



The study intergonial width after bilateral sagittal split ramus osteotomy

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Abstract

Objective: To evaluate the change of intergonial width after bilateral sagittal split ramus osteotomy (BSSRO) in mandible.

Materials and methods: A retrospective study was conducted involving 40 adults patients underwent BSSRO at Oral and Maxillofacial Surgery Department, Mahidol University between 2003 and 2011. The participants were divided into groups based on gender and mandibular advancement or setback. Posteroanterior radiographs were taken for the participants at 3 times: preoperative study (G_0), initial postoperative study (G_1) and 9 months postoperative study (G_2). The posteroanterior cephalometric radiographs were used to evaluate the distance of the intergonial width.

Results: The intergonial width of male (111.01 ± 6.72 mm) was significantly greater than that of female (100.56 ± 6.93 mm). The intergonial width increased after either BSSRO advancement or BSSRO setback, but increased more in BSSRO advancement. In female group, the intergonial width increased more than in male group in both BSSRO advancement and BSSRO setback. The female group with BSSRO advancement increased the intergonial width statistical significantly both at initial postoperative study and 9 months postoperative study period while in male patients with BSSRO advancement the intergonial width increased statistically significantly at initial postoperative study but no statistically significantly increased at 9 months postoperative study period.

Conclusions: The results showed that the intergonial width did change after BSSRO. Therefore, careful assessment of the intergonial width before surgery is required for good treatment plan.

Keywords: intergonial width, bilateral sagittal split ramus osteotomy (BSSRO), mandibular advancement, mandibular setback

How to cite: Boonsiriseth K, Siththikornsawat B, Tanpleerat S, Wongsirichat N. The study intergonial width after bilateral sagittal split ramus osteotomy. *M Dent J* 2016; 36: 241-249.

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Received: 12 September 2016

Accepted: 7 November 2016

Introduction

Orthognathic surgery nowadays is most effectively for correction of dentofacial deformities. Bilateral sagittal split ramus osteotomy (BSSRO) is the popular choice of treatment for mandibular deformities such as retrognathic mandible (Skeletal class II deformity) or prognathic mandible (Skeletal class III deformity).¹⁻⁵ The mandibular osteotomy for correction mandible, developed from Hüllihen in 1849, to Obwegeser in 1955.⁶ Nowadays mandibular osteotomies is common used modify by Hunsuck and Epker in 1978.² Osteotomies of BSSRO can be performed by intraoral approach. This osteotomy divided mandible in sagittal plane to proximal segment and distal segment. The BSSRO has been advocated in almost all types of mandibular deformities for both vertical and horizontal mandibular movement.^{2,3,7,8}

In orthognathic surgery, not only corrects the skeletal deformities but also changes the shape and position of the overlying soft tissue thus change the facial esthetic. The intergonial width is the distance between the gonion on both sides representing the lower facial width.⁹ BSSRO can change the width of the lower face, which has an important role to the overall harmony of the face. Significant increasing

or decreasing of the intergonial width may results in unsatisfied facial shape like wide and square face or triangular shape face.^{5,10,11} Therefore, prediction of lower facial change after orthognathic surgery should be taken in account as an essential part of the diagnostic and treatment planning procedure of combined surgical-orthodontic therapy.¹²

The purpose of this study was to compare the change of the intergonial width after BSSRO in 3 different times: preoperative study, initial postoperative study, and 9 months postoperative study in case of the abnormalities of skeletal class II and III deformities. The surgical procedures were mandibular advancement and mandibular setback by Hunsuck and Epker methods, with miniplate fixation.

Materials and methods

This study was conducted as a retrospective study. This study was approved by the human research ethics committee of the faculty of dentistry and faculty of pharmacy, Mahidol University, Thailand (MU-DT/PY-IRB 2013/004.0401).

Figure 1. showed total 40 patients (15 male and 25 female), underwent orthognathic surgery between 2003 to 2011. We divided in

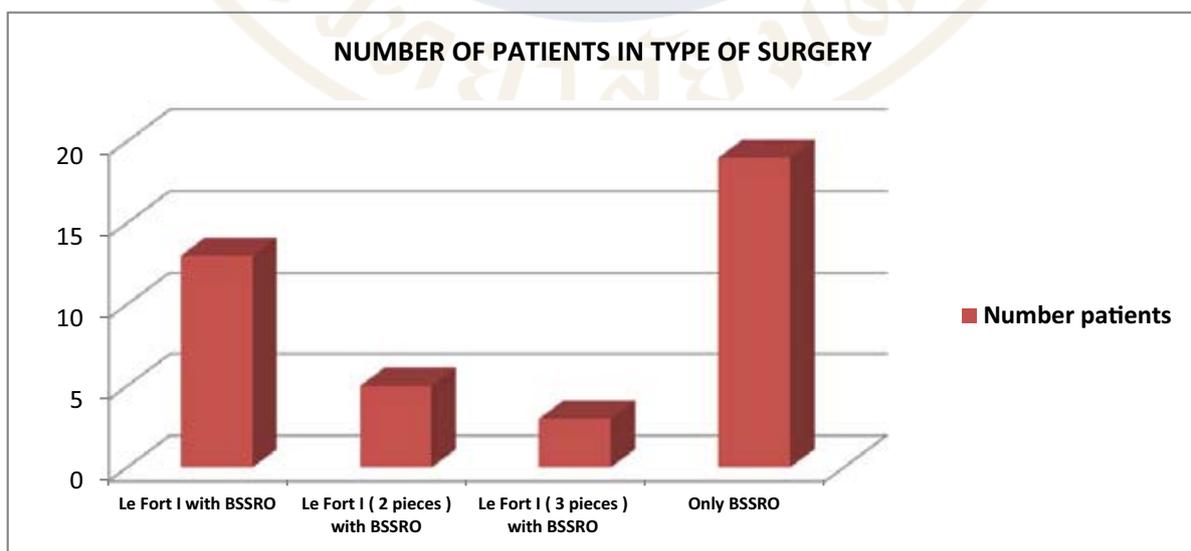


Figure 1 Number of patients in type of surgery

BSSRO advancement and BSSRO setback

BSSRO Advancement

Figure 2. showed number of patients of 20 patients underwent BSSRO advancement, mean ages of 7 males were 27 years and mean ages of 13 females were 30 years (Table 1).

BSSRO Setback

Figure 3. showed number of patients of 20 patients underwent BSSRO setback, mean aged of 8 males were 26 years and mean aged of 12 females were 24 years (Table 1).

Total of 40 patients who had retrognathic mandible (Skeletal class II deformity) or prognathic



Figure 2 Number of patients in BSSRO advancement

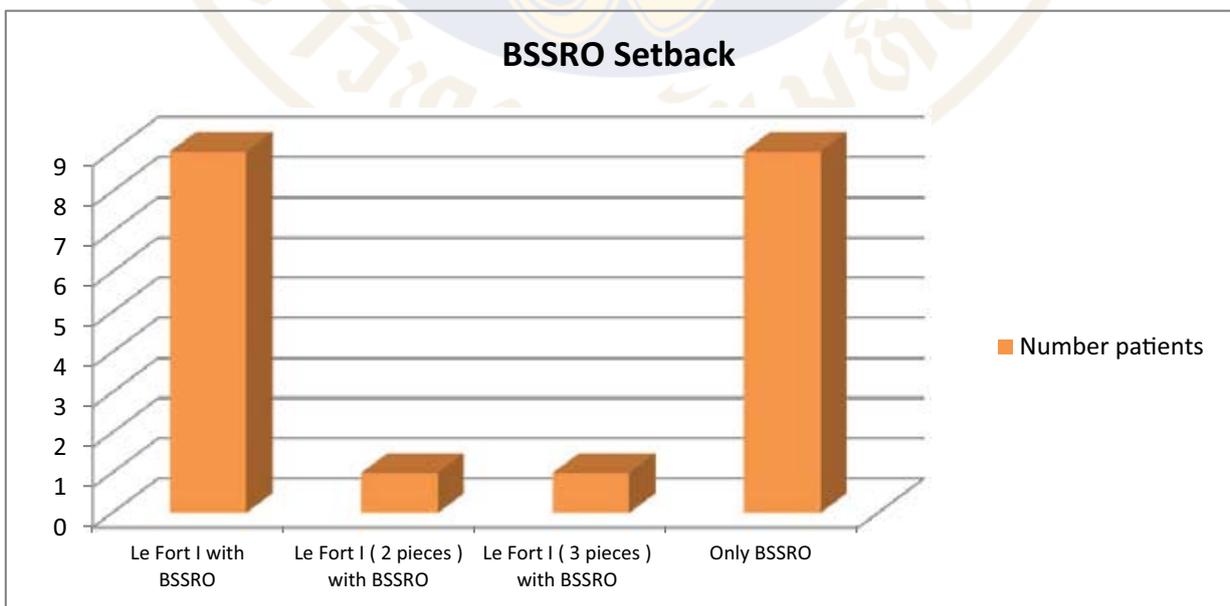


Figure 3 Number of patients in BSSRO setback

mandible (Skeletal class III deformity) underwent orthognathic surgery between 2003 to 2011, at the division of oral and maxillofacial surgery, Faculty of dentistry, Mahidol university received preoperative and postoperative orthodontic treatment were included for this study. Other craniofacial syndrome and cleft lip & palate patients were excluded.

BSSRO for mandibular advancement or mandibular setback was performed according to Hunsuck and Epker methods. After complete split of the mandibular ramus, the dentition was placed in its normal position and held with miniplate fixation both sides.

Patients' data as general characteristics of the patients, method of surgery were collected from chart record. The posteroanterior cephalograms were recorded preoperative study (G_0), initial postoperative study(G_1) and 9 months postoperative study(G_2) by the same Planmeca Proline EC[®]. The tracing the hard and soft tissue anatomy on the acetate tracing paper that is affixed to the posteroanterior cephalometric radiographs. All tracing were scanned by HP Scanjet G3110[®]. The intergonial width was calculated using Image pro plus version7[®] (Figure 4).

Table 1 Demographic data of patients treated with BSSRO, gender, age

	Surgical methods			
	BSSRO Advancement		BSSRO setback	
Gender	Male	Female	Male	Female
Number of patients	7	13	8	12
Mean ages (years)	27	30	26	24

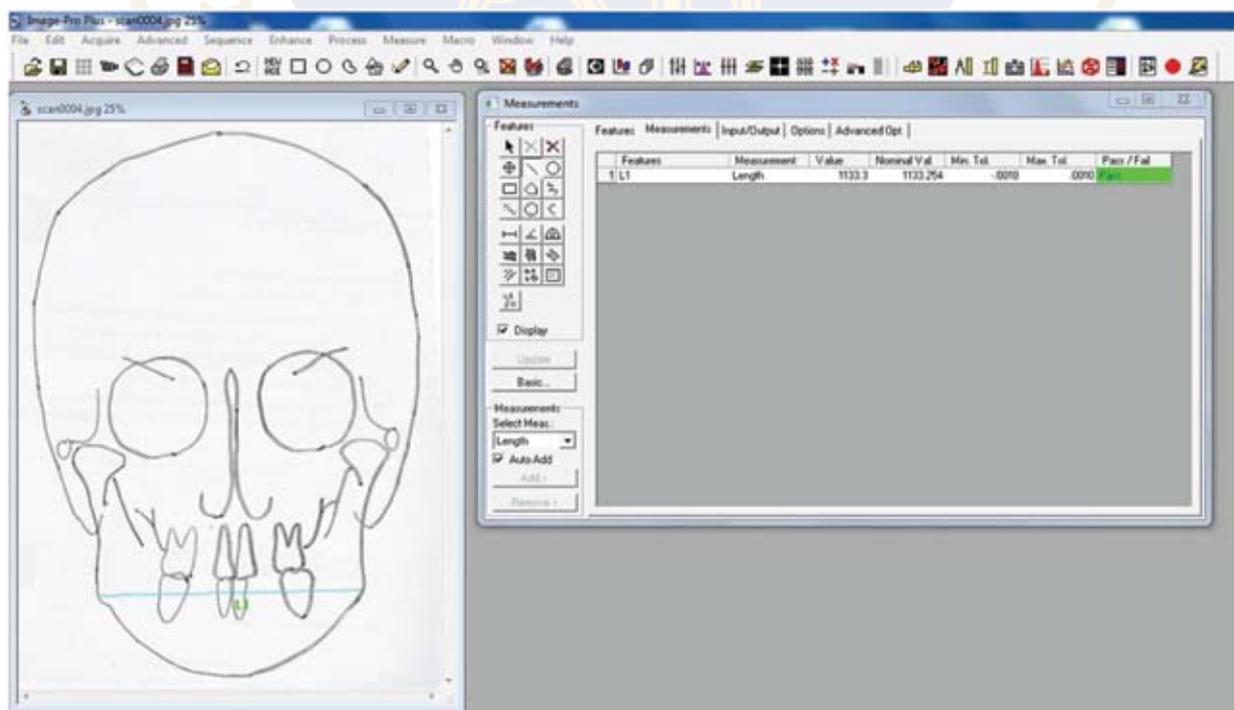


Figure 4 Measurement the intergonial width by Image pro plus version7[®].

Mann-whitney test was used to assess the differences between gender of the intergonial width. Wilcoxon Signed Ranks test was used to assess the differences of the preoperative cephalometric data and the postoperative changes by operations. Probabilities of less than 0.05 were accepted as significant. Datas were present as mean±S.D.

Error of the measurement was determined by repeated measurements of the same posteroanterior cephalograms marks. A randomly selected 10 patients were reexamined at an interval of 7 days by the same observer. The error of the method was calculated as Standard error (Se) = $\sqrt{\frac{\epsilon d^2}{2n}}$ where d is the difference between double measurements and n is the number of double measurements.

Results

The method errors in the linear measurements were within 0.10 mm. No statistically significant difference was found in the repeated measurements of the same postero-anterior cephalometric radiographs. Therefore,

the repeatability of the landmark identification in the current study was generally acceptable.

The intergonial width before surgery was 111.01±6.72 mm in male group and 100.56±6.93 mm in female group (figure 5). The intergonial width was significantly wider in male than female. (Mann–Whitney test, P <0.05)

BSSRO Advancement

Twenty patients underwent BSSRO advancement. The range of advancement in male is 5.29±2.43 mm and female is 3.19±2.30 mm (Table 2).

The study male patients in BSSRO advancement

Intergonial width in male at G₀, G₁ and G₂ are 110.74±6.81, 114.51±8.66 and 113.32±9.17 mm respectively (Table2). The patients had an increased intergonial width with a mean of 3.77±2.26 (G₀-G₁) and 2.58±3.08 (G₀-G₂) mm respectively (Table 3). Wilcoxon Signed Ranks Test showed significant change in the initial postoperative study but no significant change in 9 months postoperative study.

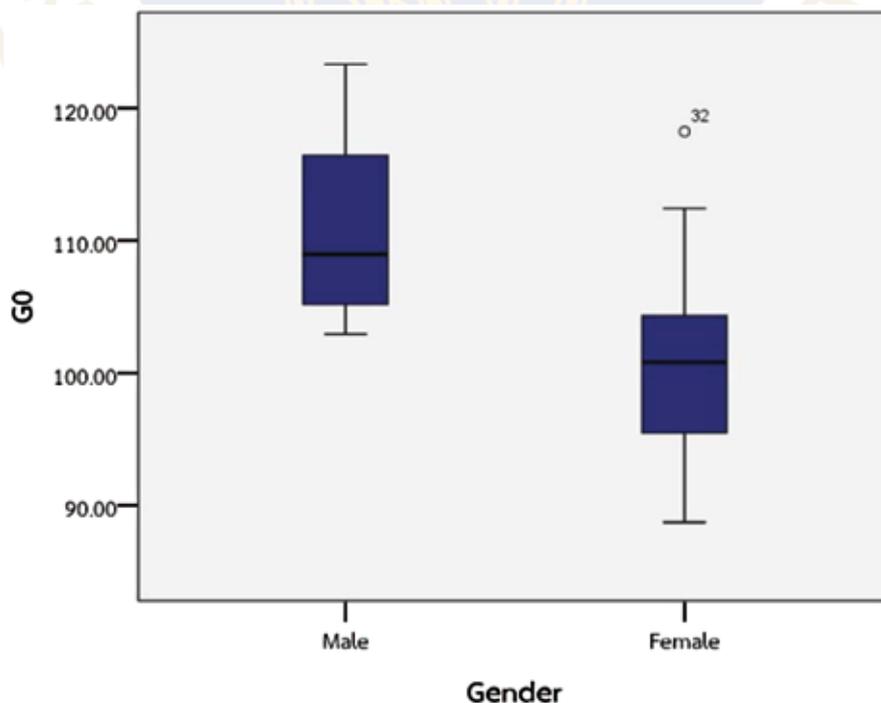


Figure 5 Intergonial width before surgery (G₀) in male and female.

Table 2 The mean and standard deviation of the difference between before and after BSSRO of the intergonial width by gender and surgical methods.

The variables studied	Surgical methods			
	BSSRO Advancement		BSSRO setback	
	Men	Female	Men	Female
G ₀ -G ₁	-3.77±2.26	-4.54±2.10	-1.84±2.38	-2.66±4.64
G ₀ -G ₂	-2.58±3.08	-3.28±2.39	-1.64±2.42	-2.11±4.50

*Wilcoxon Signed Ranks Test (p <0.05)

Table 3 The distance of teeth movement and intergonial width in the patients with BSSRO.

The variables studied	Surgical methods			
	BSSRO Advancement		BSSRO setback	
Gender	Male	Female	Male	Female
Distance of teeth movement (mm)	5.29±2.43	3.19±2.30	7.81±3.67	5.67±3.24
The intergonial width (mm)				
- G ₀ (preoperative study)	110.74±6.81	100.39±7.45	111.24±7.09	100.75±6.65
- G ₁ (early postoperatively)	114.51±8.66	104.94±7.11	113.08±6.28	103.41±4.25
- G ₂ (9 months postoperatively)	113.32±9.17	103.68±6.48	112.88±6.44	102.86±3.99

The study female patients in BSSRO advancement

Intergonial width in female at G₀, G₁ and G₂ are 100.39±7.45, 104.94±7.11 and 103.68±6.48 mm respectively (Table2). The patients had an increased intergonial width with a mean of 4.54±2.10 (G₀-G₁) and 3.28±2.39 (G₀-G₂) mm respectively (Table 3). Wilcoxon Signed Ranks Test showed significant change in both the initial postoperative study and 9 months postoperative study.

BSSRO Setback

Twenty patients underwent BSSRO setback. The range of advancement in male is 7.81±3.67 mm and female is 5.67±3.24 mm (Table 2).

The study male patients in BSSRO setback

Intergonial width in male at G₀, G₁ and G₂ are 111.24±6.81, 113.08±6.28 and 112.88±6.44 mm respectively (Table2). The patients had

an increased intergonial width with a mean of 1.84±2.38 (G₀-G₁) and 1.64±2.42 mm (G₀-G₂) respectively (Table 3). Wilcoxon Signed Ranks Test showed no significant change in both the initial postoperative study and 9 months postoperative study.

The study female patients in BSSRO setback

Intergonial width in female at G₀, G₁ and G₂ are 100.75±6.65, 103.41±4.25 and 102.86±3.99 mm respectively (Table2). The patients had an increased intergonial width with a mean of 2.66±4.64 (G₀-G₁) and 2.11±4.50 mm (G₀-G₂) respectively (Table 3). Wilcoxon Signed Ranks Test showed no significant changes in both the initial postoperative study and 9 months postoperative study.

Discussion

BSSRO is well established as an orthognathic surgical procedure.^{2,3} It is effectively

and widely used, because of good osseous healing, good stability after operation and has indication for wide range of deformities.^{1,3} This technique is for correct the abnormalities of retrognathic mandible (Skeletal class II deformity) or prognathic mandible (Skeletal class III deformity).^{1,4} In the asian human, the majority of patients treated with BSSRO setback are skeletal class III deformity.⁵

Mandibular advancement or setback may cause the proximal segment displaced laterally when there is bony interference between the proximal and distal segments after the osteotomy (figure 6). The proximal segment may move laterally or rotate three dimensionally. Despite the various methods to maintain the condyle in its natural position, the position of the proximal segment after surgery led to many horizontal and vertical changes of the mandible.^{2,5}

The gonion is very useful in transverse displacement measurements after BSSRO because it can be repeated correctly.⁴ Intergonial width can basically measure from posteroanterior cephalometric radiographs, which is the most common and useful radiographic investigation for the intergonial width after BSSRO. The posteroanterior cephalometric radiographs can be easily taken to compare presurgically with postsurgically to determine the amount of

surgical change. By assessment of these radiographs, many previous researches studied the changes of intergonial width.^{2-5,8,13} The change of intergonial width is potential to change facial esthetics.¹ Human mandibular shapes vary with age, sex and race.¹⁴ Eversion of angle is characteristic of male and more inversion in female. Male mandibles have well developed and flaring gonial regions. The mandibular condyles are smaller in females.¹⁴ The intergonial width mean was 96 ± 7 mm in male and 90 ± 7 mm in female in the previous study.^{15,16} In this study done in asian human, a square mandible with prominent mandibular angles is seen,¹¹ the mean of intergonial width was 111.01 ± 6.72 mm in men and 100.56 ± 6.93 mm in women. No previous research has studied the change in the intergonial width after BSSRO in a different gender group.

BSSRO Advancement

Several studies have reported increase of the intergonial width following BSSRO advancement.^{2,8,13} Becktor et.al. assessed the postero-anterior cephalometric radiographs of the 37 patients with postoperative BSSRO advancement. The intergonial width increased 5.6 ± 3.05 mm and this change was found to be statistically significant.⁸ They also showed that

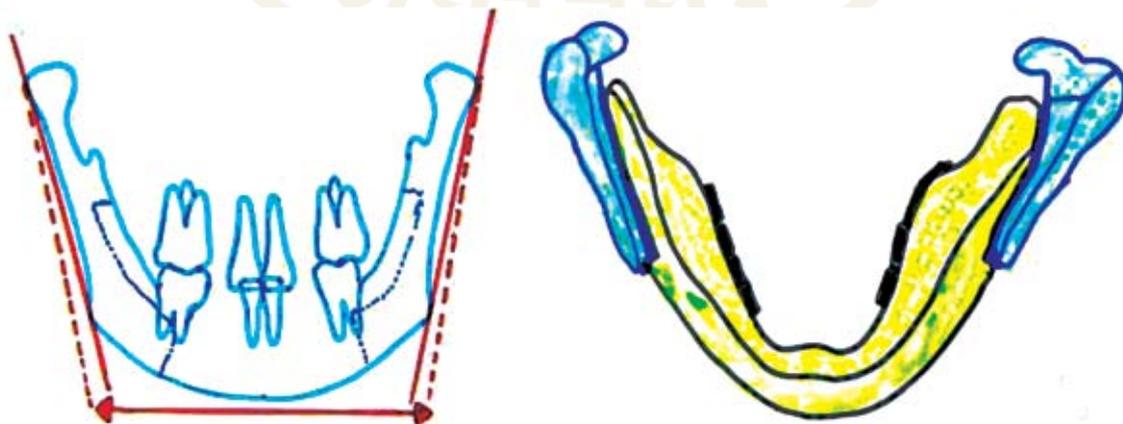


Figure 6 The proximal segment is displaced laterally when there is bony interference between the proximal and distal segments after the osteotomy.

these increased were related to the amount of horizontal movement.⁸ These findings were similar to the report from Angle et.al. They assessed the postero-anterior cephalometric radiographs of the 25 patients with postoperative BSSRO advancement. The intergonial width increased 6.5 ± 2.5 mm and this change was found to be statistically significant.¹³ This study, which divided the samples into male and female groups, the female groups found that the intergonial width increased statistically significantly both at initial postoperative study (4.54 ± 2.10 mm) and 9 months postoperative study period (3.28 ± 2.39 mm). Whereas in male patients, the intergonial width increased statistically significantly only at initial postoperative study (3.77 ± 2.26 mm), but no statistically significantly increased at 9 months postoperative study period (2.58 ± 3.08 mm).

Although the intergonial width after BSSRO advancement increased in both male and female groups, but in female group the increase was more, which would be due to more inversion of the angle and less square shape of the body of mandible.¹⁴ After advancement the mandible by BSSRO, the intergonial width increased significantly in both group at initial postoperative study period. This increasing decrease at 9 months postoperative period (G_0 - G_2) with statistical significant in female group and without statistical significant in male group. Thus decreasing after times would be due to skeletal remodeling under influence of the adaptation of the both condylar head position and anteroposterior surgical relapse.⁵

BSSRO Setback

Several studies have reported increase of the intergonial width following BSSRO setback.³⁻⁵ Choi, et al. They assessed the postero-anterior cephalometric radiographs of the 42 patients with postoperative BSSRO setback. The intergonial width increased 3.6 ± 1.9 mm

and this change was found to be statistically significant. The intergonial width at 21.7 months was 2.1 ± 2.9 mm.⁴ BSSRO setback appears to cause flaring of the proximal segment, The condyle tended to rotated inward on the axial view and backward on the sagittal view by a statistically significant amount leading to discomfort in the temporomandibular joint (TMJ) and increase the intergonial width.^{4,5}

This study also found the increasing of intergonial width after BSSRO setback in early and 9 months postoperative study period both male (1.84 ± 2.38 ; 1.64 ± 2.42) and female group (2.66 ± 4.64 ; 2.11 ± 4.50) but no statistic significant. The intergonial width decreased after times from early to 9 months postoperative study period, that may be attributed to the transverse relapse or cortical bone surface remodeling.^{4,5,17}

The increase was also more in female than male, like after BSSRO advancement. However, the increase of intergonial width after BSSRO setback were less than BSSRO advancement, that maybe due to the less interference of the posterior end of the distal segment on the proximal segment when mandible was setback. In conclusion, both BSSRO advancement and setback do increase the intergonial width of the mandible. This represents the wide lower face that results in poor esthetics, especially in female whose lower face width changed more than male. To prevent this disadvantage of BSSRO, the adequate reduction of interference between proximal and distal segment should be keep in mind before fixation. The adjunctive surgical procedure like angle reduction should be discuss with patient who has existent wide and prominent angle before orthognathic surgery.¹⁰

Acknowledgement: None

Funding: None

Competing interests: not declared

Ethical approval: This study was approved

by the human research ethics committee of the faculty of dentistry and faculty of pharmacy, Mahidol University, Thailand (MU-DT/PY-IRB 2013/004.0401).

References

- Joss CU, Joss-Vassalli IM, Kiliaridis S, Kuijpers-Jagtman AM. Soft Tissue Profile Changes After Bilateral sagittal split ramus osteotomy for Mandibular Advancement: A Systematic Review. *J Oral Maxillofac Surg* 2010; 68:1260-69. Available from PubMed PMID: 20381940.
- 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: 104-11. Available from PubMed PMID: 18083423.
- Amano K, Yagi T. Facial frontal morphological changes related to mandibular setback osteotomy using cephalograms. *J CranioMaxillofac Surg* 2009; 37: 412-6. Available from PubMed PMID: 19482484.
- Choi HS, Rebellato J, Yoon HJ, Lund BA. Effect of mandibular setback via bilateral sagittal split Ramus Osteotomy on Transverse Displacement of the Proximal Segment. *J Oral Maxillofac Surg* 2005; 63: 908-16. Available from PubMed PMID: 16003615.
- Yoo JY, Kwon YD, Suh JH, Ko SJ, Lee B, Lee JW, Kim EC, Girod S. 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. Available from PubMed PMID: 23538214.
- Takahashi H, Moriyama S, Furuta H, Matsunaga H, Sakamoto Y, Kikuta T. Three lateral osteotomy designs for bilateral sagittal split osteotomy: biomechanical evaluation with three-dimensional finite element analysis. *Head Face Med* 2010; 6: 4. Available from PubMed PMID: 20346142.
- Hoffmannová J, Foltán R, Vlček M, Klíma K, Pavlíková G, Bulík O. Factors Affecting the Stability of Bilateral sagittal split ramus osteotomy of a Mandible. *Prague Med Rep* 2008; 109: 286-97. Available from PubMed PMID: 19537679.
- 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. Available from PubMed PMID: 11928096.
- Miyashita K. *Contemporary Cephalometric Radiography*. Japan Quintessence Publishing. 1996;188-9.
- Hirohi T, Yoshimura K. Lower face reduction with full-thickness marginal osteotomy of mandibular corpus-angle followed by corticectomy. *J Plast Reconstr Aesthet Surg* 2010; 63: 1251-9. Available from PubMed PMID: 19716356.
- Khadka A, Hsu Y, Hu J, Wang Q, Zhu S, Luo E, Li J. Clinical observations of correction of square jaw in East Asian individuals. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2011; 4: 428-34. Available from PubMed PMID: 20875761.
- Rustemeyer J, Gregersen J. Quality of Life in orthognathic surgery patients: Post-surgical improvements in aesthetics and self-confidence. *J CranioMaxillofac Surg* 2012; 40: 400-4. Available from PubMed PMID: 21865051
- Angle AD, Rebellato J, Sheats RD. Transverse Displacement of the Proximal Segment After Bilateral Sagittal Osteotomy Advancement and Its Effect on Relapse. *J Oral Maxillofac Surg* 2007; 65: 50-9. Available from PubMed PMID: 17174764
- M.Punarjeevan Kumar, S.Lokanadham,Kumar MP. Sex determination & morphometric parameters of human mandible. *Int J Res Med Sci* 2013; 1: 93-6.
- Naini FB. *Facial Aesthetics Concepts & clinical Diagnosis*. UK:balckwell. 2011; 70.
- Alexander Jacobson, Richard L.Jacobson. *Radiographic Cephalometry from Basics to 3-D Imaging*. Canada: Quintessence Publishing. 2006; 265.
- Van Sickels JE, Dolce C, Keeling S, Tiner BD, Clark GM, Rugh JD. Technical factors accounting for stability of a bilateral sagittal split ramus osteotomy advancement: wire osteosynthesis versus rigid fixation. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2000; 89: 19-23. Available from PubMed PMID: 10630936.

