	90°	86°
Mandibular plane to FH	26 ± 4°	33°	40°
Mandibular arch	26 ± 4°	12°	6°
Total facial height	60 ± 3°	62°	71°
Lower facial height	47 ± 4°	50°	57°
Point A convexity	2 ± 2mm	-7mm	2mm
L1/A to Pg	22 ± 4°	20°	22°
L1 to A-Pg	1 ± 2mm	5mm	2mm
U6 to Point V	12 ± 3mm	24mm	26mm
Lower lip to E	-2 ± 2mm	0mm	0mm
Point A to McNamara line	0mm	-6mm	-4mm
Pg to McNamara line	-6mm	0mm	-8mm
Upper lip to subnasal line	0 ± 2mm	0mm	0mm
Lower lip to subnasal line	-2 ± 2mm	6mm	-3mm
Soft-tissue Pg to subnasal line	-4 ± 2mm	-1mm	-9mm
A:B	1:1	1:1.06	1:0.92
C:D	1:2	1:2.5	1:2.2

of the TMJ limited mouth opening, but the patient reported no pain or other related symptoms.

The Ricketts 11-factor analysis⁷⁻¹¹ (Fig. 1B) was supplemented with skeletal evaluation according to the McNamara analysis,¹² soft-tissue evaluation using the subnasal line, and vertical evaluation with the Holdaway analysis¹³ (Fig. 1C). The patient showed a severe dolichofacial pattern with a skeletal Class III malocclusion due to maxillary hypoplasia and mandibular advancement (Table 1). The lower facial third was long, the upper lip position was normal, and the lower lip and chin were protrusive, resulting in inadequate tooth display during smiling. The posteroanterior radiograph showed no maxillary or mandibular asymmetry. The occlusal plane was slightly inclined, and the upper and lower midlines were not coincident, possibly because

of the supernumerary tooth in the mandibular arch. A small nose was also noted.

Primary treatment goals were determined using visual treatment objectives (VTO, Fig. 1D). These included:

1. Alignment of both arches through derotation of the upper first molars and first premolars.
2. Widening of the upper lateral incisor spaces after removal of the ceramic crowns.
3. Space closure in the upper left quadrant, along with slight buccal tipping of the upper right canine.
4. Extraction of the retained lower second deciduous molars, followed by uprighting of the lower left first molar, intrusion of the lower left second molar, derotation of the lower right canine, and lower anterior stripping.

The patient was referred to a maxillofacial surgeon (Dr. Procopio), whose plan was to ad-

vance the maxilla by 2mm, with a transverse rotation, to improve the smile line and occlusal plane inclination. This would require a 1mm lowering of the anterior segment and 2.5mm right and 1mm left posterior impaction. Consequent counterclockwise rotation of the mandible would reduce the anterior vertical dimension. A 6mm vertical mandibular osteotomy was also planned, but considering the counterclockwise rotation of the mandible, the actual reduction in the vertical dimension would be 5mm.

Treatment Progress

After removal of the ceramic crowns on the upper lateral incisors, ClinCheck was used to define the presurgical objectives and to show the final positions of the teeth in both arches and the final intercuspation after surgery (Fig. 2). Six buccal attachments

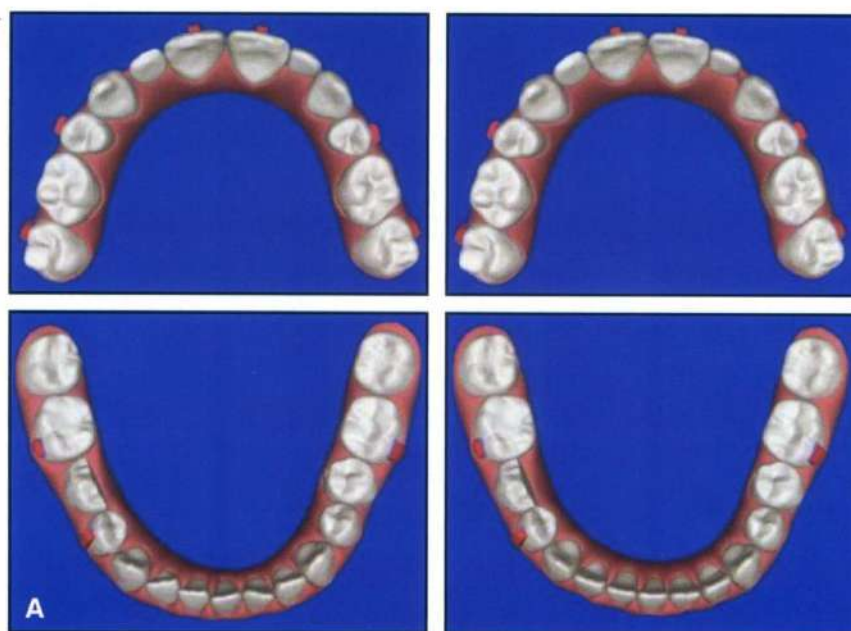


Fig. 2 A. Pretreatment and projected post-treatment ClinChecks.* **B.** ClinCheck views of maximum intercuspation before treatment, after alignment with Invisalign system, and after surgery.



Fig. 3 A. After removal of upper lateral incisor ceramic crowns. **B.** Aligner with composite material placed inside lateral incisor spaces. **C.** With aligner in place.

were bonded in the upper arch and three in the lower arch to permit three-dimensional control of tooth movement. For improved esthetics during aligner treatment, composite material was added to each upper aligner to fill in the spaces of the lateral incisors (Fig. 3). Nine lower aligners and 11 upper aligners were used during the six-month presurgical phase.

Surgery was performed four

weeks after completion of the aligner treatment. Metal buttons were bonded in both arches for rigid fixation after surgery (Fig. 4). Based on data from the VTO, we created acrylic splints to be used as surgical guides. As planned, the maxilla was advanced 2mm by Le Fort I osteotomy with posterior impaction and transverse rotation, and an Obwegeser-Dal Pont mandibular

osteotomy was performed. In the maxilla, four titanium plates were used for fixation. The mandible was fixed with stainless steel wires to permit repositioning of the condyle in the glenoid fossa through muscle guidance (Fig. 5). Although mandibular fixation with rigid plates would have elim-

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Fig. 4 Metal buttons bonded to upper and lower labial surfaces for rigid fixation after surgery.

Fig. 5 Application of titanium plates in maxilla and stainless steel wires in mandible during surgery.

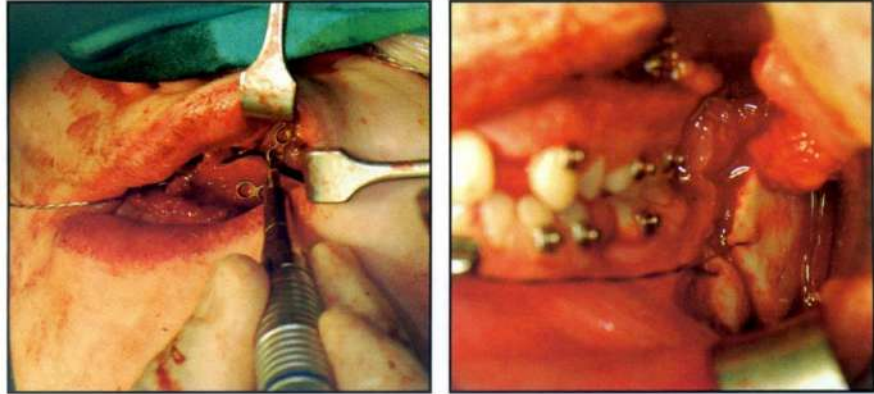


Fig. 6 Intermaxillary fixation removed four weeks after surgery.

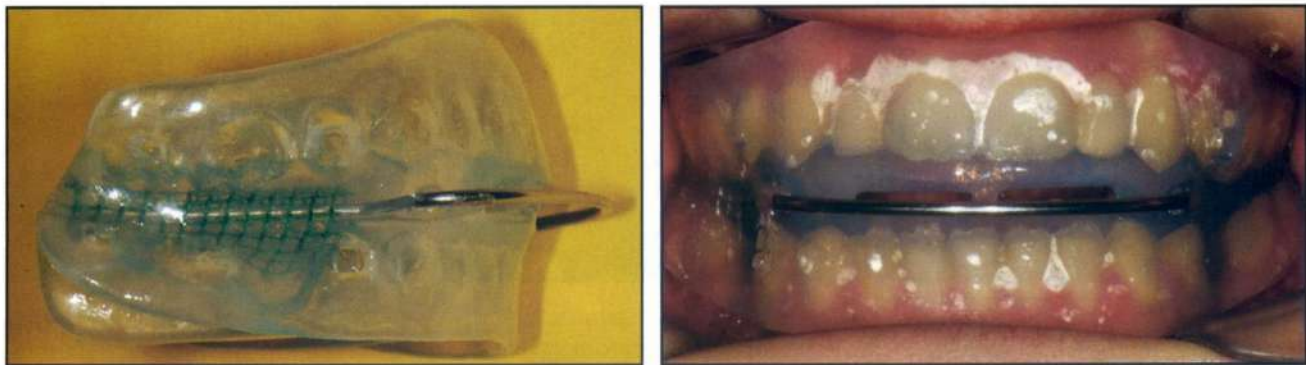


Fig. 7 Osamu** dynamic functional positioner used for three months of finishing.

inated the need for intermaxillary wires, that method allows condylar torsion, with unpredictable effects on the TMJ.

Occlusal stability was achieved through good intercuspation and maintained after sur-

gery with the mandibular acrylic splint. After four weekly follow-up visits, allowing time for bone healing, we removed the intermaxillary fixation and metal buttons (Fig. 6). A customized Osamu** dynamic functional

positioner was then worn for three months of finishing; this appliance, with a rating of 40 on the Shore A hardness scale, is used to

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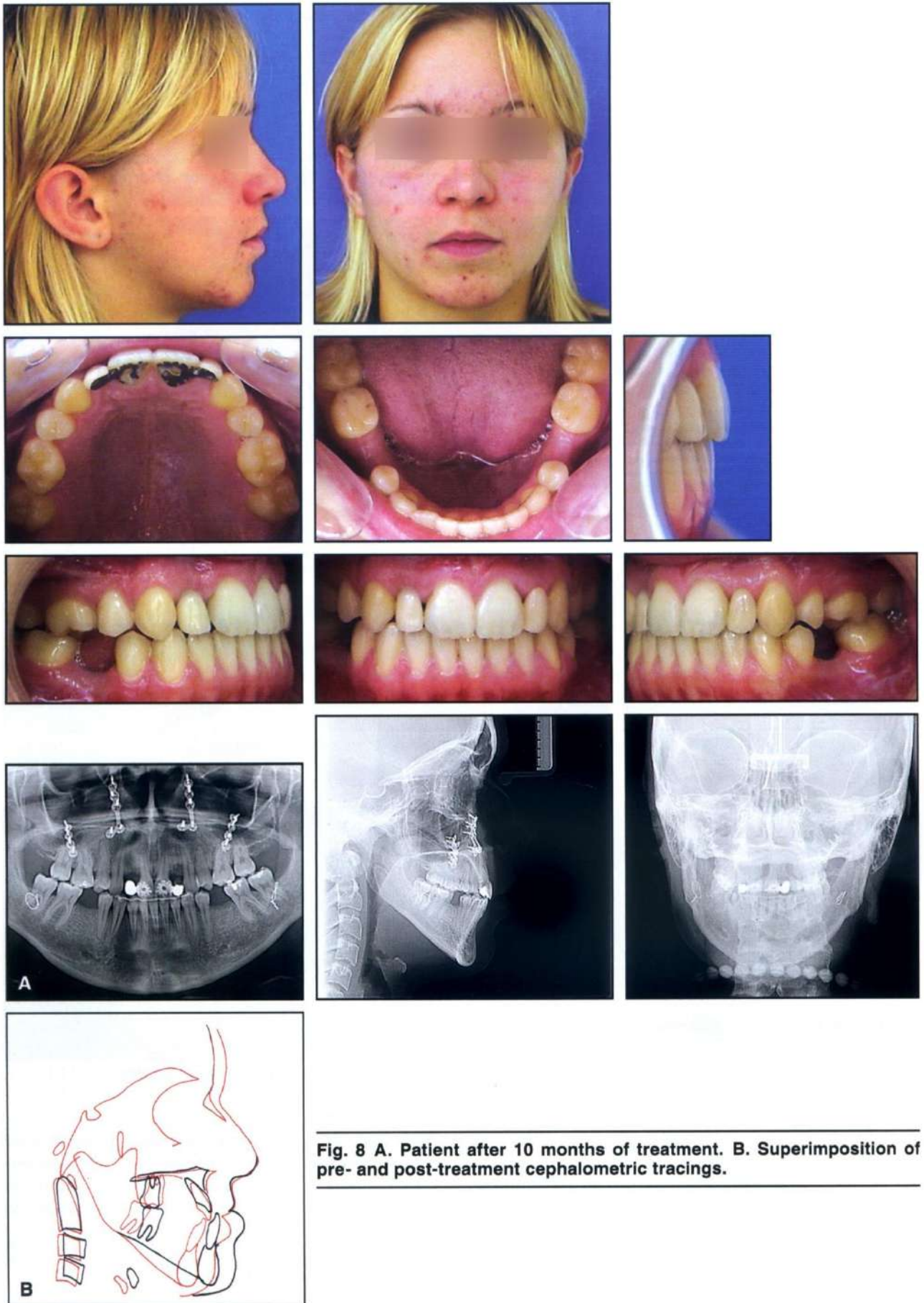


Fig. 8 A. Patient after 10 months of treatment. **B.** Superimposition of pre- and post-treatment cephalometric tracings.



Fig. 9 One year after treatment, with patient awaiting prosthodontic rehabilitation, Maryland bridges remain in upper lateral incisor spaces; lower premolar spaces are maintained by 1mm hard acrylic baseplate.

move the teeth into maximum intercuspation (Fig. 7). Ceramic brackets were bonded to several teeth in the upper and lower buccal sections to stabilize the Osamu positioner, produce further extrusion, and maintain the finished dentition. Total treatment time was 10 months.

Two Maryland bridges were fabricated to substitute for the missing upper lateral incisors,

and prosthetic replacement of the lower premolars was planned.

Treatment Results

Post-treatment records showed a significant improvement in facial esthetics from the frontal and lateral perspectives, with a harmonious soft-tissue profile and lip position (Fig. 8A). After orthognathic surgery, the patient

exhibited acceptable interdigitation and a Class I canine relationship, the overjet and overbite were normal, and correct inclinations of the teeth had been achieved. The lower second premolar and upper lateral incisor spaces had been maintained for subsequent rehabilitation. The two jaws were well-positioned relative to each other and to the cranial base. Cephalometric superimpositions

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(Fig. 8B) matched closely with the VTO goals set before treatment, except for a slightly less-than-expected correction of the vertical dimension.

One year after the end of treatment, the patient was unable to complete prosthodontic treatment for economic reasons. She still wore the Maryland bridges in the upper arch, while space for prosthetic lower premolars was being maintained with a 1mm hard acrylic appliance (Fig. 9).

Discussion

Presurgical orthodontic treatment was rapid and comfortable for this patient, requiring only six months. Application of composite material in the lateral incisor positions of the aligners instantly improved the patient's esthetic appearance and helped ensure full-time aligner wear, which is essential to the effectiveness of the Invisalign system. During and after treatment, the patient performed perioral muscle exercises for functional rehabilitation of the tongue and lips. The occlusion was finalized with an Osamu positioner in a short post-surgical phase that produced ideal intercuspation.

Class III malocclusions requiring surgery demand precise diagnosis if a predictable treatment outcome is to be achieved.¹⁴⁻¹⁶ In this patient, cephalometric superimpositions showed results closely matching the treatment objectives. The patient was highly satisfied with the functional and esthetic outcomes, reporting a significant improvement in her quality of life. This case demonstrates that the Invisalign system can be a worthwhile alternative to fixed appliances for surgical setup of orthognathic cases, especially in skeletal Class III patients with little need for dental movement.

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