Original Article

Is There Any Differences in Dento-Skeletal Stability between One Vs. Three-Screw Fixation of Mandible Following Bilateral Sagittal Split Osteotomy (BSSO)?

Majid Eshghpour [1], Sahand Samieirad [1], Farzaneh MohammadZadeh Mahrokh [2], Niloofar EbrahimZadeh[3], Samine Mozaffar [2], Haleh Hashemzadeh [4*]

1. Dental Research Center, Mashhad University of Medical Sciences, Mashhad, Iran
2. Student Research Committee, Mashhad University of Medical Sciences, Mashhad, Iran
3. Student Research Committee, Zahedan University of Medical Sciences, Zahedan, Iran
4. Department of Orthodontics, School of Dentistry, Tehran University of Medical Sciences, Tehran, Iran

***Corresponding Author:**

Haleh Hashemzadeh

Postgraduate student of department of orthodontics, school of dentistry, Tehran University of Medical Sciences.

Email: h-hashemzadeh@razi.tums.ac.ir

Received: 01 Nov 2021
Accepted: 22 Apr 2022

ABSTRACT

Background: The aim of this study was to compare the dento-skeletal stability between one and three-screw fixation of mandible following bilateral sagittal split osteotomy (BSSO) in skeletal class 3 patients.

Methods: Healthy patients with skeletal class 3 malocclusion in Mashhad, Iran, from August 2020 to May 2021 were undergone mandibular setback through bilateral sagittal split osteotomy. Rigid fixation was performed in one group with one-screw technique, and three-screw fixation was done in another group. Cephalogram x-rays were prepared and analyzed in three stages: before surgery (T0), one week after the surgery (T1), and six months postoperatively (T2). The linear and angular alterations of chosen multivariate skeletal and dental variables were evaluated and statistically compared in all three periods.

Results: This study included a total of 20 patients, 12 of them were female (60%). Patients in the one-screw fixation group had a mean age of 20.6 ± 2.2 years old, whereas those in the three-screw fixation group were 21.5 ± 2.8 years old, with no statistically significant difference. Both groups had excellent mandibular stability six months following surgery. No statistically significant differences were observed in the postoperative skeletal and dental changes between the two techniques.

Conclusion: Fixation of the mandible following the setback surgery by the BSSO technique with the one-screw fixation method may be accomplished effectively, and the therapeutic outcomes are comparable to those obtained with the traditional 3-screw fixation approach.

KEYWORDS
Skeletal Class 3; Bilateral sagittal split surgery; Fixation.

Please cite this paper as:
Eshghpour M., Samieirad S., MohammadZadeh Mahrokh F., EbrahimZadeh M., Mozaffar S., Hashemzadeh H. Is There Any Differences in Dento-Skeletal Stability between One Vs. Three-Screw Fixation of Mandible Following Bilateral Sagittal Split Osteotomy (BSSO)?. World J Plast Surg. 2022;11(2):46-56.
doi: 10.52547/wjps.11.2.46

INTRODUCTION

Considerable advancements in the specialty of the orthognathic surgeries for correcting severe malocclusions and skeletal discrepancies were initiated in 1970, and nowadays, is the choice treatment for those patients who could not benefit from camouflage orthodontic treatment

[1-5]. Regarding epidemiology of skeletal deformities, skeletal class 3 seems to be the most common type among Iranian patients, and it presents a higher functional need for the orthognathic surgery [1-3, 5].
Bilateral Sagittal Split Osteotomy (BSSO) is a highly widespread surgical technique used for correcting mandible growth disorders, and was firstly introduced by Obwegezer [1, 3, 6, 7]. BSSO is a surgical procedure, in which mandible position is improved in sagittal, vertical, and horizontal dimensions, and surgical success is dependent on fixation of the new position [8, 9]. Fixation of bony structures in BSSO depends on factors such as the type of fixation, category of skeletal deformity, the quality of orthodontic treatment, the level and direction of bony parts movements, as well as the occlusal plan changes, the elasticity of soft tissues, the temporomandibular joint (TMJ) disorders, orthodontic treatment after the surgery, and the age of the patient [7, 10]. The use of the rigid fixation method was advocated to avoid bony segments movements after BSSO to improve issue repair, and to prevent the skeletal relapses [1, 3, 11-13].
Noticeably, inappropriate fixation of mandible bone structures or incorrect position of condylar part of TMJ would result in inappropriate occlusal forces, and early relapses in the first six to eight weeks postoperatively [14, 15].
We aimed to evaluate the dento-skeletal stability between one and three-screw fixation of mandible following BSSO in skeletal class 3 patients.

MATERIALS AND METHODS

Study design

This study was conducted in Mashhad, Iran from August 2020 to May 2021. The protocol of this randomized clinical trial was approved by the Ethics and Research Committee of Mashhad University of Medical Sciences (IR.MUMS.DENTISTRY.REC.1399.032) with the project code of 941417. Based on the Helsinki Declaration principles, fully informed written consent was collected from all recruited patients.
Healthy patients suffering from malocclusion class 3 caused by mandibular prognathism were included in this single-blind clinical trial. The patients only needed mandibular setback surgery as their treatment plan. All individuals underwent the surgical procedure of BSSO using the standard method in order to set back the mandible bone in the Maxillofacial Surgery Department of Qaem Hospital, Mashhad, Iran. Exclusion criteria were patients with craniofacial disorders or congenital abnormalities like maxillofacial clefts, having simultaneous chin or maxillary surgical treatments like genioplasty or LeFort surgery.

Study variables and data collection

Consecutive patients were divided into two equal groups. The fixation was performed in one group with one-screw technique, and three-screw fixation was done in another group. The 13 mm titanium mini-screws (OSW Leibinger Co, Freiburg, Germany; 2.7 mm in diameter, self-tap) were used in this trial.
Cephalogram x-rays were prepared for each patient and analyzed in three stages: before surgery (T0), one week after the surgery (T1), and six months postoperatively (T2). The linear and angular alterations of the following skeletal and dental variables were evaluated and statistically compared in all three periods. Cephlagram tracing sheets were used to trace x-rays, then these landmarks were specified:

1. N point: the most anterior point on frontonasal suture on midsagittal plane
2. S point: geometric center of pituitary gland hole that is found out visually
3. A point: the most posterior point of midline in the concavity between the anterior nasal spine and the most lowering point of alveolar bone covering the maxillary incisor teeth
4. B point: the most posterior point of midline in the mandibular concavity between the most anterior of alveolar bone covering mandible incisors and pogonion
5. Me point: the most lowering point of symphysis shadow that is shown on lateral cephalogram
6. Pg point: the most anterior point on the chin
7. Go point: the point on mandible angle Curvature specified by a confluence of the bisecting angle between Tangential line on ramus posterior and lowering border of mandible bone
8. Pr point: the most posterior point on lowering midway of the ramus
9. Ar point: confluence point of ramus posterior neighborhood and lowering part of posterior skull base that is the occipital bone

Based on the method introduced by Costa [12, 16] on

[DOI: 10.52547/wjps.11.2.46]

T0 cephalometric radiograph, a referred horizontal line (X line) from the S point which formed a seven-degree angle with SN line in clockwise direction was drawn. The vertical one was also drawn from the S point but made 90 degrees angle with the line. These refereed points were transcribed on other cephalographs superposed on SN line, and anterior structures located on the skull base on acetate sheets for cephalometric tracing (Matte Acetate 003, 8x10mm thickness, by American Orthodontics, USA) using cephalometric pencil (black, 0.5mm diameter, American board of orthodontics, USA). After drawing these lines, horizontal, vertical, and angular linear measurements were carried out on traced cephalograms. Horizontal one was the distance between B, Pg, Me and Go to Y line. Vertical measurement was the distance between B, Pg, Me, and Go to X line and the angular one was the angle between SN and NB lines, the angle between NA and NB lines, angle of a mandibular occlusal plan, the angle between Pr-Ar and SN lines and the angle between Pr-Ar and Go-Me lines. Dental measurements were overjet that is the horizontal space between maxillary and mandibular anterior teeth edges, overbite that the vertical space of these edges, the slope of mandibular teeth that is the angle between the longitudinal axis of the most prominent mandibular tooth and MP lone, and the angle between anterior teeth of both jaws which is the angle between the longitudinal axis of the most prominent anterior tooth of the mandible and maxilla. Finally, examined points and lines in cephalometric radiographs of patients were compared between two groups using statistical methods of cephalometric indices, as well as the prevalence of the stability complications and relapses.

Sample size and Data collection

To compute sample size, One-Factor Analysis of Variance (ANOVA) considering the fixation screw type, operating characteristic curves were used which means that firstly, total $\phi^2 = ND/2a ό^2$ was calculated regarding available information and same studies [17] and based on the n rate ($\phi^2 = 0.25n$, $D=5.1$, $a=2$ and $ό^2 = 4.1$) and considering $\alpha=0.05$, and $n=10$, we reached amounts of $\beta=0.08$, and $\pi=0.092$. Therefore, the n rate of ten patients would be enough to obtain agreeable sensitivity. To compare cephalometric changes before and after the surgery as well as in follow-up sessions in both groups, the test of the repeated measures ANOVA for even figures considering the error level of 5%. To reduce test error and increase confidence level to differentiate both groups, two study variables of measurement difference between in two stages of T0 and T1 alongside with T1 and T2 for all variables were defined and computed. One-Factor multivariate ANOVA considering the number of screws with the error level of 5% was used.

Patient characteristics and surgical procedure

A total of 20 consecutive patients who needed mandibular Setback surgery were chosen based on the inclusion and exclusion criteria likewise same investigations [18] and were divided into two groups composed of ten patients. The first patient in each group underwent the surgical procedure applying one titanium fixation screws and the next patient with three screws and the process was continued to reach the sample size. A twelve-month period was inspected to complete all the selected cases. For all participating patients, model surgery was performed to ensure achieving proper occlusion before the main treatment and on the condition that the achieved occlusion had stability, and was repeatable, patients underwent BSSO using standard surgical method for mandibular setback.

At the beginning of surgical treatment, a soft tissue incision was made from the mandibular ramus anterior part in the midway distance between occlusal surfaces of both jaws' teeth which were continued towards down to the middle of retromolar fossa, facing 5 mm of a posterior second molar tooth. Afterward, surgical expansion took place in anterior and lateral directions toward the area of the first molar tooth.

The bone incision was initiated from the internal structure of ramus just upper the area of the inferior alveolar nerve (IAN) to the mandibular foramen parallel to an occlusal surface using short cut practice performed by using dental bur (Taper Fissure 169L - 25mm FG -Round 8-rotational speed of 3000 rotations per minute – Hopf Ringleb Co. GmbH Cie-Freiburg- Germany). The incision depth was half of the internal-external thickness of the ramus and was observed to reach the cancellous bone. Anteriorly, the incision was continued over the surface of the ramus anterior edge more internal than the external oblique line, and in a downward direction, it reached the external surface of the mandible facing

[DOI: 10.52547/wjps.11.2.46]

the second molar. A lateral (vertical) cut was made between the first and second molar toward the inferior edge of the mandible and its cortical sheet was completely removed. The surgeon arrived at an estimate with precision to prevent entering deep anatomical structures, vascular trauma, or nerve injury. Finally, the whole area of the incision was evaluated in terms of all cuttings' termination to cancellous bone. Osteotomy was performed in the area of first and second molar teeth using a narrow sagittal split osteotome (10mmx2mm thick, Bredent Gmbh Co- Freiburg Germany) which was parallel to the lateral border of the ramus. Thus, a larger osteotome set (10mmx250 mm thick- Bredent Gmbh Co- Freiburg Germany) was inserted in the anterior part of the area with sagittal incision and by passing it downwardly precisely with small rotation and considering the IAN location, right space was made between two externally and internally incised areas. Essentially, to separate bone tissue sheets, a curved periosteal elevator (black line- Bredent Gmbh Co- Freiburg Germany) was used to separate vascular and neural bundles which were located inside the external bone sheet and then, from more external areas to IAN, two anterior and posterior osseous sections were completely separated to the lower mandibular edge. Moreover, medial pterygoid muscle insertion to ramus was separated using the periosteal elevator, and to make the anterior section detachable, the procedure was repeated on the other side of the mandible. Afterward, teeth were inserted in predetermined positions in model surgery, and required occlusal correction was completed and two jaws were bounded by interdental elastics 0.5 mm thick. Following pulling back the anterior mandible section, excision of excess osseous structures located anteriorly to vertical incision of the external surface was accomplished. Furthermore, osseous excision in anterior and vertical parts of the ramus was performed using a large spherical dental burr.

After surgical incision of the skin, and passing the trocar needle (XION GmbH, Berlin, Germany) through it, the mandibular distal and proximal bony segments in each side were fixed by the positional screw using three titanium screws in one group and one screw in other. Screw lengths were set based on the bone thickness to surround both osseous cortices.

Cephalometric radiographic examinations were performed for each patient in the following three periods: T0 (one week before the surgery), T1(one week after the surgery), and T2(six months postoperatively) were prepared and traced in definite tracing sheets. Noticeably, all examinations were taken from one radiology center during all three periods. Clinical complications such as complaining of a screw being touchable by the patient, wound dehiscence, infection, infectious fistula of a sinus tract, need of screw removal in follow-up sessions, screw fracture during insertion, and hypersensitivity reaction to titanium was documented during the six-month follow-up period.

Data analyses

All data were collected and sent for the statistical analysis carried out using SPSS 13 (SPSS Inc, Chicago, IL). To evaluate the normality of data distribution, one Sample Kolmogorov-Smirnov was used. Furthermore, to compare cephalometric variables in three periods that were before, after, and six months after the surgery in each group of patients repeated measures of ANOVA were used for even data with an error rate of 5%. The *P*-value was considered statistically significant to be less than 0.05.

RESULTS

A total of 20 consecutive patients including 12 (60%) females and 8 (40%) males enrolled in this randomized clinical trial.

There were 3 men and 7 women in the one-screw fixation group, while 5 men and 5 women underwent surgery in the three-screw method group. Patients in the one-screw fixation group had a mean age of 20.6 ± 2.2 years old, whereas those in the three-screw fixation group were 21.5 ± 2.8 years old. Based on the results of the independent t-test, there was no statistically significant difference between the two groups in this regard ($P = 0.4$).

To evaluate the uniformity of the groups, skeletal and dental variables were compared before the operation; however, there was no significant difference between the two groups (Table 1). Comparing the previous variables, it was found that the two groups had similar changes during the operation. The amount of vertical, horizontal, and angular changes was similar.

Furthermore, to ensure that the surgical process did not affect the final comparison of the study between

[DOI: 10.52547/wjps.11.2.46]

Table 1: Comparison of skeletal and dental variables between two groups of one-screw and three-screw fixation before treatment.

The desired variable \ Radiographic stage		one-screw group	three-screw group	*P* value
Skeleton related values				
Horizontal value	B	9.86±66.94	9.86±66.94	9.86±66.94
	Pg	10.15±68.32	10.15±68.32	10.15±68.32
	Me	12.09±62.37	12.09±62.37	12.09±62.37
	Go	6.34±-6.3	6.34±-6.3	6.34±-6.3
Vertical value	B	8.54±101.28	8.54±101.28	0.56
	Pg	7.87±117.13	7.87±117.13	0.09
	Me	11.38±125.32	11.38±125.32	0.73
	Go	7.34±80.8	7.34±80.8	0.66
Angles	SNB	4.83±79.4	4.65±79.36	0.45
	ANB	2.14±-0.5	1.73±1.44	0.84
	MP.SN	6.86±37.45	6.05±35.93	0.56
	Gonial angle	7.13±129	4.87±123.75	0.09
Dental related values				
	Overjet rate	0.65±3.2	1.08±2.53	1.08±2.53
	Overbite rate	0.64±1.73	0.03±1	0.03±1
	Slope of the anterior teeth of the mandible	8.95±84.65	7.78±84.32	7.78±84.32
	The angle between the anterior teeth of the jaw	7.96±132.45	12.54±136.42	12.54±136.42

Table 2: Comparison of skeletal and dental variables between two groups of one-screw and three-screw fixation, postoperatively.

The desired variable \ Radiographic stage		one-screw group	three-screw group	*P* value
Skeleton related values				
Horizontal value	B	10.56±62.78	10.11±65.32	0.34
	Pg	11.07±64.53	11.03±67.34	0.45
	Me	11.98±58.33	11.31±60.78	0.63
	Go	6.01±-7.4	7.65±-7.6	0.72
Vertical value	B	7.87±100.03	4.02±98.78	0.56
	Pg	10.18±115.84	4.03±115.32	0.26
	Me	10.73±123.02	4.59±121.43	0.43
	Go	7.45±81.20	7.95±81.04	0.84
Angles	SNB	3.84±77.53	4.65±79.36	0.17
	ANB	1.52±1.84	1.73±1.44	0.34
	MP/SN	6.54±37.3	6.05±35.93	0.45
	Gonial angle	7.08±127.56	4.87±123.75	0.63
Values related to teeth				
	Overjet rate	1.05±3.64	1.08±2.53	0.78
	Overbite rate	0.52±1.56	0.03±1	0.64
	Slope of the anterior teeth of the mandible	10.24±83.78	7.78±84.32	0.55
	The angle between the anterior teeth of the jaw	1.05±3.64	12.54±136.42	0.39

[DOI: 10.52547/wjps.11.2.46]

Table 3: The mean and standard deviation of linear measurements and skeletal and dental angles obtained in three positions before (T0), after (T1), and six months after surgery (T2) in a one- screw fixation group.

The desired variable	Radiographic stage	T0 (before the surgery) (Standard deviation ± mean)	T1 (one week after the surgery) (Standard deviation ± mean)	T2 (six months postoperatively.0 (Standard deviation ± mean)
Skeleton related values				
Horizontal value	B	9.86±66.94	10.56±62.78	9.98±63.19
	Pg	10.15±68.32	11.07±64.53	10.98±65.09
	Me	12.09±62.37	11.98±58.33	12.3±59.04
	Go	6.34±-6.3	6.01±-7.4	5.98±-7.05
Vertical value	B	8.54±101.28	7.87±100.03	8.23±99.95
	Pg	7.87±117.13	10.18±115.84	10.32±115.03
	Me	11.38±125.32	10.73±123.02	11.09±125.05
	Go	7.34±80.8	7.45±81.20	7.68±80.9
Angles	SNB	4.83±79.4	3.84±77.53	3.93±77.6
	ANB	2.14±-0.5	1.52±1.84	1.46±1.74
	MP.SN	6.86±37.45	6.54±37.3	7.05±37.4
	Gonial angle	7.13±129	7.08±127.56	7.15±126.83
Dental related values				
	Overjet rate	2.09±-1.28	1.05±3.64	0.65±3.2
	Overbite rate	1.18±-0.2	0.52±1.56	0.64±1.73
	Slope of the anterior teeth of the mandible	9.08±83.64	10.24±83.78	8.95±84.65
	The angle between the anterior teeth of the jaw	7.65±135.2	7.56±134.35	7.96±132.45

Table 4: The mean and standard deviation of linear measurements and skeletal and dental angles obtained in three positions before (T0), after (T1), and six months after surgery (T2) in a three-screw fixation group.

The desired variable	Radiographic stage	T0 (before the surgery) (Standard deviation ± mean)	T1 (one week after the surgery) (Standard deviation ± mean)	T2 (six months postoperatively.0 (Standard deviation ± mean)
Skeleton related values				
Horizontal value	B	1.09±68.78	10.11±65.32	10.32±65.68
	Pg	12.87±70.95	11.03±67.34	10.68±67.65
	Me	13.23±64.73	11.31±60.78	12.05±61
	Go	7.39±-7	7.65±-7.6	7.3±-7.45
Vertical value	B	4.11±100.45	4.02±98.78	.3.54±98.07
	Pg	4.32±117.05	4.03±115.32	3.94±115.02
	Me	4.94±123.53	4.59±121.43	4.92±121.35
	Go	8.01±81.30	7.95±81.04	8.05±81.02
Angles	SNB	5.72±81.45	4.65±79.36	5.16±79.52
	ANB	1.13±-0.65	1.73±1.44	1.65±1.52
	MP.SN	6.32±37.54	6.05±35.93	6.59±35.87
	Gonial angle	5.32±124.78	4.87±123.75	5.15±123.53
Dental related values				
	Overjet rate	1.85±-2.13	1.08±2.53	1.17±2.26
	Overbite rate	1.73±-0.2	0.03±1	0.45±1.06
	Slope of the anterior teeth of the mandible	7.94±85.32	7.78±84.32	8.05±83.85
	The angle between the anterior teeth of the jaw	13.05±135.66	12.54±136.42	10.73±136.05

[DOI: 10.52547/wjps.11.2.46]

the two groups, these variables were compared at T2 (six months after the surgery) (Table 2). Skeletal, angular, and dental factors were not statistically different between the two groups following surgery, according to the study results.

The mean and standard deviation of linear measurements and variables' angles obtained in the one-screw fixation group in the three following intervals, before the surgery (T0), one week after the surgery (T1), and six months postoperatively (T2) are depicted in Table 3. Moreover, the mean and standard deviation of linear sizes and angles obtained in the three screw group in three periods, before the surgery (T0), one week after the surgery (T1), and six months postoperatively (T2) are illustrated in Table 4.

Table 5 illuminates the differences in the postoperative skeletal alterations between the two groups (one-screw vs three-screw fixation) had no significant differences.

Mean and standard deviation of postoperative dental changes during 6-month follow-up and comparison of two groups of one-screw and three-screw fixation are described in Table 6. When comparing the changes in the dental measures acquired throughout the follow-up period, there was no meaningful difference between the two groups of one-screw and three-screw fixation (Table 6).

Clinically, there was no difference in recovery between the two groups among the 20 operated patients. During the follow-up period of patients, wound opening, infection, infectious duct, need to remove the screw during the follow-up period and hypersensitivity reaction was not seen in any groups. None of the patients complained of joint pain and discomfort.

Table 5: The mean and standard deviation of postoperative skeletal changes during 6-month follow-up and comparison of two groups of one-screw and three-screw fixation.

The desired variable	changes stage	One-screw group (Standard deviation ± mean)	Three-screw group (Standard deviation ± mean)	*P* value
Horizontal value	B	1.02±0.58	0.78±0.49	0.88
	Pg	0.83±0.47	0.42±0.37	0.91
	Me	1.73±1.11	0.83±0.36	0.54
	Go	1.04±0.27	0.76±0.23	0.98
Vertical value	B	0.78±-0.44	0.8±-0.18	0.5
	Pg	1.24±-0.84	0.87±-0.2	0.35
	Me	0.7±0.06	0.58±-0.14	0.52
	Go	0.68±-0.38	0.73±-0.26	0.71
Angles	SNB	0.28±-0.09	0.34±0.16	0.89
	ANB	0.28±0.17	0.66±-0.06	0.51
	MP.SN	1.41 ± 0.00	03.1 ± 0.05	0.94
	Gonial angle	1.72 ± 83.0–	43.1 ± 23.0–	66.0

Table 6: The mean and standard deviation of postoperative dental changes during 6-month follow-up and comparison of two groups of one-screw and three-screw fixation.

changes stage / The desired variable	One-screw group (Standard deviation ± mean)	Three-screw group (Standard deviation ± mean)	*P* value
The amount of overjet	0.45±-0.58	0.58±-0.15	0.07
Overbite rate	0.48±0.14	0.05±0.26	0.53
Slope of the anterior teeth of the mandible	2.46±0.82	1.45±0.33	0.22
The angle between the anterior teeth of the jaw	2.95±-1.82	1.78±-0.38	0.45

[DOI: 10.52547/wjps.11.2.46]

DISCUSSION

Nowadays, rigid fixation methods are considered the standard surgical technique in orthognathic surgeries to fix osseous structures with the aim of controlling the location of bony parts against factors such as the forces of muscular tensions, soft tissues' contraction, and movements resulting from occlusal compressive forces which can lead in malocclusion and risk of recurrence after the surgery [9, 18, 19]. Rigid internal fixation is considered to be the standard strategy for BSSO [4, 10]. New theories have been recently proposed about the semi-rigid fixation to reduce the complete rigid fixation problems including occlusion adjustments difficulties after the surgery, TMJ (temporomandibular joint) disorders, neurosensory problems, and dento-skeletal recurrence [14, 20]. Semi-rigid fixation is gained by reducing the number or type of the plates and the screws which were applied for maintaining and fixing the position of osteotomised bony segments while allowing them for minute functional movements [14, 21]. The use of interdental elastics in this method after surgical treatment can improve occlusion without affecting osseous repair or the risk of recurrence [22]. Moreover, Semi-rigid fixation may lead to rapid bone regeneration as well as better adjustment of TMJ [14].

The sample size in this study was 20 patients which was similar to other related investigations [12, 23, 24]. Moreover, the mean age was 21±0.25 years that had similar to Harada et al. study [17]. Both groups in this study had similarities in terms of dental-skeletal anatomical features, age and, sex. Available data revealed distribution uniformity regarding sex and anatomical dental-skeletal morphology before the surgery and had similar surgical changes of mandible movements and overjet improvement. Based on clinical findings of this study in follow-up sessions, wound dehiscence, infection, infectious sinus tract, the requirement of taking out the screws, and hypersensitivity reaction were not detected in any group and any patient did not complain of temporomandibular joint (TMJ) pain. However, the only problem was screws being touchable in two cases.

In the six-month follow-up period, no cases of sterile abscess or local inflammation were not observed which could be because of the biocompatibility of titanium screws or fairly short period of follow-up but in Harada et al. study [17] with the 12-month follow-up period, no cases of sterile abscess were not detected.

Notably, inadequate published reports described BSSO fixation strategy following mandible setback performed by different types of screws and fixation evaluation after the surgery and authors did not find investigations in the research database conducted with our study protocol which was using only one fixation screw to fix bony parts and comparing it to conventional method applying three screws.

In the present study, post-treatment dental and skeletal stability after class 3 malocclusion correction in two patient groups based on the total screws applied for mandible fixation was analyzed and this prospective study aims to assess the skeletal stability regarding the type of screws. Using two x and y vertical axes that were argued in the method section, was to make the study method regular and similar to associated studies [16, 17, 25-27]. In all mentioned studies, horizontal measurement was the axis that had six to seven degrees' angle with SN line measured clockwise and passes S point but vertical one had 90 degrees' angle with this line in S point.

Horizontal relapse in B point in a group with one screw was 0.58 mm whereas in the other group was 0.49 mm which showed no significant correlation (P=0.88). Horizontal relapse in Pg point was in the one screw group 0.47 mm and in the other 0.37 mm but there was no significant relation (0.91). The rate of relapse after the surgery in Pg point was similar to studies that declared the percentage of 10 to 30% for it after BSSO surgical treatment [17, 26, 28]. The figure of horizontal relapse six months after the surgery in Me point in one screw group was 1.1 mm while in the other was 0.36 mm and in Go point in both groups was 0.25 mm that reveals no considerable change in the position of this point after the surgery. The risk of relapse after the surgery was only detected in horizontal measurements and in vertical ones, changes were toward decrease of vertical angle and surgical alterations. This could be due to malocclusion correction after the surgery.

Regarding vertical relapse of B point, changes were in one screw group 0.44 mm and in the other 0.18 mm, with no significant difference in the follow-up period and vertical changes after six months in Pg point in the first group was 0.84 mm while in the other one was 0.87 mm. The risk of recurrence could be associated with less mandible and maxilla

[DOI: 10.52547/wjps.11.2.46]

fixation by applying only one titanium screw.
Considering Me point, minor changes were observed that is the position of this point was displaced 0.06 mm in one screw group downwardly whereas in three screw group changed downwards 0.14 mm. There was no significant difference between the vertical position of the Go point likewise its horizontal place before and after the surgery and also in the follow-up period. Regarding SNB and ANB angles in the follow-up sessions, the changes were in the same direction with the B point which shows the surgical effects. The amount of SNB reversal in both groups was 0.15 degrees in average and the rate of ANB relapse was close together in both groups (0.09 and 0.06 respectively). Performing mandibular setback resulted in slight rotation in the gonial angle but comparing the amount of this angle's relapse did not show any difference between groups.
MPA (mandibular plane angle) which demonstrates the accuracy of fixation procedure and insertion of the posterior part in the right place, did not show any considerable alteration before and after the surgery and also in follow-up sessions, hence the surgical accuracy and preserving the mandibular condyle in the glenoid fossa during fixation procedure and applying only one screw caused no trouble. MP and SN angles' relapse after the surgery was insignificant (0.68 and 1.28, respectively) that is due to the fact that no substantial changes took place in MPA and gonial angle.
Dental changes after the surgery in this study revealed no significant difference. In other words, overjet relapse in the first group was 0.58 mm while in the other was 0.15 mm. Nevertheless, because in orthodontic treatments following BSSO surgery changes in the size of teeth happen commonly, comparing dental changes in order to evaluate relapse rate following the surgery would not be completely precise. The overbite relapse rate was 0.14 mm in the first group and 0.05 mm in the second.
The inclination of mandibular incisors changed 0.8 degrees in the first group and 0.3 in the second during six months' follow-up and showed no meaningful difference and there were no significant changes in the angle between the axes of central incisor teeth of both jaws before and after the surgery.
Dental and skeletal changes after six months revealed no considerable differences and this tendency was noticed amongst all variables. Therefore, it can be concluded that applying one fixation screw in mandible fixation in BSSO surgical treatment is certain and can be a safe substitution for three screws.
In follow-up sessions, all patients declared their satisfaction with the surgical procedure, and no signs of undesirable tissue reaction like facial swelling, erythema, or bone resorption in postoperative radiographic examinations were not discovered. No considerable differences were not found in occlusion characteristics among both groups and more prominently, in postoperative skeletal changes. Similar fixation features of both groups could confirm the practical method of applying one titanium screw in mandible fixation following BSSO surgery performed for its setback. The risk of nerve damage, and reduced operation duration could be brought about via using fewer fixation screws [1, 2].

LIMITATIONS AND SUGGESTIONS

The limitations of this research need to be acknowledged. First, the duration of follow-up could be increased to examine long-term posttreatment complications. Second, the average amount of mandibular setback in Pg point in this study was 4 mm which shows no substantial skeletal deformities and the efficiency of applying one screw in severe cases with greater needed movements is not predictable based on these findings. Since this study was carried out through a small population, it would be best if similar studies with a multicenter population would be conducted. It is recommended that future studies investigate the relationship between other influential factors related to the effectiveness of BSSO surgery in the mandibular setback.

CONCLUSION

Fixation of the mandible following the setback surgery by the BSSO technique with the one-screw fixation method may be accomplished effectively, and the therapeutic outcomes are comparable to those obtained with the traditional 3-screw fixation approach. Furthermore, it may result in a lower risk of nerve damage and possible screw placement accidents, as well as a reduction in surgical time. It is recommended to research with a larger sample size to provide more definitive outcomes.

[DOI: 10.52547/wjps.11.2.46]

ACKNOWLEDGMENTS

The authors appreciate the continued support of the research counselor of Mashhad University of Medical Sciences.

CONFLICTS OF INTEREST

The authors have no conflicts of interest to disclose.

REFERENCES

1. Zeynalzadeh F, Shooshtari Z, Eshghpour M, Hoseini Zarch SH, Tohidi E, Samieirad S. Dal Pont vs Hunsuck: Which Technique Can Lead to a Lower Incidence of Bad Split during Bilateral Sagittal Split Osteotomy? A Triple-blind Randomized Clinical Trial. *World J Plast Surg* 2021 Sep;**10**(3):25-33.
2. Eshghpour M, Mianbandi V, Samieirad S. Intra- and postoperative complications of Le Fort I maxillary osteotomy. *J Craniofac Surg* 2018 Nov;**29**(8):e797-e803.
3. Eshghpour M, Labafchi A, Samieirad S, Abrishami MH, Nodehi E, Javan. Does the Presence of Impacted Mandibular Third Molars Increase the Risk of Bad Split Incidence During Bilateral Sagittal Split Osteotomy? *World J Plast Surg* 2021 Jan;**10**(1):37-42.
4. Paunonen J, Helminen M, Peltomäki T. Long-term stability of mandibular advancement with bilateral sagittal split osteotomy. *J Craniomaxillofac Surg* 2018 Sep;**46**(9):1421-1426.
5. Bou Wadi MN, Freitas KM, Freitas DS, Cançado RH, Oliveira RC, Oliveira RC, Janson G, Valarelli FP. Comparison of profile attractiveness between class III orthodontic camouflage and predictive tracing of Orthognathic surgery. *Int J Dent* 2020 Sep **7**;2020.
6. Bertin H, Huon JF, Praud M, Fauvel F, Salagnac JM, Perrin JP, Mercier JM, Corre P. Bilateral sagittal split osteotomy training on mandibular 3-dimensional printed models for maxillofacial surgical residents. *Br J Oral Maxillofac Surg* 2020 Oct ;**58**(8):953-8.
7. Mousoulea S, Kloukos D, Sampaziotis D, Vogiatzi T, Eliades T. Condylar resorption in orthognathic patients after mandibular bilateral sagittal split osteotomy: a systematic review. *Eur J Orthod* 2017 Jun 1;**39**(3):294-309.
8. Wu TY, Denadai R, Lin HH, Ho CT, Lo LJ. The outcome of skeletofacial reconstruction with mandibular rotation for management of asymmetric skeletal class III deformity: A three-dimensional computer-assisted investigation. *Sci Rep* 2019 Sep 16;**9**(1):1-3.
9. Hoffmannová J, Foltán R, Vlk M, Klíma K, Pavlíková G, Bulik O. Factors affecting the stability of bilateral sagittal split osteotomy of a mandible. *Prague Med Rep* 2008;**109**(4):286-97.
10. Paunonen J, Svedström-Oristo AL, Helminen M, Peltomäki T. Quality of life several years after orthodontic-surgical treatment with bilateral sagittal split osteotomy. *Acta Odontol Scand* 2020 Jul;**78**(5):358-361.
11. Huang C, Chen Y-R. Orthodontic principles and guidelines for the surgery-first approach to orthognathic surgery. *Int J Oral Maxillofac Surg* 2015 Dec 1;**44**(12):1457-62.
12. Ferretti C, Reyneke JP. Mandibular, sagittal split osteotomies fixed with biodegradable or titanium screws: a prospective, comparative study of postoperative stability. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2002 May 1;93(5):534-7.
13. Van Bakelen NB, Boermans BD, Buijs GJ, Jansma J, Pruim GJ, Hoppenreijs TJ, Bergsma JE, Stegenga B, Bos RR. Comparison of the long-term skeletal stability between a biodegradable and a titanium fixation system following BSSO advancement—a cohort study based on a multicenter randomised controlled trial. *Br J Oral Maxillofac Surg* 2014 Oct 1;52(8):721-8.
14. Edwards RC, Kiely KD, Eppley BL. Fixation of bimaxillary osteotomies with resorbable plates and screws: experience in 20 consecutive cases. *J Oral Maxillofac Surg* 2001 Mar 1;**59**(3):271-6.
15. Al-Moraissi EA, Ellis E. Stability of bicortical screw versus plate fixation after mandibular setback with the bilateral sagittal split osteotomy: a systematic review and meta-analysis. *Int J Oral Maxillofac Surg* 2016 Jan 1;**45**(1):1-7.
16. Costa F, Robiony M, Zorzan E, Zerman N, Politi M. Stability of skeletal Class III malocclusion after combined maxillary and mandibular procedures: titanium versus resorbable plates and screws for maxillary fixation. *J Oral Maxillofac Surg* 2006 Apr;**64**(4):642-51.
17. Harada K, Enomoto S. Stability after surgical correction of mandibular prognathism using the sagittal split ramus osteotomy and fixation with poly-L-lactic acid (PLLA) screws. *.J Oral Maxillofac Surg* 1997 May 1;**55**(5):464-8.
18. 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 Oct;**98**(4):386-97.
19. Edwards RC, Kiely KD, Eppley BL. The fate of resorbable poly-L-lactic/polyglycolic acid (LactoSorb) bone fixation devices in orthognathic surgery. *J Oral Maxillofac Surg* 2001 Jan;**59**(1):19-25.
20. Berköz Ö, Karaali S, Kozanoğlu E, Akalın BE, Çeri A, Barış Ş, Marşan G, Cura N, Emekli U. The relationship between fixation method and early central condylar

sagging after bilateral sagittal split ramus osteotomy in orthognathic surgery. *J Craniomaxillofac Surg* 2020 Oct;**48**(10):928-932.

21. Mavili ME, Canter HI, Saglam-Aydinatay B. Semirigid fixation of mandible and maxilla in orthognathic surgery: stability and advantages. *Ann Plast Surg* 2009 Oct;**63**(4):396-403.
22. Monson LA. Bilateral sagittal split osteotomy. *Semin Plast Surg* 2013 Aug;**27**(3):145-8.
23. Maurer P, Holweg S, Knoll WD, Schubert J. Study by finite element method of the mechanical stress of selected biodegradable osteosynthesis screws in sagittal ramus osteotomy. *Br J Oral Maxillofac Surg* 2002 Feb;4**0**(1):76-83.
24. Mazzonetto R, Paza AO, Spagnoli DB. A retrospective evaluation of rigid fixation in orthognathic surgery using a biodegradable self-reinforced (70L: 30DL) polyactide. *Int J Oral Maxillofac Surg* 2004 Oct;**33**(7):664-9.
25. Matthews NS, Khambay BS, Ayoub AF, Koppel D, Wood G. Preliminary assessment of skeletal stability after sagittal split mandibular advancement using a bioresorbable fixation system. *Br J Oral Maxillofac Surg* 2003 Jun;**41**(3):179-84.
26. Landes CA, Ballon A. Skeletal stability in bimaxillary orthognathic surgery: P (L/DL) LA-resorbable versus titanium osteofixation. *Plast Reconstr Surg* 2006 Sep;**118**(3):703-21. Discussion 722.
27. Costa F, Robiony M, Sembronio S, Polini F, Politi M. Stability of skeletal Class III malocclusion after combined maxillary and mandibular procedures. *Int J Adult Orthodon Orthognath Surg* 2001 Jan 1;**16**(3):179-92.
28. Kallela I, Laine P, Suuronen R, Iizuka T, Pirinen S, Lindqvist C. Skeletal stability following mandibular advancement and rigid fixation with polylactide biodegradable screws. *Int J Oral Maxillofac Surg* 1998 Feb;**27**(1):3-8.

[DOI: 10.52547/wjps.11.2.46]