ORIGINAL ARTICLE

https://doi.org/10.5125/jkaoms.2025.51.5.278
pISSN 2234-7550 · eISSN 2234-5930

Evaluation of post-operative skeletal stability after sagittal split ramus osteotomy and contralateral intraoral vertical ramus osteotomy in asymmetric mandibular setback

Su-Young Kim, Young-Wook Park

Department of Oral and Maxillofacial Surgery, College of Dentistry, Gangneung-Wonju National University, Gangneung, Korea

Abstract (J Korean Assoc Oral Maxillofac Surg 2025;51:278-283)

Objectives: This study aims to evaluate the stability of the sagittal split ramus osteotomy (SSRO) and contralateral intraoral vertical ramus osteotomy (IVRO) surgery with resorbable fixation.

Patients and Methods: A total of 16 patients who underwent orthognathic surgery using SSRO with contralateral IVRO approach and resorbable fixation for the treatment of facial asymmetry at the Department of Oral and Maxillofacial Surgery, Gangneung-Wonju National University Dental Hospital from 2003 to 2023 were included. Lateral cephalogram images that were taken at the time point of preoperative (T0), immediately postoperative (T1) and one year after surgery (T2) were measured. The B point position changes were statistically analyzed.

Results: The sella-nasion-B point (SNB) angle and vertical reference line to B point (VRL-B) value showed significant differences between T0 and T1 (P<0.001), as well as between T0 and T2 (P<0.001), but no significant differences were found between T1 and T2 (SNB angle; P=0.460, VRL-B; P=0.638). The HRL-B value showed significant difference between T0 and T2 (P=0.008), but not between T0 and T1 (P=0.069) or between T1 and T2 (P=0.191).

Conclusion: In the present study, the combined SSRO with contralateral IVRO approach appears to offer reliable postoperative stability in asymmetric mandibular setback.

Key words: Facial asymmetry, Orthognathic surgery

[paper submitted 2025. 7. 2 / revised 2025. 8. 8 / accepted 2025. 8. 10]

I. Introduction

Facial asymmetry is commonly associated with skeletal deformities, primarily affecting the mandible more frequently than the maxilla[1-3]. In many cases, facial asymmetry is linked with skeletal Class III[3]. The most commonly used surgical correction for these patients is mandibular setback surgery. Mandibular setback is typically performed using intraoral vertical ramus osteotomy (IVRO) or sagittal split ramus osteotomy (SSRO). Each of these techniques offers distinct advantages and challenges, particularly in terms of postoperative stability, neurosensory complications, and temporomandibular joint (TMJ) function[4-6].

SSRO is a widely used procedure but it is technically more challenging in patients with severe asymmetry. Bony interference between the proximal and distal segments can occur[7], potentially leading to condylar displacement and postsurgical TMJ problems[8-10]. In cases of severe asymmetry, various modified surgical techniques have been proposed to address these challenges. For example, techniques such as distal segment posterior bending osteotomy and short lingual osteotomy have been explored to reduce bony interference in bilateral SSRO[7,11,12]. Specifically, IVRO can be applied to the side where bony interference is expected, while SSRO can be used on the contralateral side, providing an effective approach to managing asymmetry[13-15].

A combined SSRO and contralateral IVRO approach has been proposed to optimize surgical outcomes by leveraging the benefits of each technique[13,14]. IVRO is favored for

Young-Wook Park
Department of Oral and Maxillofacial Surgery, College of Dentistry, Gangneung-Wonju National University, 7 Jukheon-gil, Gangneung 25457, Korea
TEL: +82-33-640-3183
E-mail: ywpark@gwnu.ac.kr
ORCID: https://orcid.org/0000-0001-5881-7257

minimizing TMJ stress and reducing neurosensory complications, whereas SSRO offers superior post-operative stability. However, the stability of this combined approach remains to be fully elucidated. This study aims to evaluate the post-operative stability of the combined SSRO and contralateral IVRO surgical technique using lateral cephalometric analysis.

In addition, the method of fixation plays a crucial role in determining post-operative stability. Resorbable plates have been increasingly utilized in orthognathic surgery as an alternative to conventional titanium plates due to their biocompatibility and elimination of the need for secondary removal surgery[16-19]. However, concerns remain regarding their mechanical stability and potential for post-operative relapse. This study also aims to assess the stability of mandibular segment fixation using resorbable plates to determine their efficacy in maintaining skeletal positioning after SSRO and contralateral IVRO surgery.

II. Patients and Methods

Patient records from the Department of Oral and Maxillofacial Surgery at Gangneung-Wonju National University Dental Hospital were reviewed for the period from March 2003 to February 2023 to identify individuals who underwent orthognathic surgery using the combined SSRO and contralateral IVRO surgical approach on mandible. The inclusion criteria were (1) adults aged 18 years and older, (2) patients diagnosed with Class III malocclusion and facial asymmetry with at least 2 mm of lower dental midline deviation, (3) available of pre-surgery (T0), immediately after surgery (T1), and at least one year after surgery (T2) lateral cephalogram data and (4) fixed by resorbable plates and screws. Patients who diagnosed with facial asymmetry due to craniofacial syndromes, trauma, or tumor were excluded. This study was approved by the Institutional Review Board (IRB) of Gangneung-Wonju National University Dental Hospital (GWNUDH-IRB2024-A002).

Table 1. Indicators of postoperative skeletal stability

Indicator	Definition
SNB	The angle formed by the S-N line and N-B line
HRL-B	The distance from the HRL to the B point
VRL-B	The distance from the VRL to the B point. Positive value means B point is positioned anteriorly from the VRL.

(SNB: sella-nasion-B point, HRL: horizontal reference line, VRL: vertical reference line)

Su-Young Kim et al: Evaluation of post-operative skeletal stability after sagittal split ramus osteotomy and contralateral intraoral vertical ramus osteotomy in asymmetric mandibular setback. J Korean Assoc Oral Maxillofac Surg 2025

1. Study design

We used lateral cephalograms at T0, T1, and T2 to assess post-operative stability in patients who underwent mandibular segment fixation using resorbable plates. The tracing was performed manually using tracing paper, scanned, and analyzed using Quick Ceph Studio (Quick Ceph Systems). The landmarks and measurement variables are shown in Table 1 and Fig. 1.

2. Surgical procedure

All surgeries were performed by a single surgeon (Y.W.P.). Pre-operation planning was conducted using three-dimentional (3D) cone-beam computed tomography analysis, paper surgery, and model surgery analysis. The decision to perform IVRO on one side was made based on factors such as a history of TMJ disorders, proximity of the inferior alveolar nerve (IAN) canal to the buccal cortex, the need for additional surgical procedures such as buccal corticectomy on the proximal segment, and the side where bony interference is expected.

Wafers were fabricated using conventional methods. In cases of bimaxillary surgery, maxillary fixation was performed first using Le Fort I osteotomy. Post-surgical orthodontic treatment was provided to all patients.

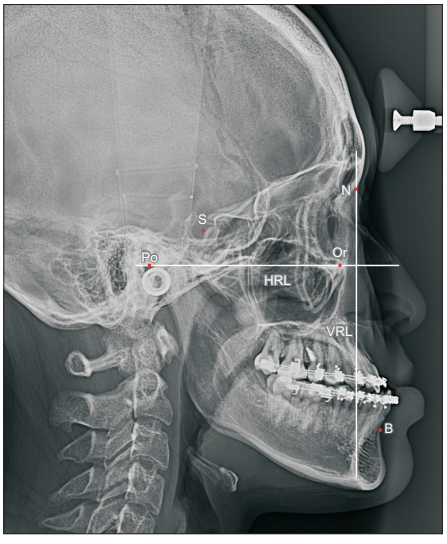

Fig. 1. Landmarks and reference lines of postoperative stability (S: sella turcica, N: nasion, Po: porion, Or: orbitale, B: B point, HRL: horizontal reference line; Frankfurt line, VRL: vertical reference line; the line passing through N and perpendicular to HRL)

Su-Young Kim et al: Evaluation of post-operative skeletal stability after sagittal split ramus osteotomy and contralateral intraoral vertical ramus osteotomy in asymmetric mandibular setback. J Korean Assoc Oral Maxillofac Surg 2025

3. Statistical analysis

All statistical analyses were performed using IBM SPSS Statistics (ver. 28.0; IBM) and $P<0.05$ were considered statistically significant. To assess inter-rater reliability, a single rater performed measurements twice with a one-month interval. Inter-rater reliability was measured using Cohen's kappa correlation coefficient. To evaluate post-operative stability, the indicators were statistically analyzed using the Wilcoxon signed-rank test.

III. Results

A total of 40 patients underwent surgery using the combined SSRO with contralateral IVRO approach. Among them, 17 were excluded due to incomplete lateral cephalogram sets, and 7 were excluded because their maxilla or mandible was fixed with metal plates. Finally 16 patients were included in the study, with 10 males and 6 females. The average age at the time of surgery was 24.88±7.46 years. Among the 16 patients, 13 underwent Le Fort I surgery on the maxilla.(Table 2)

The mean SNB angle at T0 was 81.64°±4.59°. At T1, the SNB angle was 78.56°±3.64°, and at T2, it was 78.41°±3.85°.

Table 2. Demographics of patients

	Number	Mean±standard deviation
Total	16	
Male	10	
Female	6	
Age		24.88±7.46
Le Fort I surgery	13	
IVRO side		
Lengenthed side	9	
Shortened side	2	
Buccally positioned IAN side	4	
Buccal corticectomy side	1	

(IVRO: intraoral vertical ramus osteotomy, IAN: inferior alveolar nerve)
Su-Young Kim et al: Evaluation of post-operative skeletal stability after sagittal split ramus osteotomy and contralateral intraoral vertical ramus osteotomy in asymmetric mandibular setback. J Korean Assoc Oral Maxillofac Surg 2025

Statistical analysis showed significant differences between T0 and T1 ($P<0.001$), as well as between T0 and T2 ($P<0.001$), but no significant differences were found between T1 and T2 ($P=0.460$). For the VRL-B, the mean value at T0 was 0.50±9.63 mm. At T1, the value was –5.76±7.65 mm, and at T2, it was –5.91±7.85 mm. Significant differences were observed between T0 and T1 ($P<0.001$), as well as between T0 and T2 ($P<0.001$), but no significant differences were found between T1 and T2 ($P=0.638$). The mean HRL-B value was 81.91±5.39 mm at T0, 80.77±4.59 mm at T1, and 80.26±5.37 mm at T2. A statistically significant difference was observed between T0 and T2 ($P=0.008$), but not between T0 and T1 ($P=0.069$) or between T1 and T2 ($P=0.191$).(Table 3)

IV. Discussion

In this study, changes of SNB and VRL-B changes in patients who underwent combined SSRO with contralateral IVRO demonstrated significant differences between preoperative and immediate postoperative measurements, as well as between preoperative and one-year postoperative measurements. However, there were no significant differences between the immediate postoperative period and one year after surgery. In the case of HRL-B, no significant changes were observed between the immediate postoperative period and one year postoperatively, whereas a significant difference was noted between the preoperative and one-year postoperative measurements. These findings suggest that mandibular setback using the combined surgery approach provides reliable postoperative stability.

SSRO is widely utilized in orthognathic surgery due to its capacity for rigid fixation. However, it is associated with notable risks, including IAN injury, and condylar displacement, particularly in patients with severe mandibular asymmetry, which may lead to postoperative TMJ dysfunction[8-10,20,21]. In contrast, the IVRO offers a lower risk of IAN injury and

Table 3. Postoperative skeletal stability indicators

	Mean±standard deviation (mm)			T1-T0		T3-T1		T3-T0	
	T0	T1	T3	Z	*P*	Z	*P*	Z	*P*
SNB	81.64±4.59	78.56±3.64	78.41±3.85	–3.517	<0.001*	–0.739	0.460	–3.517	<0.001*
VRL-B	0.50±9.63	–5.76±7.65	–5.91±7.85	–3.464	<0.001*	–0.471	0.638	–3.516	<0.001*
HRL-B	81.91±5.39	80.77±4.59	80.26±5.37	–1.818	0.069	–1.307	0.191	–2.670	0.008*

(SNB: sella-nasion-B point, HRL: horizontal reference line, VRL: vertical reference line)
VRL-B is represented as positive value if the B point is anterior to the VRL and negative value if it is posterior to the VRL.
*Stastically significant, $P<0.05$.
Z-value is based on the positive ranks.
Su-Young Kim et al: Evaluation of post-operative skeletal stability after sagittal split ramus osteotomy and contralateral intraoral vertical ramus osteotomy in asymmetric mandibular setback. J Korean Assoc Oral Maxillofac Surg 2025

condylar displacement, thereby reducing the incidence of TMJ-related complications[22]. Its primary disadvantage is the requirement for prolonged intermaxillary fixation, potentially leading to patient discomfort[23,24]. However, recent studies have demonstrated that early mandibular mobilization following IVRO does not compromise postoperative skeletal stability[25], supporting its reliability in minimizing bony interference and reducing the risk of nerve injury. In this context, the combined use of SSRO with contralateral IVRO has been proposed as an effective surgical strategy that integrates the advantages of both techniques—providing reliable skeletal correction while mitigating the risks of nerve injury and TMJ dysfunction.

Udayakumar et al.[26] reported that in orthognathic surgery using SSRO, patients with severe facial asymmetry of more than 4 mm of menton deviation experience large volume of bone interference on the long side (the contralateral side of the deviation) compared to the short side. They also suggested that the location and volume of bone interference are determined by the complex direction and magnitude of distal segment movement, which depends on the planned occlusion and skeletal positional changes. This indicates that bone interference cannot be simply predicted based solely on the direction of mandibular deviation. In the present study, IVRO was performed on the side where additional buccal corticectomy have been required in 1 patient, on the side where the IAN was positioned close to the buccal cortex in 4 patients, on the lengthened side where bone interference was predicted to occur in 9 patients, and on the shortened side in 2 patients where bone interference was also anticipated.

There are several studies that reported positive outcomes regarding the effectiveness and stability of combining IVRO and SSRO. According to Lee et al.[13] and Lee et al.[27], patients who underwent combination surgery (unilateral SSRO with unilateral IVRO) showed improvements in facial asymmetry and malocclusion. This aligns with the findings of the present study, as statistically significant differences were observed in SNB (T1-T0 $P<0.001$, T3-T0 $P<0.001$), VRL-B (T1-T0 $P<0.001$, T3-T0 $P<0.001$) and HRL-B (T3-T0 $P=0.008$). Lee and Han[28] demonstrated that anteroposterior stability was achieved following IVRO and SSRO surgery. Similarly, in this study, all indicators showed no statistically significant differences between the immediate postoperative period and one year after surgery.

Several studies evaluate postoperative stability when using resorbable fixation in orthognathic surgery. According to Cheung et al.[29], there is no significant difference in the stability of osteotomed segments by manual palpation between resorbable fixation and titanium fixation. Similarly, Ueki et al.[30] reported that, based on lateral cephalometric analysis, skeletal stability related to occlusion shows no significant difference between resorbable and titanium fixation. These findings are consistent with the results of this study, which demonstrate that stable anteroposterior mandibular movement can be achieved when resorbable fixation is used in orthognathic surgery combining SSRO and contralateral IVRO techniques. However, one meta-analysis suggests that while resorbable fixation can be a viable alternative to titanium fixation for maxillary setback or mandibular clockwise rotation, titanium fixation may still be more appropriate for mandibular setback[31].

In this study, the combined SSRO with contralateral IVRO was performed with rigid fixation using bioresorbable plates applied only on the SSRO side. This unilateral resorbable fixation ensures postoperative stability while allowing the IVRO side to be naturally stabilized by surrounding soft tissues and masticatory muscles. This facilitates more favorable condylar positioning and reduces the risk of condylar torque and abnormal positional changes. The results of this study showed that, despite unilateral resorbable fixation, there were no significant skeletal changes between the immediate postoperative period and one year postoperatively, demonstrating the stability of this surgical approach. Compared to conventional bilateral SSRO with rigid fixation, this method may be particularly effective for patients with severe facial asymmetry. In such cases, mandibular setback often leads to a high risk of bone interference; however, applying IVRO can effectively address this issue by minimizing bone interference and facilitating precise adjustment of the condylar position intraoperatively.

A major limitation of this study is the small sample size, which required the use of non-parametric tests. In addition, postoperative skeletal stability was analyzed using 2D lateral cephalograms, which do not fully reflect 3D changes.

V. Conclusion

Taking the limitations discussed above into account, the combined SSRO with contralateral IVRO approach appears to offer reliable postoperative stability in asymmetric mandibular setback. Prospective studies with larger patient numbers are needed.

ORCID

Su-Young Kim, *https://orcid.org/0009-0000-6843-9608*
Young-Wook Park, *https://orcid.org/0000-0001-5881-7257*

Authors' Contributions

S.Y.K. participated in the study design and draft the manuscript. Y.W.P. participated in the study design and coordination and critically reviewed the final version of the article. All authors read and approved the final manuscript.

Funding

No funding to declare.

Ethics Approval and Consent to Participate

This study was approved by the Institutional Review Board (IRB) of Gangneung-Wonju National University Dental Hospital (GWNUDH-IRB2024-A002). The consent of participation was waived as this retrospective study posed no potential risk or harm to the participants.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

References

1. Haraguchi S, Takada K, Yasuda Y. Facial asymmetry in subjects with skeletal Class III deformity. Angle Orthod 2002;72:28-35. https://doi.org/10.1043/0003-3219(2002)072%3C0028:faisws%3E2.0.co;2
2. Li J, Wu S, Mei L, Wen J, Marra J, Lei L, et al. Facial asymmetry of the hard and soft tissues in skeletal Class I, II, and III patients. Sci Rep 2024;14:4966. https://doi.org/10.1038/s41598-024-55107-4
3. Severt TR, Proffit WR. The prevalence of facial asymmetry in the dentofacial deformities population at the University of North Carolina. Int J Adult Orthodon Orthognath Surg 1997;12:171-6.
4. Peleg O, Mahmoud R, Shuster A, Arbel S, Kleinman S, Mijiritsky E, et al. Vertical ramus osteotomy, is it still a valid tool in orthognathic surgery? Int J Environ Res Public Health 2022;19:10171. https://doi.org/10.3390/ijerph191610171
5. Kim YK. Complications associated with orthognathic surgery. J Korean Assoc Oral Maxillofac Surg 2017;43:3-15. https://doi.org/10.5125/jkaoms.2017.43.1.3
6. Leung YY, Wang R, Wong NSM, Li DTS, Au SW, Choi WS, et al. Surgical morbidities of sagittal split ramus osteotomy versus intraoral vertical ramus osteotomy for the correction of mandibular prognathism: a randomized clinical trial. Int J Oral Maxillofac Surg 2021;50:933-9. https://doi.org/10.1016/j.ijom.2020.06.023
7. Yang HJ, Lee WJ, Yi WJ, Hwang SJ. Interferences between mandibular proximal and distal segments in orthognathic surgery for patients with asymmetric mandibular prognathism depending on different osteotomy techniques. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2010;110:18-24. https://doi.org/10.1016/j.tripleo.2009.12.049
8. Ueki K, Marukawa K, Shimada M, Hashiba Y, Nakgawa K, Yamamoto E. Condylar and disc positions after sagittal split ramus osteotomy with and without Le Fort I osteotomy. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2007;103:342-8. https://doi.org/10.1016/j.tripleo.2006.05.024
9. Onizawa K, Schmelzeisen R, Vogt S. Alteration of temporomandibular joint symptoms after orthognathic surgery: comparison with healthy volunteers. J Oral Maxillofac Surg 1995;53:117-21; discussion 122-3. https://doi.org/10.1016/0278-2391(95)90383-6
10. Wolford LM, Reiche-Fischel O, Mehra P. Changes in temporomandibular joint dysfunction after orthognathic surgery. J Oral Maxillofac Surg 2003;61:655-60; discussion 661. https://doi.org/10.1053/joms.2003.50131
11. Epker BN. Modifications in the sagittal osteotomy of the mandible. J Oral Surg 1977;35:157-9.
12. Yang HJ, Hwang SJ. Change in condylar position in posterior bending osteotomy minimizing condylar torque in BSSRO for facial asymmetry. J Craniomaxillofac Surg 2014;42:325-32. https://doi.org/10.1016/j.jcms.2013.05.021
13. Lee JH, Park TJ, Jeon JH. Unilateral intraoral vertical ramus osteotomy and sagittal split ramus osteotomy for the treatment of asymmetric mandibles. J Korean Assoc Oral Maxillofac Surg 2015;41:102-8. https://doi.org/10.5125/jkaoms.2015.41.2.102
14. Park J, Hong KE, Yun JE, Shin ES, Kim CH, Kim BJ, et al. Positional changes of the mandibular condyle in unilateral sagittal split ramus osteotomy combined with intraoral vertical ramus osteotomy for asymmetric Class III malocclusion. J Korean Assoc Oral Maxillofac Surg 2021;47:373-81. https://doi.org/10.5125/jkaoms.2021.47.5.373
15. Kawase-Koga Y, Mori Y, Fujii Y, Kanno Y, Chikazu D, Susami T, et al. Complications after intraoral vertical ramus osteotomy: relationship to the shape of the osteotomy line. Int J Oral Maxillofac Surg 2016;45:200-4. https://doi.org/10.1016/j.ijom.2015.07.008
16. Agnihotry A, Fedorowicz Z, Nasser M, Gill KS. Resorbable versus titanium plates for orthognathic surgery. Cochrane Database Syst Rev 2017;10:CD006204. https://doi.org/10.1002/14651858.cd006204.pub3
17. Ahn YS, Kim SG, Baik SM, Kim BO, Kim HK, Moon SY, et al. Comparative study between resorbable and nonresorbable plates in orthognathic surgery. J Oral Maxillofac Surg 2010;68:287-92. https://doi.org/10.1016/j.joms.2009.07.020
18. Park YW. Bioabsorbable osteofixation for orthognathic surgery. Maxillofac Plast Reconstr Surg 2015;37:6. https://doi.org/10.1186/s40902-015-0003-7
19. Tuovinen V, Suuronen R, Teittinen M, Nurmenniemi P. Comparison of the stability of bioabsorbable and titanium osteosynthesis materials for rigid internal fixation in orthognathic surgery. A prospective randomized controlled study in 101 patients with 192 osteotomies. Int J Oral Maxillofac Surg 2010;39:1059-65. https://doi.org/10.1016/j.ijom.2010.07.012
20. Takazakura D, Ueki K, Nakagawa K, Marukawa K, Shimada M, Shamiul A, et al. A comparison of postoperative hypoesthesia between two types of sagittal split ramus osteotomy and intraoral vertical ramus osteotomy, using the trigeminal somatosensory-evoked potential method. Int J Oral Maxillofac Surg 2007;36:11-4. https://doi.org/10.1016/j.ijom.2006.09.016
21. Al-Moraissi EA, Ellis E 3rd. Is there a difference in stability or neurosensory function between bilateral sagittal split ramus osteotomy and intraoral vertical ramus osteotomy for mandibular setback? J Oral Maxillofac Surg 2015;73:1360-71. https://doi.

org/10.1016/j.joms.2015.01.010
22. Ghali GE, Sikes JW Jr. Intraoral vertical ramus osteotomy as the preferred treatment for mandibular prognathism. J Oral Maxillofac Surg 2000;58:313-5. https://doi.org/10.1016/s0278-2391(00)90063-6
23. Chen CM, Tseng YC, Ko EC, Chen MY, Chen KJ, Cheng JH. Comparisons of jaw line and face line after mandibular setback: intraoral vertical ramus versus sagittal split ramus osteotomies. Biomed Res Int 2018;2018:1375085. https://doi.org/10.1155/2018/1375085
24. Bell WH, Yamaguchi Y. Condyle position and mobility before and after intraoral vertical ramus osteotomies and neuromuscular rehabilitation. Int J Adult Orthodon Orthognath Surg 1991;6:97-104.
25. Ohba S, Tasaki H, Tobita T, Minamizato T, Kawasaki T, Motooka N, et al. Assessment of skeletal stability of intraoral vertical ramus osteotomy with one-day maxillary-mandibular fixation followed by early jaw exercise. J Craniomaxillofac Surg 2013;41:586-92. https://doi.org/10.1016/j.jcms.2012.11.032
26. Udayakumar SIV, Kim D, Choi SY, Kwon TG. 3D simulation of interosseous interference in sagittal split ramus osteotomy for mandibular asymmetry. Maxillofac Plast Reconstr Surg 2023;45:32. https://doi.org/10.1186/s40902-023-00400-x
27. Lee SH, Chung DH, Cha KS, Lee JW, Lee SM. Orthognathic treatment using combination surgery (unilateral sagittal ramus osteotomy and unilateral intraoral vertical ramus osteotomy) for skeletal Class III malocclusion patient with facial asymmetry. Clin J Korean Assoc Orthod 2019;9:178-88. https://doi.org/10.33777/cjkao.2019.9.3.178
28. Lee JY, Han SJ. Sagittal split ramus osteotomy, intraoral vertical ramus osteotomy, and lateral corticectomy for asymmetric mandibular prognathism. J Korean Assoc Oral Maxillofac Surg 2021;47:249-56. https://doi.org/10.5125/jkaoms.2021.47.4.249
29. Cheung LK, Chow LK, Chiu WK. A randomized controlled trial of resorbable versus titanium fixation for orthognathic surgery. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2004;98:386-97. https://doi.org/10.1016/j.tripleo.2004.02.069
30. Ueki K, Nakagawa K, Marukawa K, Takazakura D, Shimada M, Takatsuka S, et al. Changes in condylar long axis and skeletal stability after bilateral sagittal split ramus osteotomy with poly-L-lactic acid or titanium plate fixation. Int J Oral Maxillofac Surg 2005;34:627-34. https://doi.org/10.1016/j.ijom.2005.02.013
31. Luo M, Yang X, Wang Q, Li C, Yin Y, Han X. Skeletal stability following bioresorbable versus titanium fixation in orthognathic surgery: a systematic review and meta-analysis. Int J Oral Maxillofac Surg 2018;47:141-51. https://doi.org/10.1016/j.ijom.2017.09.013

How to cite this article: Kim SY, Park YW. Evaluation of postoperative skeletal stability after sagittal split ramus osteotomy and contralateral intraoral vertical ramus osteotomy in asymmetric mandibular setback. J Korean Assoc Oral Maxillofac Surg 2025;51:278-283. https://doi.org/10.5125/jkaoms.2025.51.5.278