รายงานผู้ป่วย
Case Report

Combined Orthodontic and Surgical Treatment in the Correction of Mandibular Prognathism with Facial Asymmetry: A Case Report

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Abstract

This case report presents a 20-year-old Thai female projecting with facial concavity, chin deviation, and anterior crossbite. Upon clinical examination and radiographic analyses, her problems apparently derived from a true skeletal Class III malocclusion combined with the unbalanced growth of ramus and mandibular bodies. Since she had concerned on her facial esthetic and the discrepancies were too severe to succesfully manage with a conventional orthodontic treatment alone, a combination of surgical and orthodontic approach on the protruded and asymmetrical mandible was proposed. Following a pre-surgical orthodontic decompensation without any tooth extraction, bilateral sagittal split osteotomy (BSSO) was performed to set back chin protrusion and solve asymmetry. Both peg-shaped upper lateral incisors were left non-restored for the proper overjet and overbite was beautifully achieved. The patient was debonded after 28 months of treatment. Post-treatment achievements in this case include (1) improvement in facial esthetic, (2) cusp-to-fossa occlusion with normal overjet and overbite, (3) good dental level and alignment, and (4) coincided midlines. The outcome of this case enlightens the success of a precise diagnosis and a careful treatment planning in skeletal Class III correction by an orthodontic treatment combined with orthognathic surgery.

Keywords: Bilateral sagittal split osteotomy, Chin deviation, Orthognathic surgery, Skeletal Class III malocclusion

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Introduction

Apart from malocclusion, patients with severe skeletal discrepancies generally project with compromised facial profile.[1,2] Skeletal Class III patients, dominating the southern-east Asian population[3,4], manifested by facial concavity as resulted by flat midface, prominent mandible, or a combination of both.[4, 5]

Not only in an anteroposterior dimension, transverse problems may also get involve with facial disharmony of these patients.[3] Numerous studies showed that asymmetry is most frequent on the lower part of the face[6-8] and a chin deviation, as one form of lower facial asymmetry, expresses more easily in a prognathic than retrognathic mandible.[2] Because both mandibular prognathism and asymmetry can give rise to functional and esthetic issues, malocclusion and facial esthetic awareness subsequently become the main reasons for these patients in seek of an orthodontic consultation.[2, 3, 5]

There are various treatments for Class III malocclusion. Growth modification, for example, is usually considered in growing patients. In adolescents whose growth are about to end or even adult patients showing mild skeletal discrepancy, an orthodontic camouflage treatment can be successfully accomplished. However, a combined surgical and orthodontic approach is necessary when it comes to non-growing patients with moderate to severe skeletal Class III malocclusion.[3-5]

Orthognathic surgery is the method used to correct basal bone malposition and malocclusion along with each of them.[9] Not only oral function and facial esthetic, but this combined orthodontic and surgical procedure also have a huge positive impact on patients' quality of life and psychosocial as studied in many literatures.[10,11]

The aim of this case report was to narrate mandibular prognathism and asymmetry correction in the skeletal Class III patient by an orthodontic treatment combined with orthognathic surgery. Careful treatment plan and procedures were discussed.

Case Report

A 20-year-old Thai female consulted the orthodontist for her chief complaint of chin protrusion and anterior crossbite (Figure 1). Extraoral examination exhibited a concave lateral profile with normal nasolabial angle and lip position. In the frontal view, the patient had a dolicofacial face accompanied with a chin deviation (2 mm) to the left.

Intraoral examination and study models analysis revealed Class III molar relationship: 7 mm on the right side and 3 mm on the left side, 13-24/35-44 crossbite with -3 mm overjet, and normal overbite (Figure 2, 3). No functional shift was found in this case. The lower dental midline shifted 2 mm to the left which apparently coincided with chin midline. There appeared no space discrepancy noted on the upper arch. Moderate crowding existed in the lower arch predominatly within the anterior area. Because of the peg-shaped upper lateral incisors, Bolton analysis[12] revealed the tooth-size discrepancy in both anterior and posterior teeth. When the size of lower anterior teeth was assumed to be normal, the upper anterior teeth was 2.74 mm smaller than the normal size. Also, tooth number 17 was extruded due to lack of an opposing tooth.

Figure 1 Pre-treatment extraoral photographs

Figure 2 Pre-treatment intraoral photographs

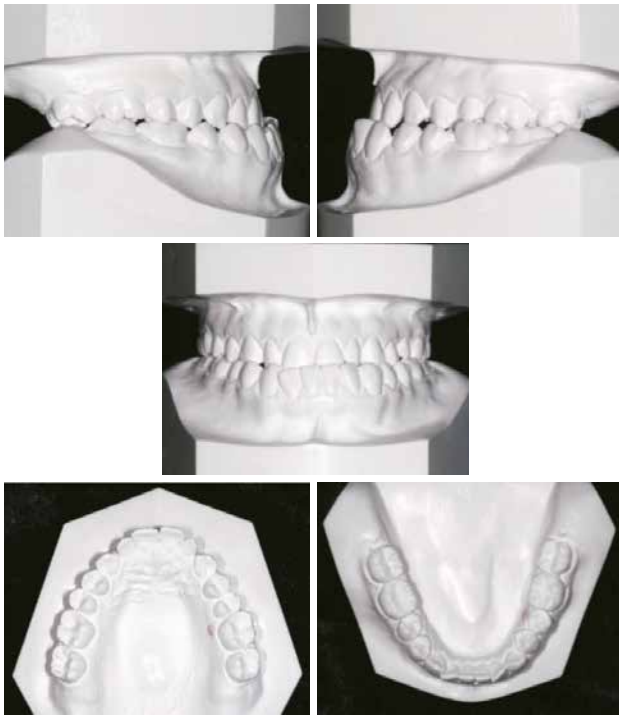

Figure 3 Pre-treatment study models

Lateral cephalometric measurement (Figure 4A, Table 1) based on Thai norm[13-15] indicated skeletal Class III hyperdivergent pattern with orthognathic maxilla and prognathic mandible. The upper incisors were normally inclined and in proper position. Nevertheless, the lower incisors appeared to be retroclined and retruded leading to an obtuse interincisal angle. As in soft tissue aspect, both upper and lower lips along with nasolabial angle were within normal limit. According to Grummon's analysis on postero-anterior cephalogram (Figure 4B), there presented the maxillary plane canting with the left side being 2 mm lower than the right. No canting of occlusal plane was noted. The length of the left mandibular ramus appeared to be longer than the right; on the contrary, the length of mandibular body on the right was longer compared to its contralateral. Lastly, the chin deviated to the left 2 mm from the facial midline. The panoramic radiograph (Figure 5) exhibited asymmetry of mandibular condyles with the right side being larger than the left and maxillary sinus pneumatization on the left side.

Figure 4 Pre-treatment lateral cephalogram (A) and posterioanterior cephalogram (B)

Figure 5 Pre-treatment panoramic radiograph

Treatment goals were aimed towards: (1) correction of asymmetric and protruded chin to

Table 1 Pre-treatment cephalometric analysis

Area		Measurement	Norm Mean±SD	Pre-treatment	Interpretation
Skeletal	Maxilla to Cranial base	SNA (degree)	84±4	85	Orthognathic maxilla
		SN-PP (degree)	9±3	9	Normal inclination of maxilla
	Mandible to Cranial base	SNB (degree)	81±4	89	Prognathic mandible
		SN-MP (degree)	29±6	36	Hyperdivergent pattern
		SN-Pg (degree)	82±3	91	Prognathic mandible
		NS-Gn (degree)	68±3	60	Hypodivergent pattern
	Maxillo-Mandibular	ANB (degree)	3±2	-4	Skeletal Class III
		Wits (mm)	-3±2	-12	Skeletal Class III
		MP-PP (degree)	21±5	27	Hyperdivergent pattern
		FMA (degree)	23±5	27	Normodivergent pattern
Dental	Maxillary dentition	U1 to NA (degree)	22±6	23	Normally inclined upper incisor
		U1 to NA (mm)	5±2	7	Normally positioned upper incisor
		U1 to SN (degree)	108±6	108	Normally inclined upper incisor
	Mandibular dentition	L1 to NB (degree)	30±6	19	Retroclined lower incisor
		L1 to NB (mm)	7±2	4	Retruded lower incisor
		L1 to MP (degree)	99±5	74	Retroclined lower incisor
	Maxillo-Mandibular	U1 to L1 (degree)	125±8	142	Obtuse interincisal angle
Soft tissue	Soft tissue	E line U. lip (mm)	-1±2	-1	Normally positioned upper lip
		E line L. lip (mm)	2±2	2.5	Normally positioned lower lip
		Nasolabial angle (degree)	91±8	89	Normal nasolabial angle
		H-angle (degree)	14±4	14	Normally positioned upper lip

improve facial esthetic, (2) good intercuspation along with normal overjet and overbite, (3) proper level and alignment in both arches, and (4) harmonized facial and dental midlines.

Since the chief complaint involved skeletal discrepancies, the suitable treatment plan for this case was an orthodontic treatment combined with one-jaw orthognathic surgery. Asymmetrical setback of mandible by bilateral sagittal split osteotomy (BSSO) was carried out to reduce chin protrusion, as well as left deviation. In spite of the hyperdivergent pattern, the procedure was planned without the mandibular rotation around the pitch axis because the patient had normal upper and lower facial height to begin with. Due to space sufficiency on the upper arch, as well as good upper incisor position, non-extraction plan of pre-surgical orthodontic treatment was favored and both peg-shaped lateral incisors would receive no

restorative treatment. To eliminate dental interference during surgery, the overhung tooth number 17 was intruded with the aid of temporary anchorage device (TAD). Further negative overjet was prepared by lower incisors proclination which would solve moderate crowding simultaneously. The lower dental midline was kept in the initial place as it had perfectly agreed with chin midline.

After hygienic phase, bi-dimensional preadjusted edgewise brackets (slot 0.018-inch and 0.022-inch on incisors and those remains respectively) was bonded to all teeth. Initial leveling and aligning were executed using nickel-titanium (NiTi) wires until 0.016 x 0.016-inch stainless steel wires were reached on both arches. Since the palatal cusps of tooth number 17 were overly extruded, imposing dental interferences during the mandibular setback, a single interradicular TAD was placed palatally between tooth number 16 and 17 under local anesthesia. The anteroposterior position of the TAD was determined by two factors; the line of intrusive force and the risk of the greater palatine nerve injury. A lingual button was attached on the palatal surface of tooth number 17 acting as an anchor for intrusive c-chain traction to TAD. The buccal cusps of a certain tooth, which merely showed a minute extrusion, would be leveled by main archwires. Within 15 months of active treatment, pre-surgical orthodontic treatment was completed with 0.016 x 0.022-inch stainless steel wires (Figure 6, 7, 8; Table 2).

Figure 6 Pre-surgical extraoral photographs

Figure 7 Pre-surgical intraoral photographs

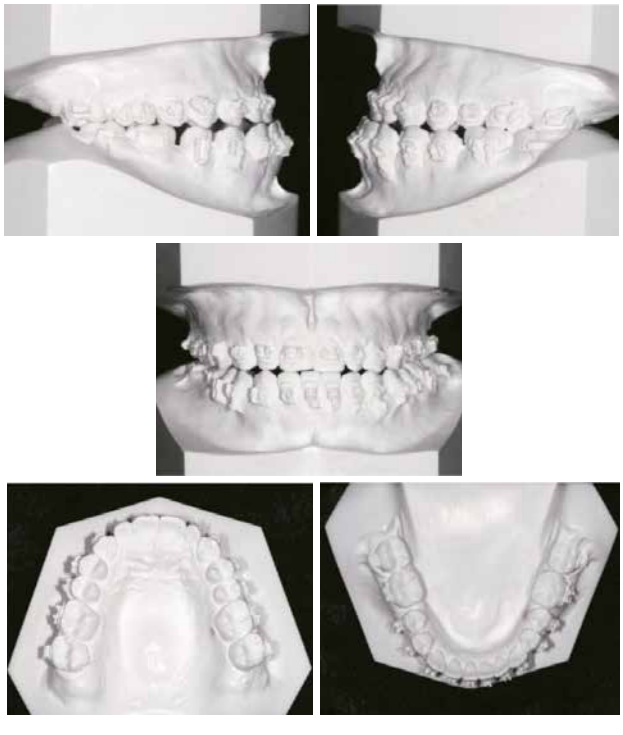

Figure 8 Pre-surgical study models

Table 2 Occlusion of Pre-surgical compared with Pre-treatment

		Pre-treatment	Pre-surgical treatment
Overjet		-3 mm	-5 mm
Overbite		2 mm	2 mm
Canine relationship	Right	Class III 6 mm	Class III 7 mm
	Left	Class III 3 mm	Class III 3 mm
Molar relationship	Right	Class III 7 mm	Class III 6 mm
	Left	Class III 3 mm	Class III 3 mm
Upper	Midline	Center	Center
	Arch form	Paraboloid-shaped	Paraboloid-shaped
	Intercanine width	30 mm	30 mm
	Intermolar width	47 mm	47 mm
Lower	Midline	Shifted to the left 2 mm (coincided with chin midline)	Shifted to the left 2 mm (coincided with chin midline)
	Arch form	Paraboloid-shaped	Paraboloid-shaped
	Intercanine width	23 mm	24 mm
	Intermolar width	46 mm	46 mm

Lateral cephalometric superimposition (Figure 9A, 10; Table 3) revealed dental and soft tissue changes. The upper incisors became more proclined and intruded, while the lower incisors showed not only proclination but also protrusion compared to the pre-treatment. The position of both upper and lower molars remained in place. The patient showed no change in the facial profile, yet the lower lip was protruded. It was

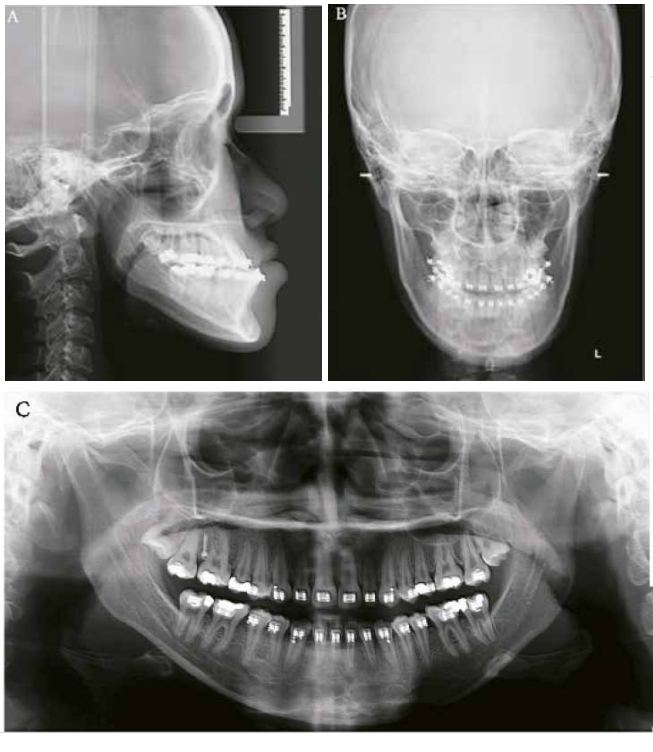

Figure 9 Pre-surgical lateral cephalogram (A), posteroanterior cephalogram (B), and panoramic radiograph (C)

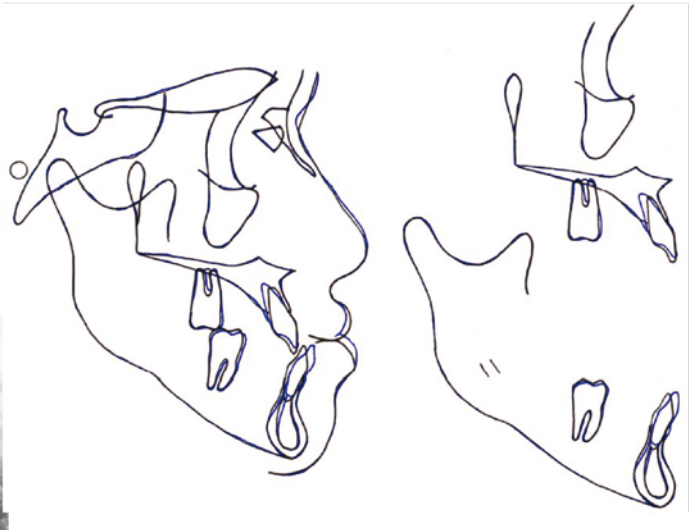

Figure 10 Lateral cephalometric superimposition Pre-treatment (Black) - Pre-surgical treatment (Blue)

Table 3 Pre-surgical cephalometric analysis

Area		Measurement	Norm Mean±SD	Pre-treatment	Pre-surgical treatment	Difference
Skeletal	Maxilla to Cranial base	SNA (degree)	84±4	85	85	0
		SN-PP (degree)	9±3	9	9	0
	Mandible to Cranial base	SNB (degree)	81±4	89	89	0
		SN-MP (degree)	29±6	36	36	0
		SN-Pg (degree)	82±3	91	91	0
		NS-Gn (degree)	68±3	60	60	0
	Maxillo-Mandibular	ANB (degree)	3±2	-4	-4	0
		Wits (mm)	-3±2	-12	-12	0
		MP-PP (degree)	21±5	27	27	0
		FMA (degree)	23±5	27	27	0
Dental	Maxillary dentition	U1 to NA (degree)	22±6	23	28	+5
		U1 to NA (mm)	5±2	7	7	0
		U1 to SN (degree)	108±6	108	113	+5
	Mandibular dentition	L1 to NB (degree)	30±6	19	28	+9
		L1 to NB (mm)	7±2	4	7	+3
		L1 to MP (degree)	99±5	74	82	+8
	Maxillo-Mandibular	U1 to L1 (degree)	125±8	142	128	-14
Soft tissue	Soft tissue	E line U. lip (mm)	-1±2	-1	-3	-2
		E line L. lip (mm)	2±2	2.5	3.5	+1
		Nasolabial angle (degree	91±8	89	98	+9
		H-angle (degree)	14±4	14	12	-2

interesting that the upper lip had been retruded despite the fact that the upper incisors position was unchanged. The explainable reasons to such phenomenon were that the increase in negative overjet might have caused upper lip trapping and the low level of productibility found in the constructed point of the upper lip.[16] On the contrary, all parameters in pre-surgical Grummon's analysis (Figure 9B) were unaltered.

As BSSO was performed, the mandible was asymmetrically set back for 6 mm on the right side and 4 mm on the contralateral. When the surgical splint was removed two months later, all teeth were releveled starting with 0.014-inch NiTi wires. To seat the occlusion, the patient was indicated to use intermaxillary triangular elastic traction (3/16-inch, 3.5 ounces) from the upper canine to the lower canine and first premolar on each side. Stiffer wires were consecutively incorporated up until 0.016 x 0.016-inch stainless steel wires. Spacing in the lower arch was dissolved during this process. The orthodontic finishing phase took approximately 11 months.

At the end of treatment, both chin protrusion and deviation had been corrected. In result, facial esthetic were satisfyingly improved (Figure 11, 12). The final occlusion (Figure 13, 14; Table 4) was Class I molar on the right side and Class II (1 mm) molar on the left with normal overjet and overbite. Bilateral Class II (1 mm) canine relationships were due to the remaining Bolton discrepancy from unrestored peg-shaped lateral incisors. Upper and lower dental midlines harmonized with facial midline. The patient was provided with upper and lower wrap-around retainers for retention.

Figure 11 Post-treatment extraoral photographs

Figure 12 Extraoral comparison Pre-treatment (A,C) - Post-treatment (B,D)

Figure 13 Post-treatment intraoral photographs

Figure 14 Post-treatment study models

Post-treatment cephalometric analysis (Figure 15A, 16; Table 5) demonstrated the major changes in skeletal, dental, and soft tissue aspects. As SNB decreased, ANB increased, and Class I skeletal relationship was successfully achieved. All dental parameters were within normal range, especially interincisal angle which showed significant improvement. Facial concavity was modified into straight profile and nasolabial angle was increased. Grummon's analysis (Figure 15B) proved no chin deviation and occlusal plane canting after treatment. Root parallel and mild root resorption were found in panoramic radiograph (Figure 15C).

Table 4 Occlusion of Post-treatment compared with Pre-surgical and Pre-treatment

		Pre-treatment	Pre-surgical treatment	Post-treatment
Overjet		-3 mm	-5 mm	2 mm
Overbite		2 mm	2 mm	2 mm
Canine relationship	Right	Class III 6 mm	Class III 7 mm	Class II 1 mm
	Left	Class III 3 mm	Class III 3 mm	Class II 1 mm
Molar relationship	Right	Class III 7 mm	Class III 6 mm	Class I
	Left	Class III 3 mm	Class III 3 mm	Class II 1 mm
Upper	Midline	Center	Center	Center
	Arch form	Paraboloid-shaped	Paraboloid-shaped	Paraboloid-shaped
	Intercanine width	30 mm	30 mm	31 mm
	Intermolar width	47 mm	47 mm	45 mm
Lower	Midline	Shifted to the left 2 mm (coincided with chin midline)	Shifted to the left 2 mm (coincided with chin midline)	Center
	Arch form	Paraboloid-shaped	Paraboloid-shaped	Paraboloid-shaped
	Intercanine width	23 mm	24 mm	24 mm
	Intermolar width	46 mm	46 mm	45 mm

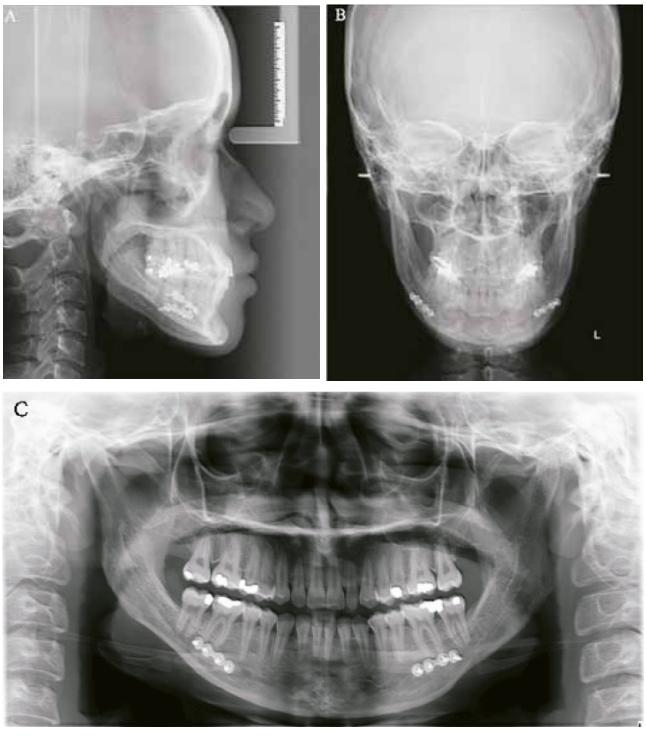

Figure 15 Post-treatment lateral cephalogram (A), posteroanterior cephalogram (B), and panoramic radiograph (C)

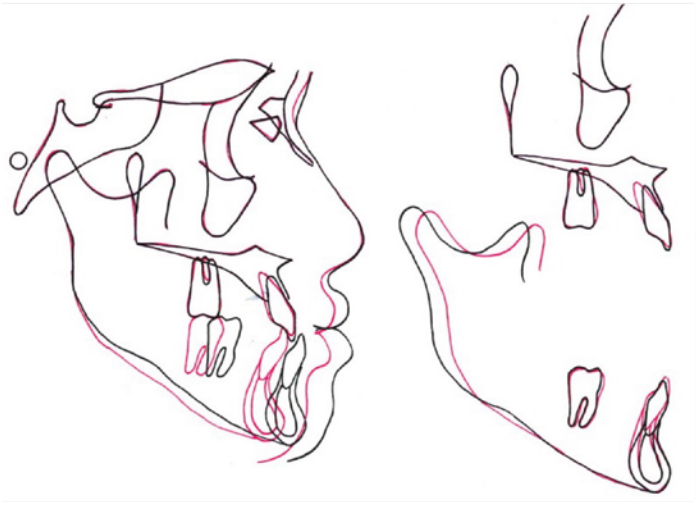

Figure 16 Lateral cephalometric superimposition Pre-treatment (Black) – Post-treatment (Red)

Table 5 Post-treatment cephalometric analysis

Area		Measurement	Norm Mean±SD	Pre-treatment	Post-treatment	Difference
Skeletal	Maxilla to Cranial base	SNA (degree)	84±4	85	85	0
		SN-PP (degree)	9±3	9	9	0
	Mandible to Cranial base	SNB (degree)	81±4	89	84	-5
		SN-MP (degree)	29±6	36	38	+2
		SN-Pg (degree)	82±3	91	87	-4
		NS-Gn (degree)	68±3	60	63	+3
	Maxillo-Mandibular	ANB (degree)	3±2	-4	1	+5
		Wits (mm)	-3±2	-12	-3	+9
		MP-PP (degree)	21±5	27	29	+2
		FMA (degree)	23±5	27	29	+2
Dental	Maxillary dentition	U1 to NA (degree)	22±6	23	28	+5
		U1 to NA (mm)	5±2	7	7	0
		U1 to SN (degree)	108±6	108	113	+5
	Mandibular dentition	L1 to NB (degree)	30±6	19	25	+6
		L1 to NB (mm)	7±2	4	5	+1
		L1 to MP (degree)	99±5	74	83	+9
	Maxillo-Mandibular	U1 to L1 (degree)	125±8	142	125	-17
Soft tissue	Soft tissue	E line U. lip (mm)	-1±2	-1	-1	0
		E line L. lip (mm)	2±2	2.5	1.5	-1
		Nasolabial angle (degree)	91±8	89	99	+10
		H-angle (degree)	14±4	14	16.5	+2.5

Figure 17 Intraoral photographs (Retention phase)

The patient was followed up a week, a month, and then three months after the fixed appliances had been debonded. She had been greatly complied with the retention regimen of all day retainner-wearing (Figure 17). No surgical or dental relapse were noticed. The patient was satisfied with the result. After the third month, she had unfortunately dropped out of the following appointments due to her occupational difficulties. It would be for the best if we could pursue more data regarding the long-term stability in this case.

Discussion

Generally, the causes of Class III malocclusion and anterior crossbite might derived from the interplay of genetic and functional elements.[4,5,17] Since the patient had no functional shift to dictate the latter, the problems could lay within genetic influences classifying

her to be true skeletal Class III malocclusion. This hypothesis was positively supported by her mother whose mandible also appeared prominent. In addition, tooth size disharmony from peg-shaped upper lateral incisors might have incited extra negative overjet.[18]

The etiology of chin deviation, a typical asymmetry manifested in the lower face,[7,8] could be split into three essential categories, (1) congenital, arising from prenatal basis, such as cleft lip and palate; (2) acquired, occuring secondary to disease or traumatic event; and (3) developmental, which was idiopathically emerged during growth.[19] According to past and present illness evaluation, the patient had denied any prenatal conditions, systemic diseases, medications, and history of trauma on the head and neck area. In consequence, her asymmetry might fall into the developmental type. Furthermore, as pre-treatment Grummon's analysis had disclosed the unbalanced mandibular ramus height and body length between both sides, together with an absence of functional shift from dental interference, those indicated the fact that her asymmetry originated from skeletal component which was referred to as *laterality* or *directional asymmetry*.[7,19,20]

In this case, the patient had complained of compromised facial esthetic. Clinical examinations and radiographic analyses demonstrated profound extraoral concavity and asymmetry. The great deal of lower anterior teeth retroclination was undeniable signifying the nature of dental compensation on the discrete Class III skeletal bases.[4,21,22] Considering the patient's expectation and such severe discrepancies by which conventional orthodontic treatment only could not be possible, orthodontic treatment combined with orthognathic surgery was carefully planned.[5,23]

It was conspicuous that the skeletal problems in this patient rested solely on the lower facial part; prognathic mandible and chin deviation. Despite the maxillary plane canting, the upper dentoalveolar had done the perfect job to camouflage the skeletal imbalance. In antero-posterior dimension, either maxilla itself or the upper incisors stood in proper position and inclination to begin with. Therefore, one-jaw surgery on the mandible without extraction of any teeth was proposed.

Generally, an optimal treatment timing for orthognathic surgery in Skeletal Class III patient should be executed after the mandibular growth was terminated.[24] The exception may apply if the skeletal discrepancy has provoked severe psychosocial problems during their teenages, especially in girls.[25] Several diagnostic tools to determine the treatment timing have been described in literatures.[26] The Cervical Vertebral Maturation (CVM) index and the Fishman skeletal maturity indicators (SMI), which are commonly used in the clinical practice, have verified to be effective.[27,28] Also, a serial of lateral cephalometric radiographs together with clinical photographs can reveal longitudinal changes in the mandibular growth.[29] In case of pathologic growth situations such as condylar hyperplasia, bone scintigraphy is suggested to detect activity of condyles.[26,30,31]

The common surgical procedures performed to treat skeletal Class III relationship were bilateral sagittal split osteotomy (BSSO) and intraoral vertical ramus osteotomy (IVRO), each had their own merits.[4,32-34] After consulting with the skilled surgeon, BSSO was preferred in this case because the certain technic advantaged over IVRO for a board bone-to-bone contact that allowed quicker wound healing and higher skeletal stability, as well as a shorter intermaxillary fixation (IMF) time.[4,33,34] However, BSSO had been reported to have a higher incidence of the inferior alveolar nerve injury.[32,34]

Since the essential skeletal and soft tissue issues had been gotten rid of surgically, the post-surgery orthodontic treatment was mainly provided to correct the remaining dental discrepancies. One that was worth considering was peg-shaped upper lateral incisors. There were abundant treatment options available for misshaped incisors; such as no treatment, either direct or indirect composite resin restoration,

various types of crowns, and extraction then implant placement or orthodontic canine substitution.[35,36] The selection of the final treatment should be based on the patient's expectation and the clinician's competence.[37] According to the intraoral examination, the patient had good functional occlusion with proper overjet and overbite. Bilateral Class II (1 mm) canine relationships were found as the result of the unsolved Bolton discrepancy. The Class I canine relationship could be executed by restoring the size of the peg-shaped lateral incisors back to normal. When asked, however, she did not have any esthetic concerns about the misshaped teeth. In consequence, no restoration was carried out on the peg-shaped upper lateral incisors. Reduction of the interproximal width of the lower anterior teeth could solve the problem, yet there were some disadvantages such as the extended treatment time and loss of sound enamel. Following discussion with the patient, the decision was made to keep the functional occlusion rather than ideal occlusion.

Conclusion

Herein, the orthodontic treatment combined with orthognathic surgery had been successful delivering a good solution to the patient with skeletal Class III hyperdivergent pattern with mandibular prognathism and asymmetry. Since the vertical proportion was acceptable, BSSO asymmetrical setback without mandibular rotation was planned. After the treatment, both occlusion and facial esthetic was greatly improved whether in anteroposterior or transverse dimension.

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