Original Article

Transverse decompensation in surgery-first approach vs conventional orthognathic surgery in mandibular prognathism patients

KyungMin Clara Lee[a]*; Huiming Xu[b]*; Hyun-Ju Jeon[c]

ABSTRACT

Objectives: To investigate transverse treatment outcomes in patients with skeletal Class III malocclusion treated with a surgery-first orthognathic approach (SFA) vs conventional orthognathic surgery (COS).

Materials and Methods: This retrospective cohort study included 128 patients, divided into four groups of 32 based on the inclusion of presurgical treatment and extraction of the maxillary premolars: (1) COS with extraction, (2) COS without extraction, (3) SFA with extraction, and (4) SFA without extraction. CBCT scans were taken before and after treatment, with an additional scan after presurgical orthodontic treatment for the COS group only. The primary outcome variable was transverse decompensation, assessed through changes in maxillary and mandibular molar inclination and intermolar width. Predictor variables included treatment approach (SFA vs COS) and extraction status (extraction vs nonextraction). Transverse measurements were compared among the four groups throughout the treatment process.

Results: Maxillary molar inclination relative to the occlusal plane increased after treatment, whereas the mandibular molar inclination decreased after treatment, indicating transverse decompensation in the COS and SFA groups, and the extraction and nonextraction groups. There were no statistically significant differences in transverse changes between the COS and SFA groups.

Conclusions: Although the difference in transverse decompensation between the COS and SFA groups was not statistically significant, clinicians may still need to consider careful management of transverse decompensation during postsurgical treatment, particularly in SFA cases. (*Angle Orthod*. 2025;00:000–000.)

KEY WORDS: Transverse decompensation; Mandibular prognathism; Surgical orthodontic treatment; Surgery-first approach

INTRODUCTION

The surgery-first approach (SFA) involves performing orthognathic surgery without prior orthodontic preparation, unlike traditional three-stage surgical orthodontic treatment, which includes presurgical orthodontic treatment followed by conventional orthognathic surgery (COS).[1–3] With SFA, patients can achieve rapid improvement in their facial profile without the typical 1 to 2 years of presurgical orthodontic treatment.[1,2] As a result, in the SFA group, orthodontic tooth movement and dental decompensation occur postsurgical treatment, in contrast to the COS group in which decompensation is achieved during the presurgical orthodontic period. Transverse displacement has been studied as one of the factors affecting skeletal stability after orthognathic surgery.[4–7]

Coordination of the maxillary and mandibular arches, or establishment of normal transverse relationships, is critical for surgical occlusal stability which, in turn, contributes to postsurgical stability and successful surgical outcomes. In COS, transverse decompensation must be completed before surgery. In

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contrast, in SFA, orthodontic tooth movement occurs after surgery, thus, transverse decompensation is achieved only during postsurgical orthodontic treatment. Theoretically, the extent of decompensation may be calculated before surgery and incorporated into the surgical plan[8,9] but, in clinical practice, this is challenging. Potts et al. demonstrated in their study that many Class II patients who underwent surgical-orthodontic treatment did not achieve ideal incisor decompensation.[10] From a clinician's perspective, during postsurgical orthodontic treatment, it is generally easier to focus on compensation rather than decompensation, since surgery has already been completed.

Although previous studies have compared postsurgical skeletal relapse in COS versus SFA,[11–17] particularly in the anteroposterior direction, few have focused on transverse outcomes. There is a relationship between transverse changes and anteroposterior (AP) projection of the maxillary incisors and these interactions need to be established as part of any presurgical or postsurgical orthodontic treatment. The present study aimed to compare the transverse treatment outcome between COS and SFA treatment groups, and to incorporate these findings into the planning of postsurgical orthodontic treatment.

MATERIALS AND METHODS

This retrospective study was approved by the Institutional Review Board of the Chonnam National University Dental Hospital in compliance with the principles of the Declaration of Helsinki. Patients treated in the Department of Orthodontics of the Chonnam National University Dental Hospital Gwangju, Korea from January 2016 to March 2024 were enrolled. Each patient was evaluated according to the following inclusion criteria: (1) skeletal Class III malocclusion, (2) age $\geq$ 18 years, (3) ANB $< 0°$, and (4) lateral cephalograms and cone-beam computed tomography images (CBCT) obtained before treatment (T0), after presurgical orthodontic treatment (T1), and after treatment completion (T2). Exclusion criteria were: presence of cleft lip/palate or other craniofacial syndromes, severe facial asymmetry ($\geq$4 mm of chin point deviation from the facial midline), congenitally missing tooth in the anterior region, or tooth anomaly, and history of rapid maxillary expansion (RME), surgically assisted RME, or previous orthodontic treatment.

Patients with skeletal Class III malocclusion who underwent surgical orthodontic treatment between January 2016 and March 2024 were initially screened, totaling 352 patients. Among them, 211 patients who underwent isolated mandibular setback surgery were evaluated, but subsequently excluded due to the absence of posttreatment lateral cephalograms or CBCT scans (18 patients), the presence of cleft lip/palate or craniofacial syndromes (26 patients), severe facial asymmetry (24 patients), congenital missing anterior teeth (two patients), a history of rapid maxillary expansion (RME) or surgically assisted RME (six patients), or previous orthodontic treatment (seven patients).

One hundred twenty-eight patients with skeletal Class III malocclusion who underwent surgical orthodontic treatment with isolated mandibular setback surgery were divided into four groups: (1) COS ($n = 32$): presurgical orthodontic treatment without extraction of maxillary premolars, followed by orthognathic surgery and postsurgical orthodontic treatment. (2) COS ($n = 32$): presurgical orthodontic treatment with extraction of maxillary premolars, followed by orthognathic surgery and postsurgical orthodontic treatment. (3) SFA ($n = 32$): orthognathic surgery and postsurgical orthodontic treatment without extraction of maxillary premolars. (4) SFA ($n = 32$) orthognathic surgery and postsurgical orthodontic treatment with extraction of maxillary premolars. All patients were of Asian ethnicity. Table 1 shows the demographic data of the groups.

All patients were treated with a 0.018-inch straight wire appliance with the Roth prescription and sliding mechanics. The study used 0.016×0.022-inch stainless steel wires as surgical and final archwires. In the COS group, Class II elastics for sagittal decompensation, or anchorage reinforcement such as transpalatal arches and mini-implants, were not used during presurgical orthodontic treatment. Postsurgical orthodontic treatment started after 3 weeks of wearing surgical wafers. The mechanics of postsurgical orthodontic treatment did not differ between the two groups.

To obtain the transverse measurements, CBCT scans were imported into InVivo5 (version 5.4, Anatomage, Santa Clara, CA) software. In the section tab, after adjusting to visualize the maxillary first molar in the coronal view, the inclination of the maxillary first molar relative to the occlusal plane was measured. In the same manner, in the section tab, after adjusting to visualize the mandibular first molar in the coronal view, the inclination of the mandibular first molar relative to the occlusal plane was measured (Figure 1). Additionally, intermolar width (IMW) was measured at the crown level using the central fossa and at the root level using the furcation area of the maxillary and mandibular first molars (Figure 2).

Statistical Analysis

Statistical evaluations were performed at a 5% level of significance with SPSS software (version 29.0, IBM,

Table 1. Demographic Data of the Patients

Variables	COS Group Without Extraction (n = 32) Mean ± SD	COS Group Without Extraction (n = 32) Mean ± SD	SFA Group Without Extraction (n = 32) Mean ± SD	SFA Group Without Extraction (n = 32) Mean ± SD	*P* Value
Sex (M/F)	18/14	16/16	17/15	14/18	.196
Age (mo)	20.9 ± 3.4	21.1 ± 2.7	22.1 ± 3.0	22.3 ± 5.4	.515
Treatment duration (month)					
Presurgical orthodontic treatment	12.8 ± 4.7	14.8 ± 6.4	—	—	N/A
Postsurgical orthodontic treatment	10.5 ± 5.8^{a}	15.6 ± 8.4^{b}	17.9 ± 4.0^{b}	21.9 ± 4.1^{c}	<.001*
Total treatment duration	23.3 ± 6.8^{a}	29.7 ± 9.2^{b}	17.9 ± 4.0^{c}	21.9 ± 4.1^{c}	<.001*
Amount of setback (mm)					
Right	5.1 ± 3.7^{a}	7.4 ± 3.4^{ab}	8.7 ± 4.1^{b}	10.5 ± 3.3^{b}	<.001*
Left	6.5 ± 2.8^{a}	7.3 ± 2.3^{a}	8.0 ± 2.6^{a}	9.2 ± 3.8^{b}	.021*
Amount of menton deviation (°)	4.4 ± 3.3	2.8 ± 2.5	3.0 ± 2.4	2.7 ± 1.9	.123
Amount of crowding (mm)					
Maxillary arch	1.2 ± 4.0^{a}	7.2 ± 5.1^{b}	1.7 ± 2.5^{a}	7.3 ± 4.6^{b}	<.001*
Mandibular arch	1.7 ± 3.7	3.0 ± 4.0	0.9 ± 3.0	3.7 ± 4.1	.116
Overjet (mm)	−1.6 ± 2.3	−1.8 ± 2.0	−2.3 ± 2.4	−1.8 ± 2.5	.730
Overbite (mm)	0.0 ± 1.7^{a}	0.9 ± 2.0^{a}	1.3 ± 2.2^{a}	−0.5 ± 2.2^{b}	.015*

[a] COS indicates conventional orthognathic surgery; N/A, not applicable; SFA, surgery-first approach; SD, standard deviation. Analysis of variance was used for statistical significance. Tukey HSD was used for post hoc analysis and the different superscript letter indicates statistical significance.

* $P < .05$.

Armonk, NY). The sample size calculation for analysis of covariance (ANCOVA) was performed according to findings obtained by Kee et al.[18] G*power (version 3.1.9.2, Heinrich-Heine-University, Dusseldorf, Germany) was used to calculate the sample size. To evaluate the effect of the intervention (COS vs SFA) on transverse changes before and after treatment (two covariates), expected effect of medium size 0.25, statistical power of 80%, type I error of 5%, numerator df = 1, number of groups = 4, and number of covariates = 2. Each group required 32 patients.

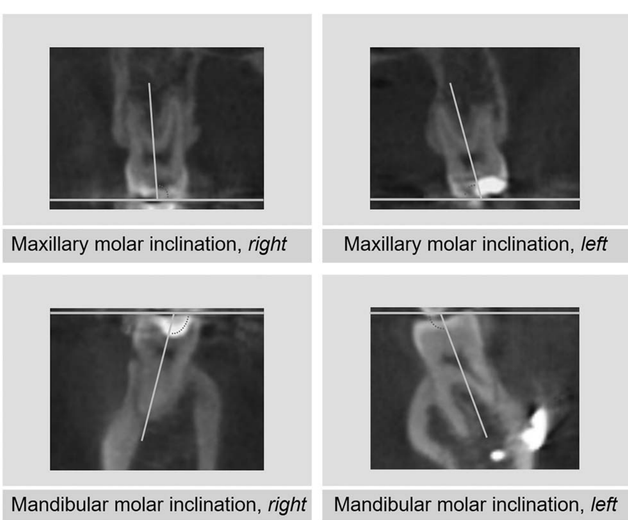

Figure 1. Measurement of molar inclination relative to the occlusal plane.

The values of cephalometric measurements at pretreatment were compared among the four groups. The measurements were initially tested for normal distribution. Analysis of variance (ANOVA) was applied to determine potential statistically significant differences among the four groups. Repeated-measures ANOVA was used to examine the changes in transverse measurement variations over time in the COS group, whereas a paired *t*-test was utilized for the SFA group. ANCOVA was performed to analyze the differences in

Figure 2. Measurement of intermolar width at the root level.

Table 2. Comparison of Cephalometric Measurements at Pretreatment Among Groups

Variables	COS Group Without Extraction (n = 32)		COS Group With Extraction (n = 32)		SFA Group Without Extraction (n = 32)		SFA Group With Extraction (n = 32)		*P* Value
	Mean	SD	Mean	SD	Mean	*SD*	*Mean*	*SD*	
SNA (°)	80.7	4.1	80.5	3.1	79.7	2.6	79.9	3.1	.691
SNB (°)	83.5	4.7	83.0	3.8	83.2	3.9	82.5	4.1	.890
ANB (°)	−2.8	2.3	−2.2	2.6	−3.5	2.8	−2.6	3.0	.422
SN/GoGn (°)	35.5	7.3	33.0	5.2	35.0	5.2	37.5	6.2	.117
Wits appraisal (mm)	−11.0	4.2	−9.6	3.9	−12.1	5.2	−11.4	6.0	.394
U1 to SN (°)	110.9	7.4	109.7	6.8	109.0	7.3	109.5	7.8	.856
IMPA (°)	82.3	6.7	84.1	10.3	81.0	7.3	82.0	8.4	.650
U1 to FP (mm)	3.1	2.5	2.9	4.5	1.6	4.1	2.8	5.4	.662
L1 to FP (mm)	4.5	2.6	4.3	4.3	4.8	3.2	4.4	3.5	.971
Interincisal angle (°)	131.1	7.0	133.7	11.9	135.0	10.4	130.9	13.4	.536
U1 to NA (°)	29.0	5.0	29.0	6.6	29.2	5.7	29.6	6.5	.983
U1 to NA (mm)	9.1	2.8	8.9	3.2	8.4	2.8	9.2	2.7	.765
L1 to NB (°)	21.1	4.1	19.0	9.7	19.6	6.7	21.9	7.4	.535
L1 to NB (mm)	6.7	2.0	6.4	3.7	6.5	2.6	6.6	3.2	.990

[a] COS indicates conventional orthognathic surgery; SFA, surgery-first approach; SD, standard deviation. Analysis of variance was performed to compare the variables among the four groups.

the pattern of change in transverse measurements between the COS and SFA groups with/without extractions.

All measurements were obtained by a single examiner who repeated the measurements from 20 randomly selected patients for intrarater reliability after 2 weeks. Differences calculated with Dahlberg's formula[19] ranged from 0.11 to 0.18 mm for linear measurements and 0.15° to 0.21° for angular measurements. The intraclass correlation coefficient values ranged from 0.85 to 0.91, with a mean of 0.87, indicating excellent reliability.

RESULTS

Table 1 shows the demographic data. There were no differences in sex, age, menton deviation, mandibular crowding, and overjet among the nonextraction COS and SFA groups or the COS and SFA groups with maxillary premolar extractions. In contrast, the treatment duration was significantly different among the four groups. The total treatment duration was longer in the COS and SFA extraction groups.

The average treatment period was 23.3 ± 6.8 months in the COS group without extraction, 29.7 ± 9.2 months in the COS group with extraction, 17.9 ± 4.0 months in the SFA group without extraction, and 21.9 ± 4.1 months in the SFA group with extraction. In the extraction COS and SFA treatment groups, longer treatment durations were evident. This was due to the extraction treatment, which extended the overall treatment duration by an average of 6 months in the COS group and by an average of 4 months in the SFA group. In addition, the amount of setback showed a statistically significant difference among the four groups, with a greater setback observed in cases in which maxillary premolars were extracted. There was also a significant difference in maxillary crowding among the four groups. Maxillary crowding was more severe in the extraction COS and SFA groups. In contrast, mandibular crowding did not differ significantly among the four groups. This suggests that the degree of maxillary crowding might be considered as a criterion for maxillary premolar extraction in skeletal Class III orthognathic surgery treatment.

Table 2 compares the pretreatment cephalometric measurements and there were no significant differences among the four groups. Transverse measurements in the COS and SFA groups without extractions are shown in Table 3. Maxillary molar inclination in the COS group showed a statistically significant increase after treatment, while the mandibular molar inclination showed a statistically significant decrease. After treatment, maxillary molar inclination relative to the occlusal plane increased by an average of 3.4° in the COS nonextraction group, 2.2° in the SFA nonextraction group, 5.3° in the COS extraction group, and 3.9° in the SFA extraction group. Meanwhile, mandibular molar inclination decreased in all groups, with an average reduction of 4.1° in the COS nonextraction group, 1.5° in the SFA nonextraction group, 3.3° in the COS extraction group, and 1.2° in the SFA extraction group. Additionally, the maxillary IMW in the COS group showed a statistically significant increase after treatment, whereas mandibular IMW showed no significant clinical change. For the SFA group, the maxillary molar inclination showed a statistically significant

Table 3. Comparison of Changes in Transverse Measurements After Treatment Within the COS and SFA Groups Without Extraction

Variables	COS Group Without Extraction (n = 32)				SFA Group Without Extraction (n = 32)		
	T0 Mean ± SD	T1 Mean ± SD	T2 Mean ± SD	P Value	T0 Mean ± SD	T2 Mean ± SD	*P* Value
Molar Inclination, *Maxilla*							
First molar, *Right* (°)	82.3 ± 3.8[a]	82.4 ± 4.8[a]	85.5 ± 4.6[b]	0.008*	81.6 ± 6.5	83.1 ± 7.4	.037*
First molar, *Left* (°)	81.1 ± 5.5[a]	81.2 ± 3.9[a]	84.7 ± 5.6[b]	0.012*	80.0 ± 5.8	82.8 ± 5.2	.013*
Molar Inclination, *Mandible*							
First molar, *Right* (°)	110.3 ± 8.3[a]	106.7 ± 7.6[b]	105.9 ± 5.0[b]	0.013*	109.8 ± 6.9	108.5 ± 6.1	.292
First molar, *Left* (°)	106.5 ± 6.7[a]	102.6 ± 6.3[b]	102.6 ± 5.2[b]	0.006*	106.0 ± 6.7	104.4 ± 4.6	.183
Intermolar width, *Maxilla*							
Intermolar width, *Cr* (mm)	59.9 ± 3.5[a]	61.8 ± 2.8[b]	60.7 ± 3.1[a]	0.001*	61.5 ± 3.5	61.5 ± 2.4	.987
Intermolar width, *Root* (mm)	47.1 ± 3.2[a]	48.0 ± 2.7[b]	48.6 ± 3.0[b]	0.003*	48.1 ± 2.6	48.5 ± 2.2	.228
Intermolar width, *Mandible*							
Intermolar width, *Cr* (mm)	57.8 ± 3.3	58.3 ± 2.6	58.1 ± 2.4	0.454	58.7 ± 3.3	58.7 ± 2.4	.993
Intermolar width, *Root* (mm)	50.3 ± 3.3	49.7 ± 2.3	49.7 ± 2.2	0.193	51.0 ± 2.7	50.4 ± 2.4	.069

[a] COS indicates conventional orthognathic surgery; Cr, crown level; Rt, root level; SD, standard deviation; SFA, surgery-first approach; T0, before surgery; T1, after presurgical orthodontic treatment; T2, after treatment. Repeated-measures analysis of variance was performed to compare the variables among three time points in COS group, and paired *t*-test was performed to compare the variables between two time points in SFA group.

* $P < .05$.

increase after treatment, while the mandibular molar inclination showed a decrease, following a pattern similar to the COS group. Minimal changes in IMW in the maxilla and mandible before and after treatment were noted for the SFA group.

Table 4 presents the transverse measurements for the COS and SFA groups with maxillary premolar extractions. In the COS group, maxillary molar inclination increased with extraction treatment, whereas mandibular molar inclination decreased. Similarly, in the SFA group, maxillary molar inclination increased with extraction treatment, as observed in the COS group. However, mandibular molar inclination decreased slightly, differing from the COS group. In addition, maxillary IMW decreased significantly at the crown and root levels in the SFA group. Conversely, in the COS group, the maxillary IMW at the root level did not change. The mandibular IMW exhibited a tendency for minimal change in the COS and SFA groups. However, at the root level in the COS group, the IMW decreased during postsurgical orthodontic treatment.

Table 5 presents the intergroup comparison of transverse changes in extraction and nonextraction cases. Although the ANCOVA results showed no statistically significant differences between the COS and SFA groups, different trends were observed. Notably, the maxillary and mandibular molar inclination changes in the SFA group tended to be less than in

Table 4. Comparison of Changes in Transverse Measurements After Treatment Within the COS and SFA Groups With Extraction

Variables	COS Group With Extraction (n = 32)				SFA Group With Extraction (n = 32)		
	T0 Mean ± SD	T1 Mean ± SD	T2 Mean ± SD	T0 P Value	T2 Mean ± SD	Mean ± SD	*P* Value
Molar Inclination, *Maxilla*							
First molar, *Right* (°)	84.0 ± 6.0[a]	84.0 ± 8.8[a]	89.0 ± 5.0[b]	0.039*	84.6 ± 4.7	88.2 ± 4.3	.005*
First molar, *Left* (°)	83.0 ± 8.6[a]	82.4 ± 5.5[a]	88.5 ± 5.8[b]	0.005*	80.8 ± 5.2	85.6 ± 4.8	<.001*
Molar Inclination, *Mandible*							
First molar, *Right* (°)	110.8 ± 7.2[a]	107.5 ± 5.8[b]	106.7 ± 5.6[b]	0.039*	108.0 ± 6.4	107.0 ± 6.8	.597
First molar, *Left* (°)	107.2 ± 7.2	105.4 ± 8.2	104.8 ± 7.8	0.158	107.1 ± 6.2	105.7 ± 5.7	.404
Intermolar width, *Maxilla*							
Intermolar width, *Cr* (mm)	58.2 ± 2.8[a]	58.6 ± 2.9[a]	56.9 ± 2.5[b]	0.010*	58.5 ± 3.5	56.4 ± 2.5	<.001*
Intermolar width, *Rt* (mm)	45.8 ± 2.5	45.3 ± 2.8	45.3 ± 2.4	0.360	45.8 ± 3.0	44.6 ± 2.7	.005*
Intermolar width, *Mandible*							
Intermolar width, *Cr* (mm)	57.1 ± 2.7	57.5 ± 2.5	56.9 ± 2.9	0.113	57.9 ± 2.9	57.9 ± 2.7	.807
Intermolar width, *Rt* (mm)	49.9 ± 2.4[a]	49.1 ± 2.4[b]	48.9 ± 3.0[b]	0.001*	50.3 ± 3.1	49.9 ± 2.8	.155

[a] COS indicates conventional orthognathic surgery; Cr, crown level; Rt, root level; SD, standard deviation; SFA, surgery-first approach; T0, before surgery; T1, after presurgical orthodontic treatment; T2, after treatment. Repeated-measures analysis of variance was performed to compare the variables among three time points in COS group, and paired *t*-test was performed to compare the variables between two time points in SFA group.

* $P < .05$.

Table 5. Comparison of Changes in Transverse Measurements After Treatment Between the COS and SFA Groups With/Without Extraction

	Without Extraction			With Extraction		
Variables	COS Group (n = 32) Mean ± SD	SFA Group (n = 32) Mean ± SD	P value	COS Group (n = 32) Mean ± SD	SFA Group (n = 32) Mean ± SD	*P* value
Molar Inclination, *Maxilla*						
First molar, *Right* (°)	3.2 ± 5.4	1.5 ± 5.7	0.243	5.0 ± 5.8	3.7 ± 2.5	.954
First molar, *Left* (°)	3.6 ± 6.1	2.8 ± 4.2	0.323	5.6 ± 5.7	4.0 ± 3.7	.467
Molar Inclination, *Mandible*						
First molar, *Right* (°)	−4.4 ± 8.2	−1.3 ± 5.8	0.080	−3.9 ± 8.6	−1.0 ± 6.1	.445
First molar, *Left* (°)	−3.8 ± 6.5	−1.6 ± 5.7	0.153	−2.7 ± 7.7	−1.4 ± 7.0	.684
Intermolar width, *Maxilla*						
Intermolar width, *Cr* (mm)	0.8 ± 2.0	0.0 ± 2.1	0.722	−1.3 ± 1.9	−2.0 ± 1.0	.161
Intermolar width, *Rt* (mm)	1.5 ± 2.2	0.4 ± 1.5	0.135	−0.4 ± 1.3	−1.1 ± 0.7	.108
Intermolar width, *Mandible*						
Intermolar width, *Cr* (mm)	0.3 ± 2.1	0.0 ± 2.0	0.814	−0.3 ± 1.6	−0.1 ± 1.1	.449
Intermolar width, *Rt* (mm)	−0.6 ± 2.2	−0.5 ± 1.3	0.430	−1.1 ± 1.4	−0.4 ± 1.1	.108

[a] COS indicates conventional orthognathic surgery; Cr, crown level; Rt, root level; SD, standard deviation; SFA, surgery-first approach. ANCOVA was done.

* $P < .05$.

the COS group. Among the nonextraction cases, the IMW changes were minimal in the COS and SFA groups. However, among the extraction cases, the maxillary IMW changes in the SFA group showed a greater decrease compared to the COS group. In contrast, the mandibular IMW changes in the extraction and nonextraction COS and SFA groups remained relatively unchanged clinically.

DISCUSSION

The possible reasons for the differences in treatment outcomes in the transverse dimension may include one or more of the following: errors in surgical planning, unintended surgical outcomes, surgical errors, or postsurgical skeletal relapse. In the present study, the aim was to investigate whether the differences in transverse treatment outcomes could be attributed to the two distinct surgical-orthodontic approaches: presurgical orthodontic treatment in the COS group and postsurgical orthodontic treatment in the SFA group. Specifically, the transverse dimension outcomes between the COS and SFA approaches were compared. It might be questioned whether the timing of orthodontic treatment, before or after surgery, could significantly impact treatment outcomes. Clinically, performing orthodontic treatment presurgically or postsurgically seems to influence the final treatment results. This perspective served as motivation to undertake the present study. Rather than dismissing the differences as merely due to errors in presurgical treatment, unsuccessful SFA management, or various confounding factors, the samples were carefully selected, and a thorough comparison was conducted, to provide valuable insights for clinicians.

An increase in the maxillary molar inclination measurement after treatment indicated decompensation in the maxilla, whereas a decrease in the mandibular molar inclination after treatment indicated decompensation in the mandible. The maxillary molar inclination in the COS group showed a statistically significant increase after treatment, while the mandibular molar inclination showed a statistically significant decrease, indicating greater decompensation during treatment. This trend was observed in COS and SFA groups, confirming that transverse decompensation occurred during surgical orthodontic treatment. Although the amount of change was smaller in the SFA group compared to the COS group, there was no statistically significant difference between the groups. Based on the observed surgical changes in the SFA groups, the slightly greater magnitude of AP change at the time of surgery may have contributed to differences in the transverse dimension. This could help explain the trend of less effective decompensation in the SFA group. However, it is important to note that the differences between the groups were not statistically significant, and their clinical relevance remains uncertain. Additionally, as previously mentioned, the potential relationship between AP changes in the incisors and differences in the transverse dimension warrants further consideration. Although this study did not find statistically significant differences, clinicians should remain aware of these possible interactions when planning and managing transverse decompensation, particularly in SFA cases. Future studies with a larger sample size and refined methodology may help clarify these associations.

The extraction treatment group showed a greater amount of maxillary crowding than the nonextraction treatment group, for both the COS and the SFA patients. The degree of maxillary crowding was found to significantly influence the decision to extract maxillary premolars. In the future, this observation could be applied to artificial intelligence or deep learning technology for surgical planning.

In the present study, patients with severe facial asymmetry were excluded due to the possibility of asymmetric transverse decompensation. Previous studies have reported differences in molar inclination among patients with facial asymmetry.[20–22] Patients with facial asymmetry often exhibit differences in ramus inclination between the left and right sides of the mandible, and this variation in frontal ramal inclination (FRI) can affect facial contours.[23–26] Therefore, it is crucial to restore the ramus inclination to a symmetrical angle through surgical intervention. This process involves establishing a decompensation strategy during presurgical orthodontic treatment to optimize skeletal asymmetry correction and enhance postsurgical stability. Specifically, achieving sufficient transverse decompensation before surgery is essential to fully correct asymmetry and prevent relapse after surgery. This approach allows for symmetrical inclination of the canines, premolars, and molars, and contributes to ensuring adequate transverse mandibular movement. Consequently, this study excluded patients with facial asymmetry who may present FRI inclination differences and, as a result, require asymmetric decompensation.

Wang et al.[27] compared the inclination change of canines and molars in surgical skeletal Class III patients with and without presurgical orthodontics. They concluded that the transverse dental changes in patients with surgical skeletal Class III were similar regardless of presurgical orthodontic treatment. However, their measurements were from two-dimensional posteroanterior cephalograms, and not CBCT data.[24] Although the authors stated that the results were similar between the two groups, there was a significant difference in the inclinations of the maxillary and mandibular molars.[27]

It is known that any transverse maxillary width discrepancy should be corrected through preoperative orthodontic expansion or surgically assisted rapid palatal expansion, ideally before or during orthognathic correction of Class III patients.[28,29] If the orthognathic surgery is conducted without complete transverse correction, it may impact postsurgical stability, leading to instability of the proximal segment. This, in turn, could result in unwanted menton deviation or postsurgical skeletal relapse.

In SFA, various attempts have been made to predict postsurgical mandibular movement, especially in the anteroposterior direction, as changes in the vertical dimension during surgery can influence mandibular positioning.[8,9, 30] This predictive approach allows clinicians to anticipate postsurgical mandibular shifts based on these dimensional changes. Given that orthodontic treatment is performed postoperatively in SFA, future studies should also focus on predicting postsurgical skeletal relapse due to transverse instability after surgery. This would provide a more comprehensive understanding of the potential relapse patterns and enhance treatment planning for long-term stability.

CONCLUSIONS

- The results suggest that transverse decompensation after treatment occurred in SFA and COS.
- There were no statistically significant differences in transverse changes among the groups.
- Clinicians may need to carefully monitor and manage transverse decompensation during postsurgical treatment, especially when undertaking SFA.

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REFERENCES

1. Nagasaka H, Sugawara J, Kawamura H, Nanda R. “Surgery first” skeletal Class III correction using the skeletal anchorage system. *J Clin Orthod.* 2009;43:97–105.
2. Villegas C, Uribe F, Sugawara J, Nanda R. Expedited correction of significant dentofacial asymmetry using a “surgery first” approach. *J Clin Orthod.* 2010;44:97–103.
3. Faber J. Anticipated benefit: a new protocol for orthognathic surgery treatment that eliminates the need for conventional orthodontic preparation. *Dental Press J Orthod* 2010;15: 144–157.
4. Becktor JP, Rebellato J, Becktor KB, Isaksson S, Vickers PD, Keller EE. Transverse displacement of the proximal segment after bilateral sagittal osteotomy. *J Oral Maxillofac Surg*. 2002;60:395–403.
5. Becktor JP, Rebellato J, Sollenius O, Vedtofte P, Isaksson S. Transverse displacement of the proximal segment after bilateral sagittal osteotomy: a comparison of lag screw fixation versus miniplates with monocortical screw technique. *J Oral Maxillofac Surg*. 2008;66:104–111.
6. Yoo JY, Kwon YD, Suh JH, et al. Transverse stability of the proximal segment after bilateral sagittal split ramus osteotomy for mandibular setback surgery. *Int J Oral Maxillofac Surg*. 2013;42:994–1000.
7. Guo J, Wang T, Han JJ, et al. Corrective outcome and transverse stability after orthognathic surgery using a surgery-first approach in mandibular prognathism with and without facial asymmetry. *Oral Surg Oral Med Oral Pathol Oral Radiol.* 2018:S2212–4403(18)30053-1.
8. Lee J, Kim YI, Hwang DS, Kim KB, Park SB. Effect of occlusal vertical dimension changes on postsurgical skeletal

changes in a surgery-first approach for skeletal Class III deformities. *Am J Orthod Dentofacial Orthop.* 2014;146: 612–619.
9. Aljawad H, Kook MS, Han JJ, Lee KC. Postsurgical changes of mandible based on vertical dimension increase in Skeletal Class III deformities. *J Craniomaxillofac Surg*. 2020;48: 1100–1105.
10. Potts B, Shanker S, Fields HW, Vig KW, Beck FM. Dental and skeletal changes associated with Class II surgical-orthodontic treatment. *Am J Orthod Dentofacial Orthop*. 2009;135:566.e1–7.
11. Lee NK, Kim YK, Yun PY, Kim JW. Evaluation of post-surgical relapse after mandibular setback surgery with minimal orthodontic preparation. *J Craniomaxillofac Surg*. 2013;41: 47–51.
12. Kim JW, Lee NK, Yun PY, Moon SW, Kim YK. Postsurgical stability after mandibular setback surgery with minimal orthodontic preparation following upper premolar extraction. *J Oral Maxillofac Surg*. 2013;71:1968.e1–1968.e11.
13. 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;72:779–787.
14. Lee YS, Kim YK, Yun PY, Larson BE, Lee NK. Comparison of the stability after mandibular setback with minimal orthodontics of Class III patients with different facial types. *J Oral Maxillofac Surg*. 2016;74:1464.e1–1464.e10.
15. Larson BE, Lee NK, Jang MJ, Yun PY, Kim JW, Kim YK. Comparing stability of mandibular setback versus 2-jaw surgery in Class III patients with minimal presurgical orthodontics. *J Oral Maxillofac Surg*. 2017;75:1240–1248.
16. Sun L, Lee KM. Three-dimensional evaluation of the postsurgical stability of mandibular setback with the surgery-first approach: comparison between patients with symmetry and asymmetry. *J Oral Maxillofac Surg*. 2019; 77:1469.e1–1469.e11.
17. Shin Y, Choi TH, Yoon JY, Kim YK, Yun PY, Lee NK. Comparison of posttreatment stability between mandibular setback surgery-early and conventional surgery in Class III patients: a 4.6-year follow-up. *J Craniofac Surg*. 2023;34: e675–e678.
18. Kee YJ, Moon HE, Lee KC. Evaluation of alveolar bone changes around mandibular incisors during surgical orthodontic treatment of patients with mandibular prognathism: surgery-first approach vs conventional orthognathic surgery. *Am J Orthod Dentofacial Orthop*. 2023;163:87–94.
19. Dahlberg G. Statistical Methods for Medical and Biological Students. London: George Allen and Unwin; 1940:122–132.
20. Ahn J, Kim SJ, Lee JY, Chung CJ, Kim KH. Transverse dental compensation in relation to sagittal and transverse skeletal discrepancies in skeletal Class III patients. *Am J Orthod Dentofacial Orthop.* 2017;151:148–156.
21. Lee JY, Han SH, Ryu HS, Lee HM, Kim SC. Cone-beam computed tomography analysis of transverse dental compensation in patients with skeletal Class III malocclusion and facial asymmetry. *Korean J Orthod*. 2018;48:357–366.
22. Kim HJ, Hong M, Park HS. Analysis of dental compensation in patients with facial asymmetry using cone-beam computed tomography. *Am J Orthod Dentofacial Orthop*. 2019; 156:493–501.
23. Kim KA, Lee JW, Park JH, Kim BH, Ahn HW, Kim SJ. Targeted presurgical decompensation in patients with yaw-dependent facial asymmetry. *Korean J Orthod*. 2017;47: 195–206.
24. Chen YF, Liao YF, Chen YA, Chen YR. Surgical-orthodontic treatment for class II asymmetry: outcome and influencing factors. *Sci Rep*. 2019;9:17956.
25. Ma T, Wang YH, Zhang CX, Liu DX. A novel maxillary transverse deficiency diagnostic method based on ideal teeth position. *BMC Oral Health*. 2023;23:82.
26. Park EH, Ha AR, Kim KA, Park KH, Kang YG. Ramal inclination in the frontal plane after bimaxillary orthognathic surgery in skeletal class III facial asymmetry: spontaneous changes and stability. *J Orofac Orthop* 2023;84(Suppl 2): 37–44.
27. 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; 68:1807–1812.
28. Graber TM, Vanarsdall RL, Vig KW. *Orthodontics: Current Principles and Techniques*. 4th ed. St. Louis: Elsevier Mosby; 2005:1213.
29. Proffit WR, Fields HW, Sarver DM. *Contemporary Orthodontics*. 4th ed. St. Louis, Mo.: Mosby Elsevier; 2007:751.
30. Han JJ, Jung S, Park HJ, Oh HK, Kook MS. Evaluation of postoperative mandibular positional changes after mandibular setback surgery in a surgery-first approach: isolated mandibular surgery versus bimaxillary surgery. *J Oral Maxillofac Surg*. 2019;77:181.e1–e12.