CASE REPORT

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Stability of unilateral sagittal split ramus osteotomy for correction of facial asymmetry: long-term case series and literature review

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Abstract (J Korean Assoc Oral Maxillofac Surg 2015;41:156-164)

Bilateral sagittal split ramus osteotomy is considered a standard technique in mandibular orthognathic surgeries to reduce unexpected bilateral stress in the temporomandibular joints. Unilateral sagittal split ramus osteotomy (USSO) was recently introduced to correct facial asymmetry caused by asymmetric mandibular prognathism and has shown favorable outcomes. If unilateral surgery could guarantee long-term postoperative stability as well as favorable results, operation time and the incidence of postoperative complications could be reduced compared to those in bilateral surgery. This report highlights three consecutive cases with long-term follow-up in which USSO was used to correct asymmetric mandibular prognathism. Long-term postoperative changes in the condylar contour and ramus and condylar head length were analyzed using routine radiography and computed tomography. In addition, prior USSO studies were reviewed to outline clear criteria for applying this technique. In conclusion, patients showing functional-type asymmetry with predicted unilateral mandibular movement of less than 7 mm can be considered suitable candidates for USSO-based correction of asymmetric mandibular prognathism with or without maxillary arch surgeries.

Key words: Unilateral sagittal split ramus osteotomy, Functional facial asymmetry, Laterognathism, Temporomandibular joint

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I. Introduction

Sagittal split ramus osteotomy (SSO) is one of the most common procedures to correct mandibular deformities including prognathism, retrognathism, and asymmetry since its introduction by Trauner and Obwegeser[1]. Performing SSO on bilateral mandibular rami (bilateral SSO, BSSO) to reduce unexpected stress or torsion in the temporomandibular joint (TMJ) is considered a standard technique in mandibular orthognathic surgeries. Previously, it was believed that only bilateral mandibular approaches could be used to separate the tooth-bearing distal mandible segment from both TMJ-attached proximal segments, allowing free repositioning of the proximal segments into neutral condyle positions and fixing the distal segment with minimal TMJ tension[2,3].

However, in a recent report, unilateral SSO (USSO) was used to correct lateral deviation of the mandible and yielded favorable outcomes[3]. If unilateral surgery could guarantee long-term postoperative stability, as well as favorable results in correcting facial asymmetry, operation time and the incidence of postoperative complications, including inferior alveolar nerve damage, hemorrhage, or a bad split, could be reduced compared to those observed in bilateral mandibular surgeries[3,4]. However, USSO may cause rotation of the opposing mandibular condyle, likely leading to adverse effects such as condylar resorption, limited mouth opening, or TMJ disorders[2,5]. Due to these considerations, current use of USSO has been extremely limited. Thus, the use and acceptance of

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USSO as an orthognathic surgical method could be improved if thoroughly documented clinical guidelines or criteria are provided for unilateral approaches.

To further validate the feasibility of USSO, we report three consecutive cases with long-term follow-up in which USSO was used to correct asymmetric mandibular prognathism.(Tables 1, 2) In this case series, changes in the vertical condylar height (CH), ramal height (RH), and mandibular width (MW) were analyzed at both operative and non-operative sites using preoperative and 2-year postoperative panoramic and cephalometric radiographs (Fig. 1, Table 2), similar to previous reports[6-8]. In addition, for 3 years following the USSO, any evidence of mandibular condylar resorption at the non-osteotomized side was evaluated by computed tomography

Table 1. Data summary of USSO in the present study

Case	Age (yr)/sex	Osteotomy (site)	Direction of movement	Setback amount (mm)	TMJ symptom	Follow-up period (mo)
1	39/female	USSO+USARPE (left)	Setback	6	None	62
2	28/female	USSO+UTO (right)	Setback	7	None	74
3	43/female	USSO+UPMSO (right)	Setback	6	None	38

(USSO: unilateral sagittal split ramus osteotomy, USARPE: unilateral surgically assisted rapid palatal expansion, UTO: unitooth osteotomy, UPMSO: unilateral posterior maxillary segmental osteotomy, TMJ: temporomandibular joint)

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Table 2. Preoperative and postoperative radiographic analysis of the ramal and condylar height, and the mandibular width in the present cases

Case	Site	RH[1] (mm)		CH[1] (mm)		RH[2] (mm)		MW[2] (mm)		Condylar resorption in CT[3]
		Preop	Postop	Preop	Postop	Preop	Postop	Preop	Postop	
1	Osteotomy	61.50	61.30	4.20	4.20	71.50	70.50	90.40	90.00	
	Opposite[4]	60.71	60.50	4.13	4.00	71.00	70.20	91.20	91.00	None
2	Osteotomy	63.50	63.10	4.07	4.00	72.50	72.20	91.50	91.00	
	Opposite[4]	62.72	62.50	4.25	4.16	71.88	71.65	92.20	91.70	None
3	Osteotomy	58.00	57.75	3.95	3.85	70.50	70.22	90.50	90.00	
	Opposite[4]	59.75	59.70	4.25	4.15	69.85	69.80	91.70	90.50	None

(RH: ramal height, CH: condylar height, MW: mandibular width, Preop: preoperative, Postop: more than 2 years postoperatively)

[1]Measured in panoramic radiography, [2]Measured in posteroanterior cephalometric radiography, [3]Evidence of condylar resorption in computed tomography (CT) views at 3 years postoperatively, [4]Non-osteotomy site.

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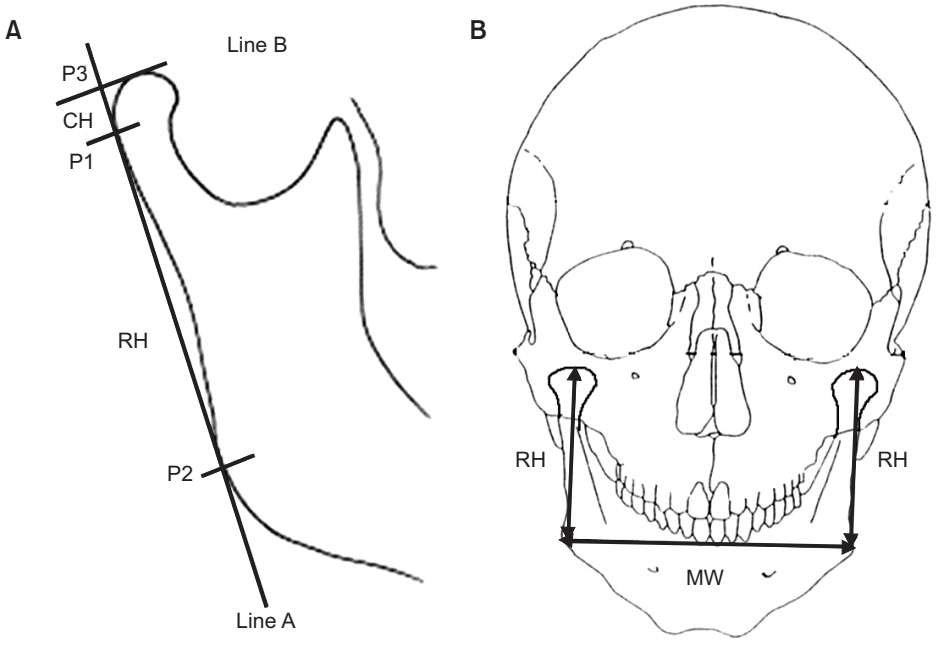

Fig. 1. Measurement of the ramal height (RH), condylar height (CH), and mandibular width (MW). A. On panoramic radiography, RH and CH were measured preoperatively and 2 years postoperatively, as previously described by Habets et al.[6] and Kilic et al.[8]. B. On posteroanterior cephalometric radiography, the MW (bigonial width) and RH were measured simultaneously, as described by Snodell et al.[7]. (P1, P2: the most lateral points of the ramus, P3: intersection point of line A and line B, Line A: ramus tangent, Line B: perpendicular line from line A to the superior part of the condylar image).

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(CT). Informed consents were obtained from the patients for publication of the present report and accompanying images.

II. Cases Report

1. Case 1

A 39-year-old woman visited the clinic complaining of facial asymmetry. Initial examinations revealed mandibular prognathism with right-sided deviation, right posterior crossbite, absence of the lower first molars bilaterally, extrusion of the left upper first molar, and a narrow maxillary arch with crowded incisors.(Fig. 2. A-C) Radiographs showed that both mandibular condyles were symmetrical and equal in size, with elongation of the left mandibular ramus and rightward deviation of the chin point.(Fig. 2. B) The patient was diagnosed with asymmetric mandibular prognathism (laterognathism), and Le Fort I osteotomy and BSSO with preoperative orthodontic treatment were recommended to correct the jaw deformities. However, the patient was reluctant to undergo conventional bimaxillary surgery and requested a less invasive option. Therefore, the protocol was revised to include a minimally invasive approach (MIA), consisting of miniscrew-aided orthodontic intrusion of the extruded upper left molar, left unilateral surgically-assisted rapid palatal expansion (USARPE) to expand the constricted maxilla, and

Fig. 2. Preoperative and postoperative clinical examination and radiography in case 1. A, B. Preoperative facial photography and cephalometry shows facial asymmetry with rightward chin deviation, but both condyles are symmetrical in size and thickness. C. Preoperative intraoral photography indicates unilateral posterior crossbite on the right side and a narrow palatal arch. D. Intraoperative photography shows the unilateral surgically-assisted rapid palatal expansion, with osteotomy only at the mid-palatal suture and the left side of the anterior maxillary wall (arrows). E-G. Two years after unilateral sagittal split ramus osteotomy (left side, 6-mm setback) and postoperative orthodontic treatment, the patient had symmetrical chin morphology and balanced occlusion.

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USSO on the mandible for its rotated setback on the left side. The patient underwent 3 months of preoperative orthodontic treatment initially to align the dentition. Intraoperatively, the mandible was moved to a 6-mm setback on the left side only, the right side of the mandibular condyle was smoothly rotated without any resistance.(Fig. 2. D) After 12 months of postoperative orthodontic treatment and dental implantation for the missing teeth, the patient had normal occlusion and symmetric facial morphology.(Fig. 2. E-G) Follow-up examinations over 5 years did not show any postoperative complications, including TMJ disorders. The preoperative and 2-year postoperative RH, CH, and MW were measured using panoramic and cephalometric radiography, and were not significantly different after USSO.(Fig. 3, Table 2) Moreover, the condylar shape in the non-osteotomized site was preserved without any long-term postoperative osteolysis on follow-up panoramic radiographs.(Fig. 3)

2. Case 2

A 28-year-old woman was referred to the clinic for treatment of facial asymmetry. Clinical and radiological examinations revealed left posterior crossbite, right mandibular ramus elongation, leftward chin deviation, absence of both mandibular first molars, extrusion of the upper right second premolar, and symmetrical mandibular condyles.(Fig. 4. A-C) The patient was diagnosed with asymmetric mandibular prognathism with missing teeth (bilateral mandibular first molars) and consented to correction of her facial asymmetry using MIA rather than bimaxillary surgeries. After 3 months

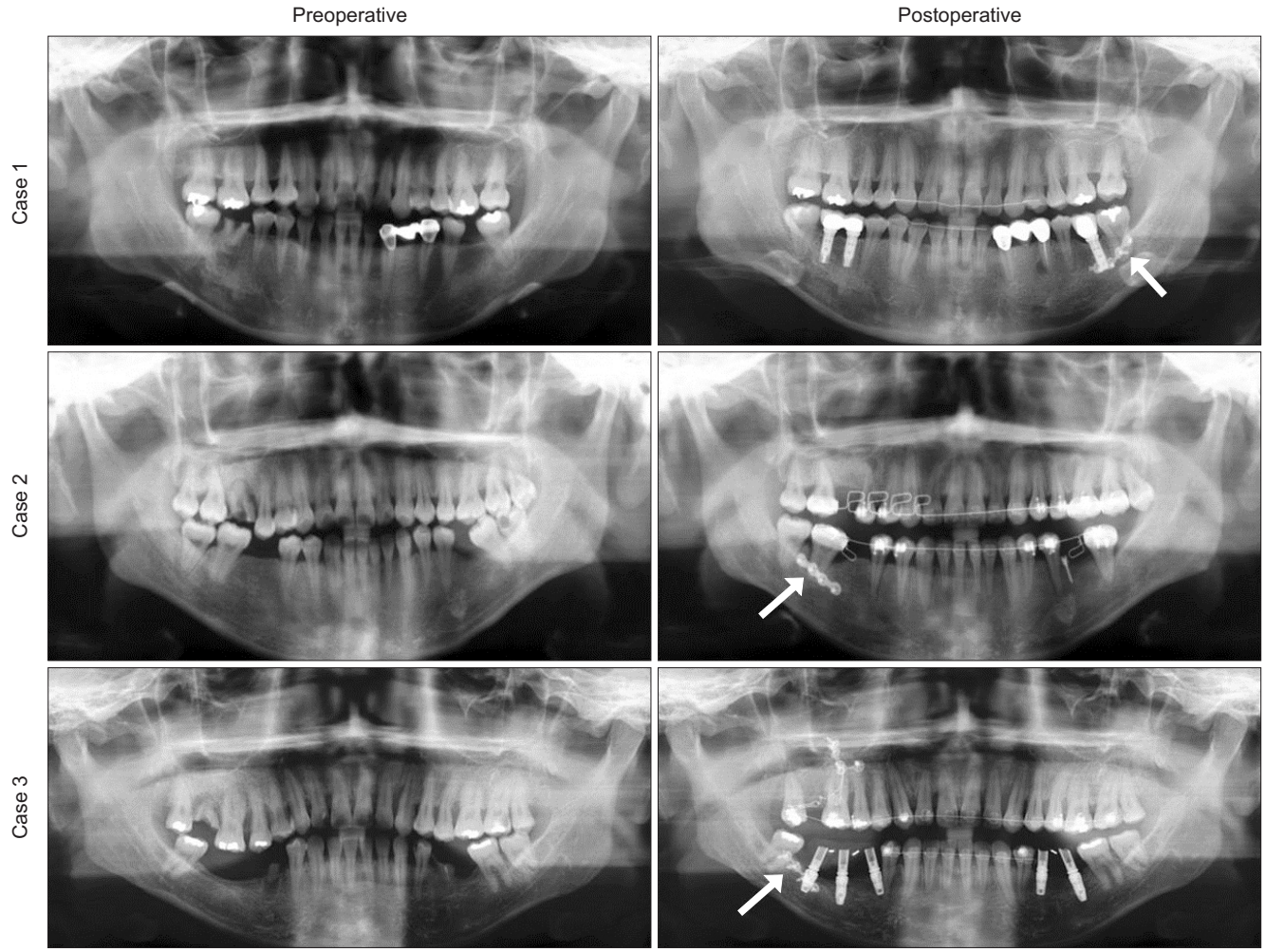

Fig. 3. Preoperative and 2-year postoperative panoramic radiography of present cases. The osteotomy sites and remaining miniplates are indicated by arrows. On postoperative panoramic radiography, all cases show symmetric mandibular condylar size and ramus height, and no evidence of condylar resorption after unilateral sagittal split ramus osteotomy.

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Fig. 4. Clinical and cephalometric radiography of case 2. A, B. Preoperative facial photography and cephalometry shows a protruded mandible and leftward chin deviation, both the condyles and the ramus height are uniform. C. Intraoral preoperative photography reveals unilateral posterior crossbite on the left side, missing right lower posterior teeth, and extrusion of the opposing upper teeth. D-F. After performing unilateral mandibular setback (7 mm) with unilateral sagittal split ramus osteotomy on the right side and postoperative orthodontic treatment, the patient achieved facial symmetry and stable occlusion.
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of preoperative orthodontic dental alignment, the patient underwent unitooth osteotomy for intrusion of the upper right second premolar and USSO with a 7-mm setback on the right mandible. She showed symmetrical facial morphology and stable occlusion after 18 months of postoperative orthodontic treatment.(Fig. 4. D-F) Follow-up examinations over 6 years showed no evidence of TMJ dysfunction or condylar resorption on routine panoramic radiography.(Fig. 3) Moreover, the RH and CH remained unchanged postoperatively and the condylar shape appeared intact on CT at approximately 6 years after USSO in both the operative and non-operative sites.(Fig. 5, Table 2)

3. Case 3

A 43-year-old woman visited the clinic complaining of an asymmetric face and multiple teeth losses. Clinical and radiological examination revealed the absence of multiple mandibular posterior teeth bilaterally (#35, #36, #45, #46, and #47), extrusion of the right upper posterior teeth (#14, #15, and #16), left unilateral cross bite, leftward chin point deviation, and normal and symmetrical mandibular condyles.(Fig. 6. A-C) Based on these findings, the patient was diagnosed with asymmetric mandibular prognathism with multiple missing teeth. Right unilateral posterior maxillary segmental osteotomy (PMSO), USSO for intrusion of the extruded posterior maxillary segment and unilateral 6-mm setback of the

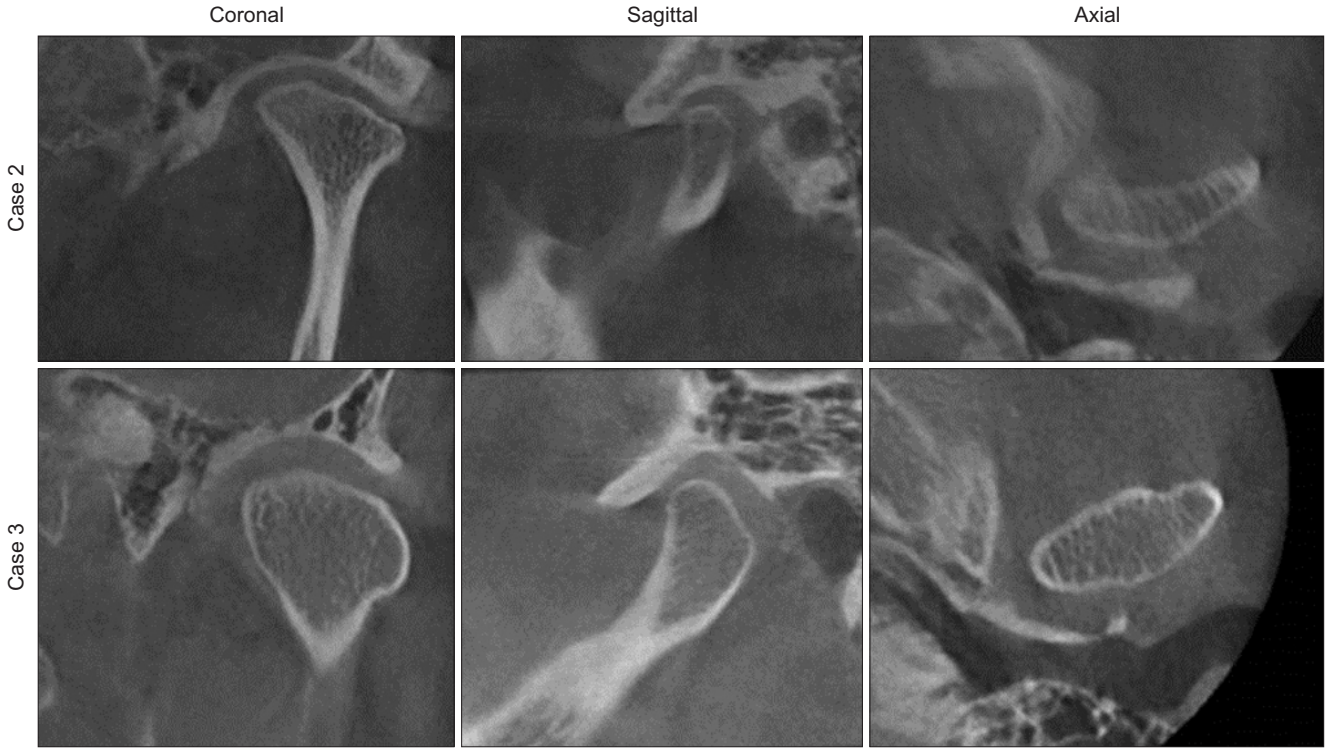

Fig. 5. Computed tomography to evaluate condylar contour at the non-osteotomized site more than 3 years after unilateral sagittal split ramus osteotomy. There was no evidence of cortical bone destruction.
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right mandible were performed after 3 months of preoperative orthodontic treatment. After 16 months of postoperative orthodontic treatment and restoration of the missing teeth with dental implants, the patient achieved balanced occlusion and symmetrical facial morphology.(Fig. 6. D-F) On preoperative and postoperative routine radiography and CT at 3 years postoperatively, there was no significant change in the RH or CH, and no evidence of cortical bone resorption in the non-osteotomized mandibular condyle.(Table 2, Fig. 3, 5) Clinically, she had normal TMJ function and mouth opening range for more than 3 years postoperatively.

III. Discussion

Facial asymmetry can be either developmental or functional, occurring along the horizontal, vertical, and transverse planes according to predisposing or contributing factors related to the onset period. The developmental type of facial asymmetry, which includes unilateral condylar hyperplasia, unilateral mandibular hypertrophy, and hemifacial hypertrophy, presents as skeletal asymmetry with complete dentition, elongated condylar neck on the non-deviated side, and resorptive condyle contour on the deviated side with bilateral posterior crossbite[9]. The functional type of facial asymmetry, such as asymmetrical mandibular prognathism (laterognathism), is characterized by positional facial asymmetry with dento-alveolar compensation. This condition presents as unilateral posterior crossbite with symmetrical mandibular condylar shape and size, which are usually accompanied by unilateral absence of the lower posterior teeth[8-10].

Irrespective of the type of facial asymmetry, bimaxillary surgeries, including Le Fort I osteotomy and bilateral mandibular surgeries, are the traditional treatment modalities. However, several recent studies have described the correction of facial asymmetry with minimally invasive surgical techniques. Motamedi[11] reported favorable outcomes in 6 cases of unilateral mandibular osteotomy to correct unilateral condylar hyperplasia. Either unilateral extraoral subcondylar osteotomy or extraoral vertical ramus osteotomy with or without Le Fort I osteotomy was used to treat skeletal-based facial asymmetry caused by unilateral condylar hyperplasia with mandibular movement in the osteotomy side ranging from 5 to 10 mm[11]. In addition, cohort studies have reported the use of USSO in orthognathic surgeries, but have not detailed the magnitude or direction of mandibular movement[12-15]. The USSO technique has also been used to correct post-traumatic

Fig. 6. Clinical photography and radiography of case 3. A-C. The patient shows asymmetric mandibular prognathism, left unilateral crossbite, loss of multiple bilateral lower posterior teeth, and extrusion of opposing teeth. D-F. Postoperative orthodontic treatment after right unilateral sagittal split ramus osteotomy (6-mm setback) and unilateral posterior maxillary segmental osteotomy, the patient obtained symmetrical facial morphology and balanced occlusion.
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Table 3. Review of unilateral mandibular osteotomy in orthognathic surgeries reported previously

Reference	No. of cases	Operative	Diagnosis	Direction of movement	Amount of movement (mm)	TMJ problem
Merkx and Van Damme[12] (1994)	5	USSO				
Motamedi[11] (1996)	6	1 Case: ESCO 3 Cases: EVRO 2 Cases: EVRO+Le Fort I	Unilateral condylar hyperplasia	Setback	5-10	None
Westermark[13] (1999)	1	USSO		Advancement		
Ozdemir et al.[14] (2009)	12	USSO				
Wohlwender et al.[3] (2011)	26	3 Cases: USSO 23 Cases: USSO+Le Fort I	Laterognathism	3 Cases: advancement 20 Cases: setback 3 Cases: NA	2-7	2 Cases: condylar resorption (1, unilateral; 1, bilateral)
Fujita et al.[15] (2013)	-	USSO				
Current report	3	USSO	Laterognathism	Setback	6-7	None

(USSO: unilateral sagittal split ramus osteotomy, ESCO: extraoral subcondylar osteotomy, EVRO: extraoral vertical ramus osteotomy, NA: not available, TMJ: temporomandibular joint)
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malocclusion caused by unilateral condyle fracture or to remove intrabony tumors such as odontoma or myxoma in the mandible[16-19]. Thus, USSO has not been readily accepted as a common orthognathic surgical technique to correct jaw deformity.

Recently, researchers completed the first evaluation of long-term outcomes and TMJ function after USSO as an orthognathic surgical technique[3]. In their study, 26 patients underwent USSO to correct laterognathism; three underwent isolated USSO, and the remainder underwent USSO combined with Le Fort I osteotomy. In these cases, the mandibular movement was between 2 to 7 mm at the affected site, and two cases of condylar resorptions were noted within 1 year postoperatively. However, there was no significant impairment in condylar movement on the non-operated side. They reported that the 2-year postoperative condylar resorption rate of USSO was not higher than that of BSSO (approximately 4%)[2]. Prior studies that utilize USSO in mandibular orthognathic surgery are summarized in Table 3[3,11-15].

In the present study, three patients are described who underwent USSO as a unilateral mandibular setback to correct functional facial asymmetry caused by laterognathism. TMJ function was evaluated both preoperatively and postoperatively, looking specifically at noise, pain and mouth opening. The unilateral mandibular setback ranged between 6 and 7 mm, and patients did not show any TMJ dysfunction with normal mouth opening ($\geq$40 mm) after at least 3 years of follow-up.(Table 1) In both the operative and non-operative sides of the mandibles, the RH and CH were not significantly changed on panoramic or cephalometric radiography over more than 3 years of follow-up. Moreover, the condylar shapes at the non-osteotomy sites remained intact without any evidence of resorption on CT.(Table 2, Fig. 3, 5) Along with USSO, USARPE, uni-tooth osteotomy, or unilateral PMSO was also used in each case to correct maxillary dento-alveolar compensation. These minimal and selective surgical approaches in the maxillary dento-alveolus region could reduce the need for Le Fort I osteotomy, which would minimize the risk of potential surgical complications associated with more aggressive surgical approaches.

Similar to previous cases, the maximum unilateral mandibular movement of USSO was 7 mm in the present study, which rotated the mandibular condyle within 3° to 4° on the non-operated contralateral site[3]. In a previous report, the mean proximal segment's rotation was 5.6° after mandibular movement with BSSO, and the maximum rotational tolerance of the mandibular condyle was approximately 10° to 15° after orthognathic mandibular surgery[11,20]. Thus, unilateral mandibular movement of 7 mm after USSO, which would rotate the mandibular condyle 3° to 4° in non-osteotomy side, should be tolerable and would rarely affect TMJ function.

In conclusion, this case series shows that in cases of functional facial asymmetry with unilateral posterior crossbite, dento-alveolar compensation for partial missing teeth, and predicted unilateral mandibular movement of less than 7 mm, USSO could be considered a useful mandibular orthognathic surgical technique for reducing operation time and the incidence of postoperative complications.

Conflict of Interest

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

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References

1. Trauner R, Obwegeser H. The surgical correction of mandibular prognathism and retrognathia with consideration of genioplasty. I. Surgical procedures to correct mandibular prognathism and reshaping of the chin. Oral Surg Oral Med Oral Pathol 1957;10:677-89.
2. Borstlap WA, Stoelinga PJ, Hoppenreijs TJ, van't Hof MA. Stabilisation of sagittal split advancement osteotomies with miniplates: a prospective, multicentre study with two-year follow-up. Part III--condylar remodelling and resorption. Int J Oral Maxillofac Surg 2004; 33:649-55.
3. Wohlwender I, Daake G, Weingart D, Brandstätter A, Kessler P, Lethaus B. Condylar resorption and functional outcome after unilateral sagittal split osteotomy. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2011;112:315-21.
4. Falter B, Schepers S, Vrielinck L, Lambrichts I, Thijs H, Politis C. Occurrence of bad splits during sagittal split osteotomy. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2010;110:430-5.
5. Cutbirth M, Van Sickels JE, Thrash WJ. Condylar resorption after bicortical screw fixation of mandibular advancement. J Oral Maxillofac Surg 1998;56:178-82.
6. Habets LL, Bezuur JN, Naeiji M, Hansson TL. The orthopantomogram, an aid in diagnosis of temporomandibular joint problems. II. The vertical symmetry. J Oral Rehabil 1988;15:465-71.
7. Snodell SF, Nanda RS, Currier GF. A longitudinal cephalometric study of transverse and vertical craniofacial growth. Am J Orthod Dentofacial Orthop 1993;104:471-83.
8. Kilic N, Kiki A, Oktay H. Condylar asymmetry in unilateral posterior crossbite patients. Am J Orthod Dentofacial Orthop 2008;133:

382-7.
9. Cheong YW, Lo LJ. Facial asymmetry: etiology, evaluation, and management. Chang Gung Med J 2011;34:341-51.
10. Primozic J, Perinetti G, Richmond S, Ovsenik M. Three-dimensional evaluation of facial asymmetry in association with unilateral functional crossbite in the primary, early, and late mixed dentition phases. Angle Orthod 2013;83:253-8.
11. Motamedi MH. Treatment of condylar hyperplasia of the mandible using unilateral ramus osteotomies. J Oral Maxillofac Surg 1996; 54:1161-9.
12. Merkx MA, Van Damme PA. Condylar resorption after orthognathic surgery. Evaluation of treatment in 8 patients. J Craniomaxillofac Surg 1994;22:53-8.
13. Westermark A. LactoSorb resorbable osteosynthesis after sagittal split osteotomy of the mandible: a 2-year follow-up. J Craniofac Surg 1999;10:519-22.
14. Ozdemir R, Baran CN, Karagoz MA, Dogan S. Place of sagittal split osteotomy in mandibular surgery. J Craniofac Surg 2009;20: 349-55.
15. Fujita T, Shirakura M, Koh M, Itoh G, Hayashi H, Tanne K. Changes in the lip-line in asymmetrical cases treated with isolated mandibular surgery. J Orthod 2013;40:313-7.
16. Rubens BC, Stoelinga PJ, Weaver TJ, Blijdorp PA. Management of malunited mandibular condylar fractures. Int J Oral Maxillofac Surg 1990;19:22-5.
17. Wong GB. Large odontogenic myxoma of the mandible treated by sagittal ramus osteotomy and peripheral ostectomy. J Oral Maxillofac Surg 1992;50:1221-4.
18. Becking AG, Zijderveld SA, Tuinzing DB. Management of posttraumatic malocclusion caused by condylar process fractures. J Oral Maxillofac Surg 1998;56:1370-4.
19. Casap N, Zeltser R, Abu-Tair J, Shteyer A. Removal of a large odontoma by sagittal split osteotomy. J Oral Maxillofac Surg 2006; 64:1833-6.
20. Harris MD, Van Sickels JE, Alder M. Factors influencing condylar position after the bilateral sagittal split osteotomy fixed with bicortical screws. J Oral Maxillofac Surg 1999;57:650-4.