Original Article

pISSN, eISSN 0125-5614
M Dent J 2021; 41 (2) : 97-112

Correction of mandibular prognathism using a surgery-first approach or early surgery: Two case reports

Parinya Choovait, Varisara Puranitee, Passiri Nisalak

Department of Orthodontics, Faculty of Dentistry, Mahidol University, Bangkok, Thailand

Patients with severe malocclusion and dentofacial deformities often require combined orthodontic and surgical treatment. The current treatment protocols are evolving from a traditional pre-surgical orthodontics phase to completely correct the tooth positions before surgery to a modified approach in which surgical correction is performed before orthodontic treatment. The appropriate diagnosis and treatment planning are essential to design the ideal treatment sequence for each individual patient. Here, we present two case reports of patients with mandibular prognathism who received treatment using either the surgery-first approach (SFA) or early surgery. The total treatment time for each patient of 17 months and 18 months 2 weeks, respectively, indicates that this modified treatment sequence significantly reduced treatment time compared with a conventional approach. In addition, the patients benefited from an immediate improvement in their facial profile after the early surgical procedure, and the short-term results were stable.

Keywords: asymmetry, class III malocclusion, early surgery, mandibular prognathism, orthognathic surgery, surgery-first approach

How to cite: Choovait P, Puranitee V, Nisalak P. Correction of mandibular prognathism using a surgery-first approach or early surgery: Two case reports. M Dent J 2021; 41: 97-112.

Introduction

For patients with dentofacial deformities, achieving satisfactory outcomes with orthodontic treatment alone is typically not possible. Orthognathic surgery is necessary to obtain an ideal facial appearance, appropriate masticatory function, and a stable occlusion. In 1849, Hullihen first reported using orthognathic treatment for a patient with a mandibular excess [1]. Until the 1960s, orthognathic surgery was typically performed without any pre-surgical orthodontic treatment. Although this resulted in facial improvement, it often resulted in poor occlusion. Orthodontists had to rectify the unstable dental malocclusion after the skeletal discrepancy was surgically corrected, thus, pre-surgical orthodontics was introduced. However, pre-surgical orthodontics has its own disadvantages, such as prolonged treatment time and temporary worsening of the facial appearance. To overcome these disadvantages, a surgery-first approach (SFA was introduced by Behrman and Behrman in 1988 [2]. The advantages of SFA include an early immediate change in the facial profile and the often-unsightly profile created from pre-surgical orthodontics can be avoided. These outcomes resolve the common chief complaint of patients with dentofacial discrepancies at the initial treatment stage. This early improvement increases patient cooperation throughout the rest of orthodontic treatment. The overall treatment duration is also reduced, partly due to the regional acceleratory phenomenon (RAP) that occurs post-operatively and is responsible for rapid tooth movement [3]. However, there have been some reports of instability and unpredictable outcomes when using SFA. Therefore, a revised treatment sequence, early surgery that includes minimal pre-surgical orthodontic treatment

Correspondence author: Parinya Choovait
Department of Orthodontics, Faculty of Dentistry, Mahidol University,
6 Yothi Road, Ratchathewi, Bangkok 10400, Thailand
Tel: +666 1624 6944 Email: mrchoovait@yahoo.com
Received: 25 August 2020 Revised: 22 May 2021 Accepted: 23 May 2021

of less than six months in duration, has been proposed as a protocol to decrease post-surgical occlusion instability and efficiently increase the predictability of treatment result [4, 5]. This aim of the short pre-surgical orthodontic phase is to minimize occlusal interferences that may interfere with the surgical procedure, such as intrusion, obtaining the appropriate buccolingual inclination of the posterior teeth, and coordinating the arch forms [6]. These case reports describe the management of two patients with skeletal class III malocclusions by SFA or early surgery.

Case Report A

Surgery-First Approach (SFA)

Diagnosis and Etiology

A 21-year-old Thai male sought improvement in his dental function after being involved in an accident one year ago. He was referred to the Orthodontic Department. He complained about poor chewing efficiency and mandibular asymmetry due to previous trauma of the right temporomandibular joint (TMJ) and malunion of the mandibular fracture site. He reported no family history of a Class III facial appearance. Photographic records, dental impressions, and radiographs were taken, followed by a detailed discussion about the treatment plan a few weeks later.

The clinical examination revealed that the patient had an asymmetrical oval facial form and a straight facial profile, with chin deviation to the right by 3 mm in relation to the facial midline at rest and in occlusion. The lips canted downwards to the right by ~2 mm, or 10°. The lips were competent; with a normal lip line at rest and upon smiling, however, the smile arc was inconsonant due to the downward canting of the lower lip to the right (Figure1). Intraorally, the patient had a bilateral Class III malocclusion and an edge-to-edge bite (overjet and overbite were 0 mm). The upper dental midline was coincident with the facial midline; however, the lower dental midline was deviated to the right by 3 mm that coincided with the midpoint of his mandible (Figure 2). Space analysis of the dentition revealed mild crowding in the upper arch. The patient's periodontal tissues were generally healthy, however, he presented with clicking and occasional pain from the right TMJ.

The patient's panoramic radiograph demonstrated a good condylar contour and clear maxillary sinuses. Due to the patient's previous accident, the right mandibular angle and left parasymphysis had been fixed using plates and screws; however, malunion had occurred at the mandibular angle (Figure 3). The lateral cephalometric analysis revealed an anteriorly positioned mandible according to the SNB value. The mandibular plane and gonial angle were within normal limits; however, the occlusal plane exhibited a mild anterior rotation. The maxillary incisors were proclined and in a protruded position, while the inclinations and positions of the mandibular incisors were within the normal range (Table 1). Based on these clinical and radiographic findings, the patient was diagnosed as having a skeletal Class III malocclusion with facial asymmetry due to a history of trauma.

Treatment Planning

A surgery-first approach (SFA) was chosen for managing this patient. One-jaw orthognathic surgery using a bilateral sagittal split osteotomy of the mandibular ramus was planned for an asymmetrical mandibular setback, 9 mm on the left and 7 mm on the right side. The aim was to achieve a bilateral Class I molar relationship and to coordinate the upper and lower dental midlines. Extraction of the upper left third molar (Tooth 28) and lower left third molar (Tooth 38) was also planned to be done during the operation. After the patient agreed to the treatment plan, dental impressions were taken for splint fabrication. In the model surgery, the upper and lower casts were simulated as a Class I molar relationship and optimum dental interdigitation with minimal canine interference.

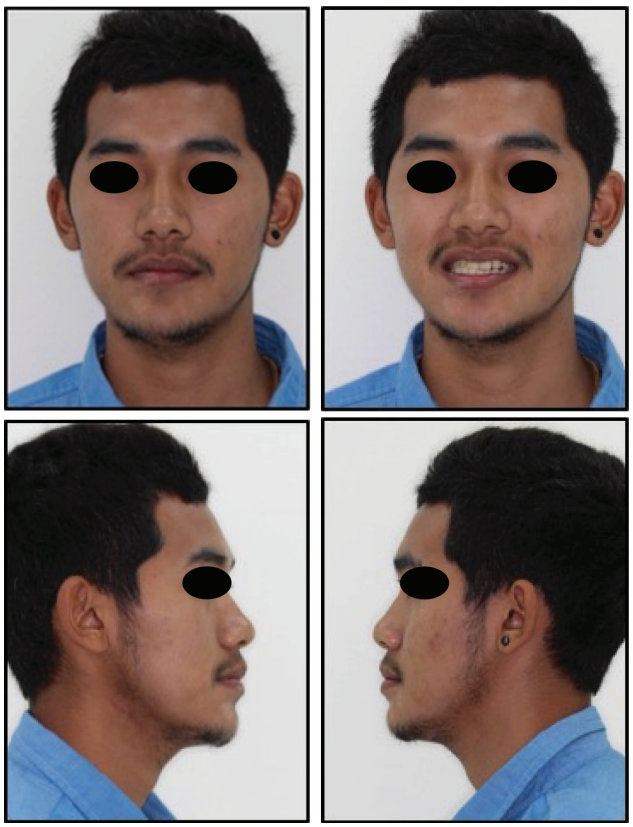

Figure 1 Pre-treatment extraoral photographs.

Figure 2 Pre-treatment intraoral photographs.

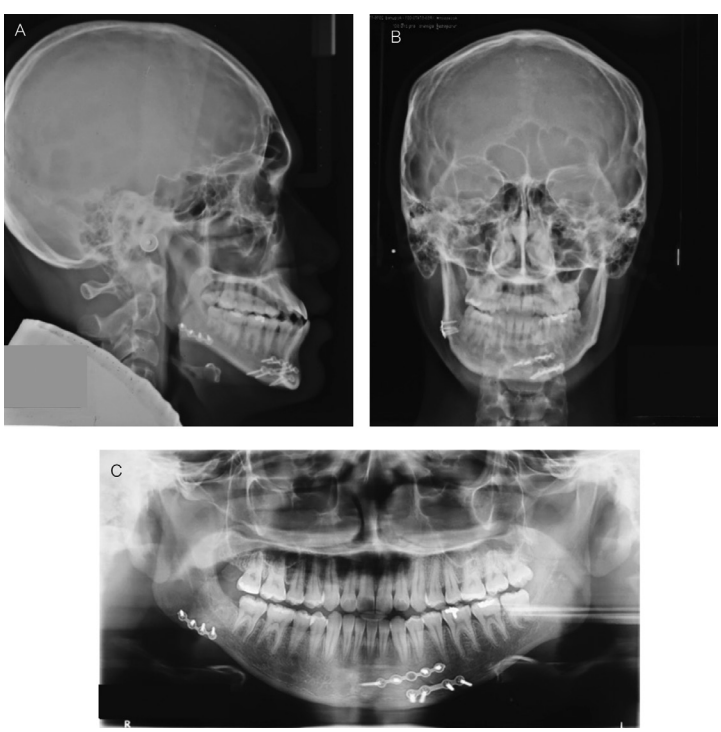

Figure 3 Pre-treatment (A) lateral cephalogram, (B) postero-anterior cephalogram, and (C) panoramic radiograph.

Table 1 Lateral cephalometric analysis.

	Measurement	Norm		Pretreatment	Posttreatment	Retention
		Mean	SD			
Skeletal	SNA (degree)	84	3.58	85	85	85
	SNB (degree)	81	3.59	88	84	84
	ANB (degree)	3	2.50	-3	1	1
	MP-PP (degree)	21	5.25	27	30	30.5
Dental	1 to NA (degree)	22	5.94	34	28	28
	1 to NA (mm.)	5	2.13	9	5	5
	1 to SN (degree)	108	6.13	118	113	113
	1 to NB (degree)	30	5.61	34	24	24.5
	1 to NB (mm.)	7	2.22	7	6	6.5
	1 to MP (degree)	97	5.97	96	87	87.5
	1 to 1 (degree)	125	8.03	118	128	127.5
Soft tissue	E line U. lip (mm.)	-1	1.76	-1	1	1
	E line L. lip (mm.)	2	2.03	2.5	0	0
	Naso-labial angle (degree)	91	7.98	92	89	89

Treatment Progress

Two days before the surgical procedure, fixed appliances were bonded on the upper and lower arches, and passive 0.016x0.022-inch stainless steel arch wires were inserted. The surgical splint was tried in.

The operation proceeded uneventfully, and the patient was discharged after three days without any complications. For the first two weeks post-surgery, intermaxillary fixation (IMF) was used to stabilize the jaw segments. After releasing the IMF, the patient was put on a semi-solid diet for 3 weeks. The entire course of recovery was uneventful.

After the IMF was removed, the patient returned monthly for orthodontic adjustment. Six months post-surgery, the dental crowding was almost completely relieved. The patient was instructed to wear short intermaxillary Class III box elastics to obtain good interdigitation. After the teeth were in a normal position and inclination, the appliances were debonded and removable wraparound retainers were delivered.

The patient and his family were satisfied with the immediate facial improvement and the rapid completion of treatment. A symmetric, harmonious relationship of the facial tissues and a pleasant profile were obtained (Figure 4). Significant improvements in the frontal facial proportions and occlusal function were noted. Bilateral Class I occlusion with a normal overjet and overbite were established (Figure 5).

The immediate post-treatment panoramic radiograph presented good root parallelism and the lateral cephalogram demonstrated appropriate labiolingual angulations of the upper and lower incisors and an improved position of the mandible (Figure 6). Superimposition of the pre-treatment and immediate post-treatment lateral cephalometric tracings is shown in Figure 7.

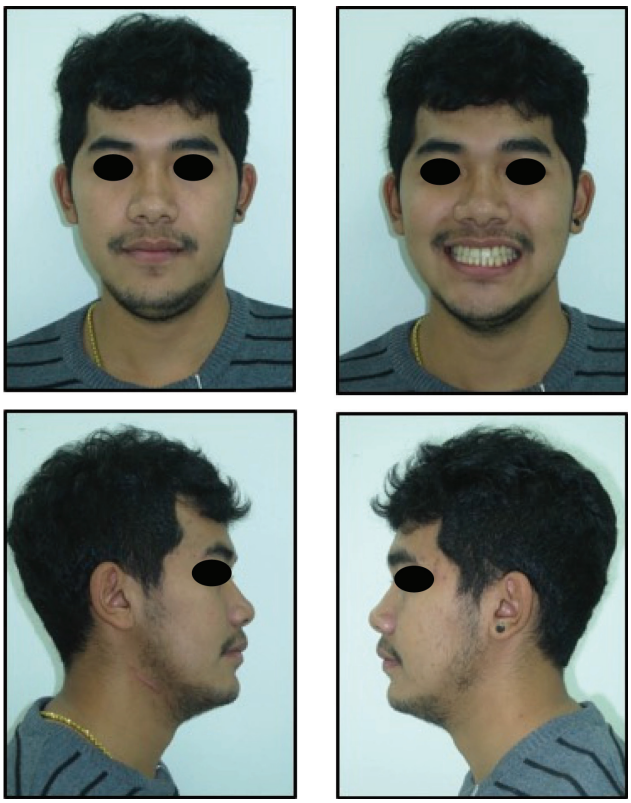

Figure 4 Immediate post-treatment extraoral photographs.

Figure 5 Immediate post-treatment intraoral photographs.

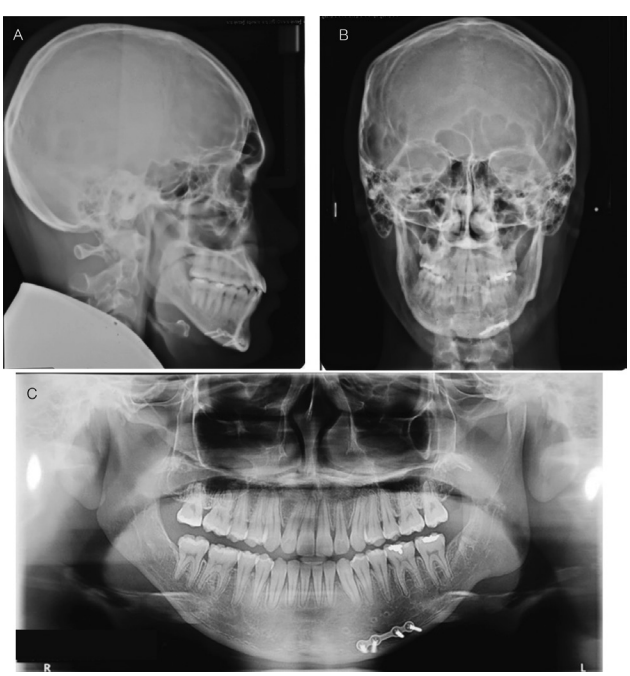

Figure 6 Immediate post-treatment (A) lateral cephalogram, (B) postero-anterior cephalogram, and (C) panoramic radiograph.

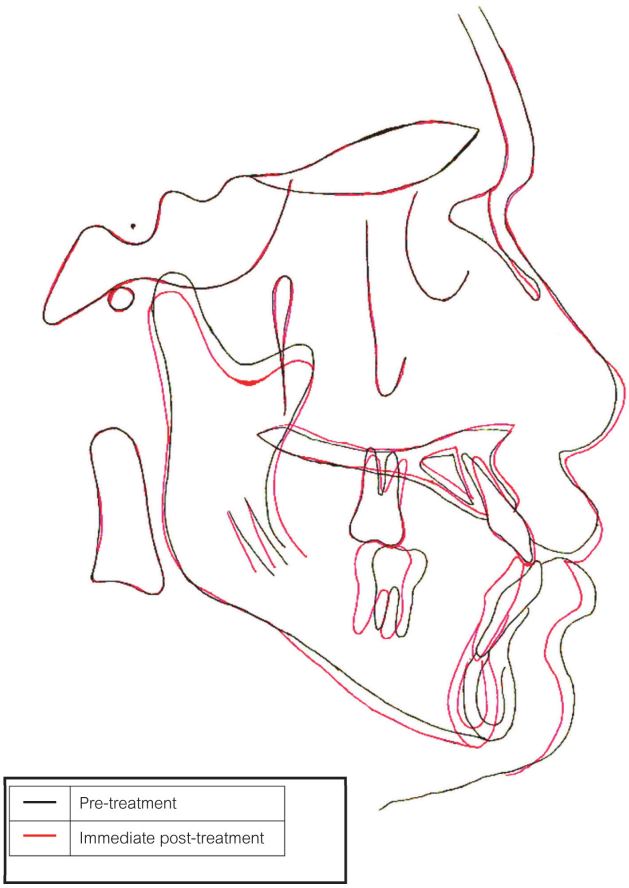

Figure 7 Superimposition of the pre-treatment and immediate post-treatment lateral cephalometric tracings.

Retention

The patient was recalled 1 year following treatment completion. Intraorally, the Class I molar and canine relationships were maintained, while the lower incisors were observed to be slightly irregular (Figure 8). Comparing the post-treatment and retention lateral cephalograms (Figure 9), the inclinations of the upper teeth remained stable, while the lower incisors had become more proclined. No skeletal relapse was observed.

Case Report B

Early Surgery

Diagnosis and Etiology

A 19-year-8-month-old Thai male seeking to improve the appearance of his long mandible and the poor chewing ability of his anterior teeth was referred to the Orthodontic Clinic. He reported no family history of mandibular prognathism and no history of allergy or systemic disease. Extra- and intra-oral photographic records, radiographs, and dental impressions were taken during the first visit.

Figure 8 1-year post-treatment extraoral and intraoral photographs.

Figure 9 Superimposition of immediate post-treatment and retention phase lateral cephalometric tracings.

The clinical examination revealed that the patient had a concave facial profile, competent lips, slightly increased lower anterior facial height, and a shallow mentolabial sulcus. Facial asymmetry was detected with the chin deviated to the right (Figure 10). The patient had finished his growth spurt and the lateral cephalogram showed skeletal maturity.

Intraoral examination demonstrated a bilateral Class III malocclusion with an anterior open bite of 0.5 mm and a reverse overjet of -2 mm. The upper dental midline was coincident with the facial midline, while the lower dental midline was shifted to the right by 2 mm in relation to the facial midline, and coincident with the chin (Figure 11). Space analysis revealed mild crowding in the upper and lower arches. The upper right second permanent molar was supra-erupted with hanging palatal cusps. No abnormal findings were found in the periodontal tissues or TMJ.

The reformatted panoramic radiograph showed normal condylar contours and clear maxillary sinuses. The lateral cephalometric analysis confirmed the class III skeletal pattern due to an orthognathic maxilla and a prognathic mandible, according to the SNA and SNB values (Table 2). The mandible was rotated backward and downward. The inclinations of the maxillary incisors were within normal range; however, the mandibular incisors were retroclined. The reformatted antero-posterior view verified the deviation of the chin towards the right (Figure 12).

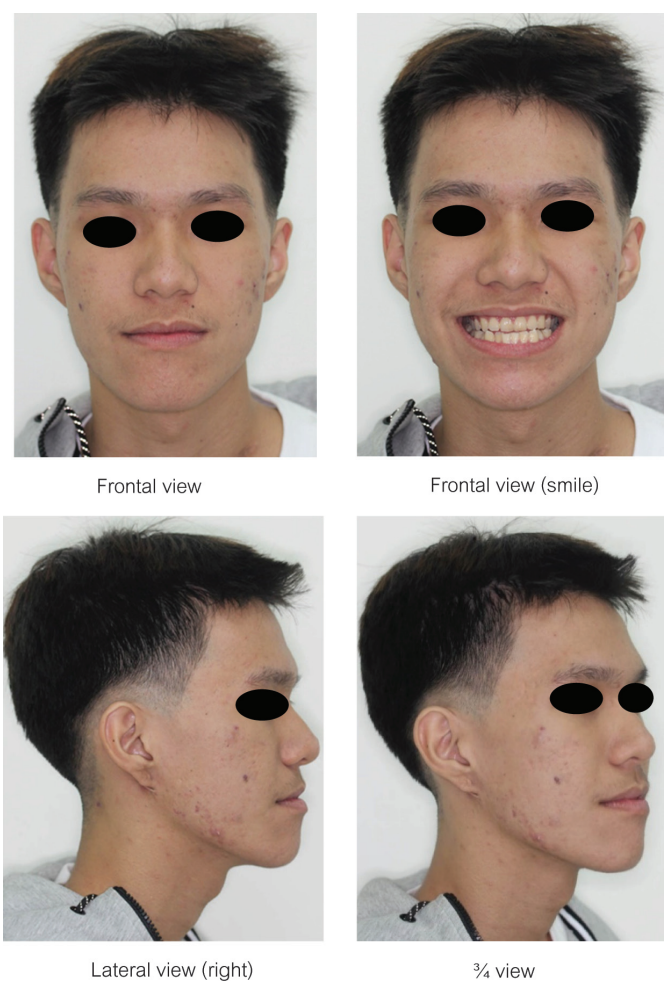

Figure 10 Pre-treatment extraoral photographs.

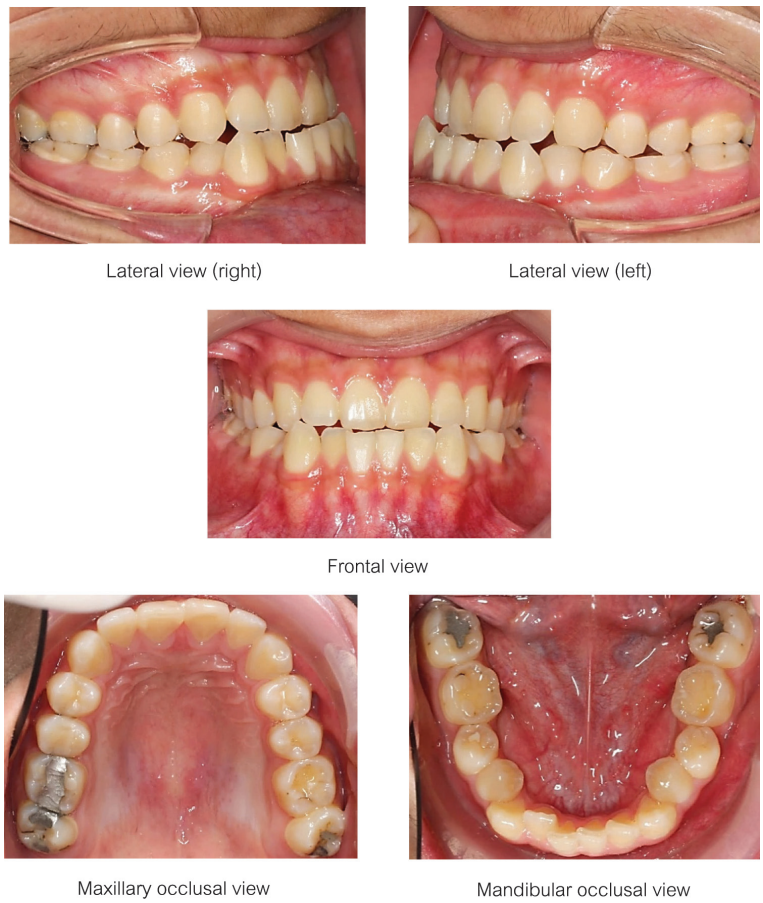

Figure 11 Pre-treatment intraoral photographs.

Table 2 Lateral cephalometric analysis.

	Measurement	Norm		Pretreatment	Posttreatment	Retention
		Mean	SD			
Skeletal	SNA (degree)	84	3.58	86	87	87
	SNB (degree)	81	3.59	89	86	86
	ANB (degree)	3	2.50	-3	1	1
	MP-PP (degree)	21	5.25	23	26.5	26.5
Dental	1 to NA (degree)	22	5.94	28	29	29
	1 to NA (mm.)	5	2.13	5	6	6
	1 to SN (degree)	108	6.13	114	115	116
	1 to NB (degree)	30	5.61	19	22.5	18
	1 to NB (mm.)	7	2.22	4	6	5
	1 to MP (degree)	97	5.97	81	85	81
	1 to 1 (degree)	125	8.03	141	130	133
Soft tissue	E line U. lip (mm.)	-1	1.76	-5.5	-2.5	-2
	E line L. lip (mm.)	2	2.03	0.5	0	-0.5
	Naso-labial angle (degree)	91	7.98	90	93	92.5

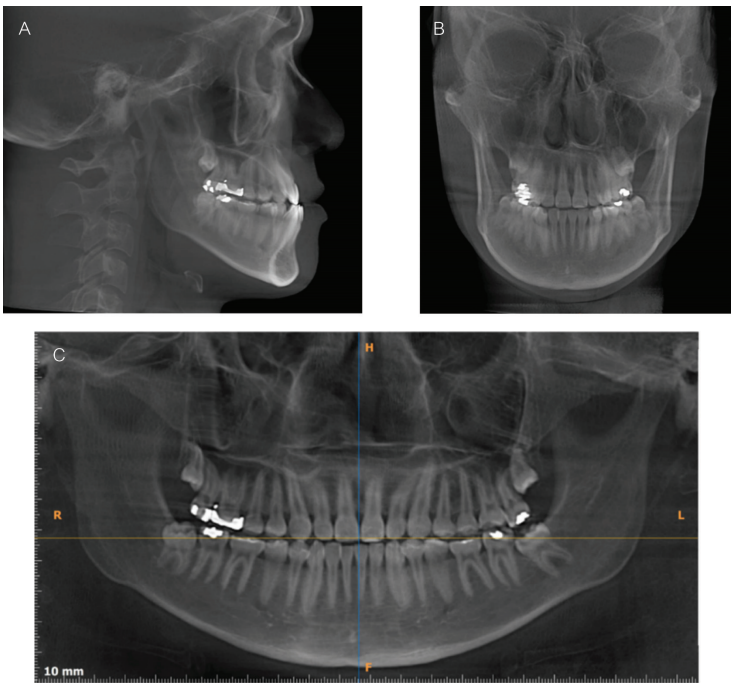

Figure 12 Pre-treatment (A) reformatted lateral view, (B) reformatted antero-posterior view, and (C) reformatted panoramic radiograph.

Treatment Planning

The treatment goals for this patient were to obtain a well-balanced facial form, correct the skeletal and dental class III relationship, eliminate the anterior crossbite, and establish an appropriate overjet.

The early surgery approach, a modified SFA, comprises pre-surgical orthodontics of less than six months, followed as soon as possible by the surgical procedure and then the post-surgical orthodontic treatment. After a discussion between the patient, surgeon, and orthodontist, the early surgery plan was chosen because the patient desired early immediate improvement in his facial profile and a shorter overall treatment time. Hence, a single-jaw orthognathic surgery was planned, using a mandibular bilateral sagittal split osteotomy for setback by 7 mm, to achieve a bilateral Class I molar relationship.

Treatment Progress

Before orthodontic treatment commenced, the patient was referred for full mouth prophylaxis and extraction of all third molars. Fixed appliances were bonded to level and align the arches and to eliminate the supra-erupted upper right second permanent molar to provide a stable post-surgical occlusion. Once this was achieved, dental impressions were taken for model surgery and fabricating a surgical splint, where the upper and lower casts were simulated as a Class I molar relationship with maximum dental intercuspation. One day before the day of surgery, 0.016" x 0.022" nickel-titanium arch wires were placed on the upper and lower arches (Figure 13).

Two weeks post-operatively, orthodontic treatment was resumed, and the patient was recalled every two weeks for appliance adjustment. Two months post-operatively, the dental crowding was almost completely relieved, and the inclinations of the lower incisors had improved (Figure 14). Thirteen months post-operatively, all appliances were debonded and wraparound retainers were delivered.

Figure 13 Pre-operation extraoral and intraoral photographs.

Figure 14 Two months post-operation extraoral and intraoral photographs.

Treatment Results

The patient and his family were satisfied with the early immediate improvement in his facial appearance and the rapid completion of the orthodontic treatment. A harmonious relationship of the facial soft tissues was obtained by achieving facial symmetry and transformation of the facial profile from concave to slightly convex.

Significant improvement in the anteroposterior position of the mandible and masticatory function were noted. The post-treatment occlusion demonstrated good interdigitation and a well-aligned dentition with Class I molar and canine relationships on both sides. An appropriate positive overjet and overbite were attained (Figure 15).

The immediate post-treatment postero-anterior cephalogram confirmed that the chin deviation had been corrected (Figure 16). Superimposition of the pre-treatment and immediate post-treatment lateral cephalometric tracings revealed that the mandibular plane was maintained (Figure 17).

Retention

The patient was recalled nine months after completing treatment. Intraorally, the Class I molar and canine relationships were maintained, while the lower incisors were observed to be slightly more upright (Figure 18). Comparing the immediate post-treatment and retention phase lateral cephalometric values (Figure 19), the inclinations of the upper teeth remained stable, while the lower incisors had become more retroclined (Table 2). No skeletal relapse was observed.

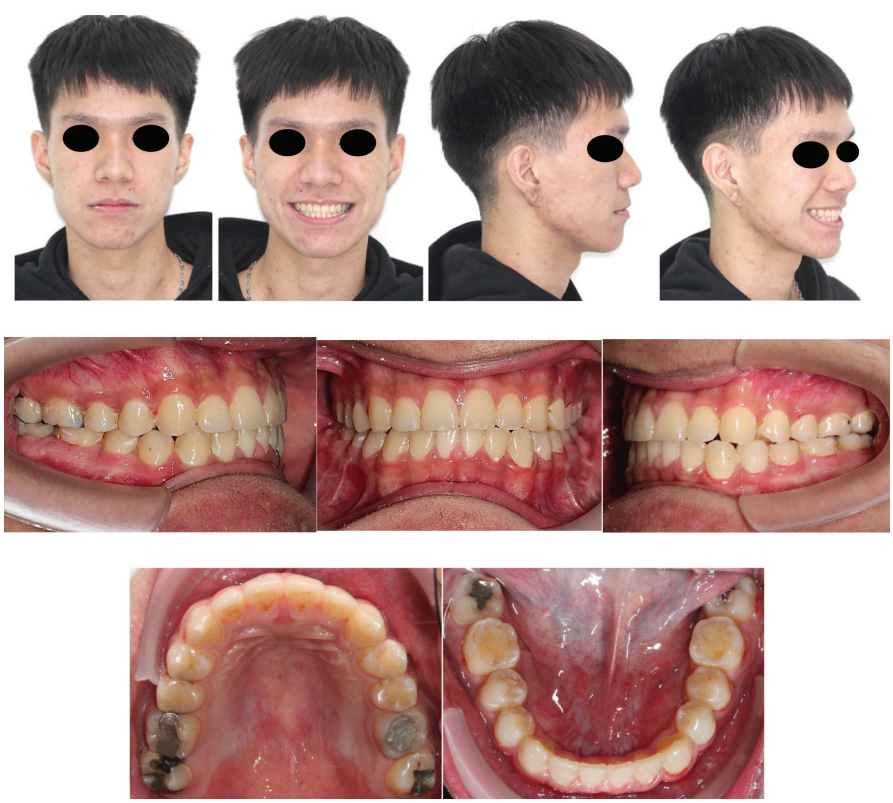

Figure 15 Immediate post-treatment extraoral and intraoral photographs.

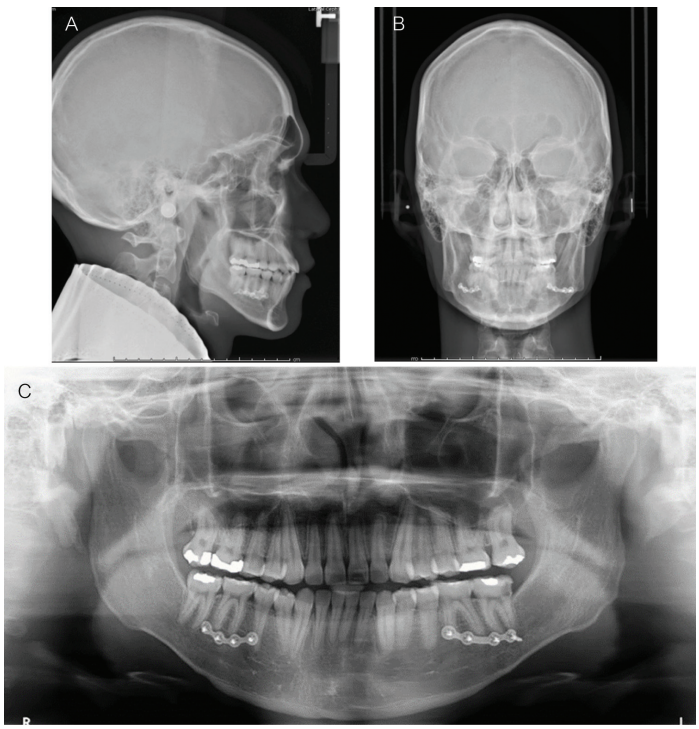

Figure 16 Immediate post-treatment (A) lateral cephalogram, (B) postero-anterior cephalogram, and (C) panoramic radiograph.

Figure 17 Superimposition of pre-treatment and immediate post-treatment lateral cephalometric tracings.

Figure 18 Nine months post-treatment extraoral and intraoral photographs.

Figure 19 Superimposition of the immediate post-treatment and retention phase lateral cephalometric tracings.

Discussion

The indications for SFA are (1) minimal crowding in the anterior teeth, (2) favorable curve of Spee, (3) normal or mildly proclined/retroclined incisor inclination, and (4) the patient wants an immediate esthetic change [3].

The early surgery approach is an option for patients who want early and immediate esthetic change but who do not completely meet the criteria for SFA. The early surgery concept was proposed to reduce the instability of the post-surgical occlusion and efficiently increase the predictability of the surgical results [4, 5]. Long-term outcomes of the SFA have demonstrated similar skeletal and dental stability in the transverse [4], vertical [8], and sagittal [5] dimensions compared with the conventional approach. Many studies have found that SFA patients commonly experience shorter treatment time [6, 7, 9, 10, 11], with a mean total duration of 14.2 months (range 10.2–19.4 months), while conventional treatment averaged 20.16 months (range 15.7–22.5 months) [5, 9, 12]. It has been suggested that after correcting the skeletal base discrepancy, the direction of the post-surgical orthodontic tooth movement coincides with the natural direction of spontaneous dental compensation and muscular forces, thereby decreasing the time required for dental decompensation [6, 8]. Moreover, the rate of orthodontic tooth movement may be facilitated by the surgically-induced RAP [3, 6, 7, 13]. This mechanism is a complex physiologic phenomenon involving accelerated bone turnover and decreased regional mineral density [3].

The drawbacks of the SFA are that the occlusion of the dental arches cannot be used to predict the final occlusion and that the postsurgical occlusion is always unstable [14]. Estimating the final outcome is the most challenging aspect of using this approach. If occlusal prematurities are present, the maxillary and mandibular study models cannot be seated in an ideal relationship, and minimal pre-surgical orthodontics should be performed to eliminate the prematurities to create a more stable post-surgical occlusion and more accurate final occlusion, as seen in case report B. If the prediction of the final occlusion is not accurate or the predicted final occlusion is not realistic or achievable, the results would be far from satisfactory.

Conclusion

SFA and early surgery can be effective for managing severe skeletal Class III malocclusions. The advantages include shortened total treatment time and early improvement in the patient's facial esthetics. Careful case selection, correct diagnosis, and a detailed treatment prediction and simulation are necessary to increase the long-term success of SFA outcomes. Thus, proper communication between the surgeon and orthodontist is important to select the appropriate treatment protocol to achieve the patient's needs and goals.

Declaration of Patient Consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patients have signed their consent for their images and other clinical information to be published.

References

1. Poulton DR, Ware WH. The American academy of oral roentgenology joins our journal. *Oral Surg Oral Med Oral Pathol* 1959; 12: 389-90.
2. Behrman SJ, Behrman DA. Oral surgeons considerations in surgical orthodontic treatment. *Dent Clin North Am* 1988: 32: 481-507.

3. Liou EJW, Chen PH, Wang YC. Surgery-first accelerated orthognathic surgery: postoperative rapid orthodontic tooth movement. *J Oral Maxillofac Surg* 2011: 69: 781-85.
4. Wang YC, Ko EW, Huang CS, Chen YR, Takano-Yamamoto T. Comparison of transverse dimensional changes in surgical skeletal Class III patients with and without presurgical orthodontics. *J Oral Maxillofac Surg* 2010; 68: 1807-12.
5. Ko EW, Hsu SS, Hsieh HY, Wang YC, Huang CS, Chen YR. Comparison of progressive cephalometric changes and postsurgical stability of skeletal Class III correction with and without presurgical orthodontic treatment. *J Oral Maxillofac Surg* 2011; 69: 1469-77.
6. Baek S, Ahn HW, Kwon YH, Choi JY. Surgery-first approach in skeletal class III malocclusion treated with 2-jaw surgery: evaluation of surgical movement and postoperative orthodontic treatment. *J Craniofac Surg* 2010; 21: 332-38.
7. Hernandez-Alfaro F, Guijarro-Martinez R, Peiro-Guijarro MA. Surgery first in orthognathic surgery: what have we learned? A comprehensive workflow based on 45 consecutive cases. *J Oral Maxillofac Surg* 2014; 72: 376-90.
8. Liao YF, Chiu YT, Huang CS, Ko EW, Chen YR. Presurgical orthodontics versus no presurgical orthodontics: Treatment outcome of surgical-orthodontic correction for skeletal class III open bite. *Plast Reconstr Surg* 2010; 126: 2074-83.
9. Choi JW, Lee JY, Yang SJ, Koh KS. The reliability of a surgery-first orthognathic approach without presurgical orthodontic treatment for skeletal class III dentofacial deformity. *Ann Plast Surg* 2015; 74: 333-41.
10. Park HM, Lee YK, Choi JY, Baek SH. Maxillary incisor inclination of skeletal Class III patients treated with extraction of the upper first premolars and two-jaw surgery: conventional orthognathic surgery vs surgery-first approach. *Angle Orthod* 2014; 84: 720-29.
11. Kim JY, Jung HD, Kim SY, Park HS, Jung YS. Postoperative stability for surgery-first approach using intraoral vertical ramus osteotomy: 12 months follow-up. *Br J Oral Maxillofac Surg* 2014; 52: 539-44.
12. Kim CS, Lee SC, Kyung HM, Park HS, Kwon TG. Stability of mandibular setback surgery with and without presurgical orthodontics. *J Oral Maxillofac Surg* 2014; 72: 779-87.
13. Hernandez-Alfaro F, Guijarro-Martinez R, Molina-Coral A, Badia- Escriche C. “Surgery first” in bimaxillary orthognathic surgery. *J Oral Maxillofac Surg* 2011; 69: e201-7.
14. Yu HB, Mao LX, Wang XD, Fang B, Shen SG. The surgery first approach in orthognathic surgery: a retrospective study of 50 cases. *Int J Oral Maxillofac Surg* 2015; 44:1463-67.