Postoperative relapse after bilateral sagittal split osteotomy of the mandible for correction of dentofacial deformity: Is it common?

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Aim

To investigate the effect of the magnitude of mandibular movement during bilateral sagittal split osteotomy (BSSO) on the incidence of postoperative relapse.

Patients and methods

The present cohort study included patients presented to the Maxillofacial Unit, General Surgery Department, Assiut University Hospital, Egypt. All patients underwent BSSO to correct class II malocclusion. Patients were divided into two groups, the first group included patients with mandibular movement less than 7 mm and the second group included patients with mandibular movement more than 7 mm. Then, we investigated the incidence of postoperative relapse in both groups.

Results

The study included 32 patients (64 sides). The first group included 24 patients (48 sides) and the second group included eight patients (16 sides). The incidence of postoperative relapse is 12.5%.

Conclusion

magnitude of mandibular movement more than 7 mm during BSSO is considered to be a risk factor for postoperative relapse.

Keywords:
bilateral sagittal split osteotomy, dentofacial deformity, orthognathic surgery, postoperative relapse

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Introduction

A dentofacial deformity is an imbalance of the position, size, shape, or orientation of the bones that comprise the upper and lower jaws. Dentofacial deformities requiring surgery exist in about 2% of the population [1].

Dentofacial deformities can be classified into 'dental deformities' that exist because the teeth are abnormally related to each other; 'skeletal deformities' that exist due to abnormalities in the mandible and/or the maxilla regarding their vertical or transverse dimensions, or may be mixed 'skeleto-dental deformities' [2].

Until the early 1950s, the correction of most of the dentofacial deformities was concentrated in the dentition. Orthodontists were left with the burden of correcting the disproportion of dental and jaw relationship by dental manipulations alone, which was not enough to restore the normal anatomical and functional relationships between the upper and lower jaws. This creates the need for surgical intervention [3]. Orthognathic surgery involves surgical correction of the components of the facial skeleton to restore the proper anatomical and functional relationship in patients with dentofacial skeletal deformities using mandibular and maxillary osteotomies [4].

An important component of orthognathic surgery is the bilateral sagittal split osteotomy (BSSO), which is the most commonly performed orthognathic surgery, either with or without upper jaw surgery. Indications for a bilateral sagittal split include horizontal mandibular excess, deficiency, and/or asymmetry. It is the most commonly performed procedure for mandibular advancement and can be used for a mandibular setback [5].

The benefits of BSSO include better masticatory, reduced temporomandibular joint pain, and improved facial esthetics [6,7].

Nowadays, BSSO has become one of the most preferred surgical techniques used to correct mandibular deformity and malocclusion. Because of the elective nature of BSSO, it is important to reduce the risk of complications as much as possible. So great attention is given in recent research to assess its outcomes and its most common complications, namely the postoperative relapse and neurosensory disturbance (inferior alveolar nerve injury) [8].

Patients and methods

This study includes 32 patients diagnosed with dentofacial deformities – class II or class III malocclusion visiting the maxillofacial surgery outpatient clinic in Assiut University Hospitals during the period between January 2014 and December 2018. Inclusion criteria: patients complaining of abnormal bite (functional complaint) or facial disproportion (esthetic complaint), who are diagnosed to have dentofacial deformities classified as class II or class III malocclusion deformity between the ages of 18 and 50 years.

Exclusion criteria: patients with age less than 18 years and more than 50 years, patients who have undergone previous mandibular surgery, patients with chronic temporomandibular joint disease, and patients with post-cleft palate surgery facial deformities.

Patients' assessment: history taking and clinical examination either extraoral examination for facial shape, facial profile, maxillary size, position and symmetry, mandibular size, position and symmetry and chin shape, position and symmetry. Intraoral examination (Figs 1 and 2) for the class of occlusion (occlusal deformity), overbite or crossbite, deep bite or open bite for all patients were done.

Standardization of facial medical photography and cephalometric radiograph, which is the main and standard imaging diagnostic tool. It helps in the diagnosis of the class of occlusion; the type of deformity whether dental, facial, or dentofacial; the site of deformity (mandible, maxilla, or both); define the treatment plan (setback or advancement); patient follow-up and diagnosis; and estimation of relapse if occurs.

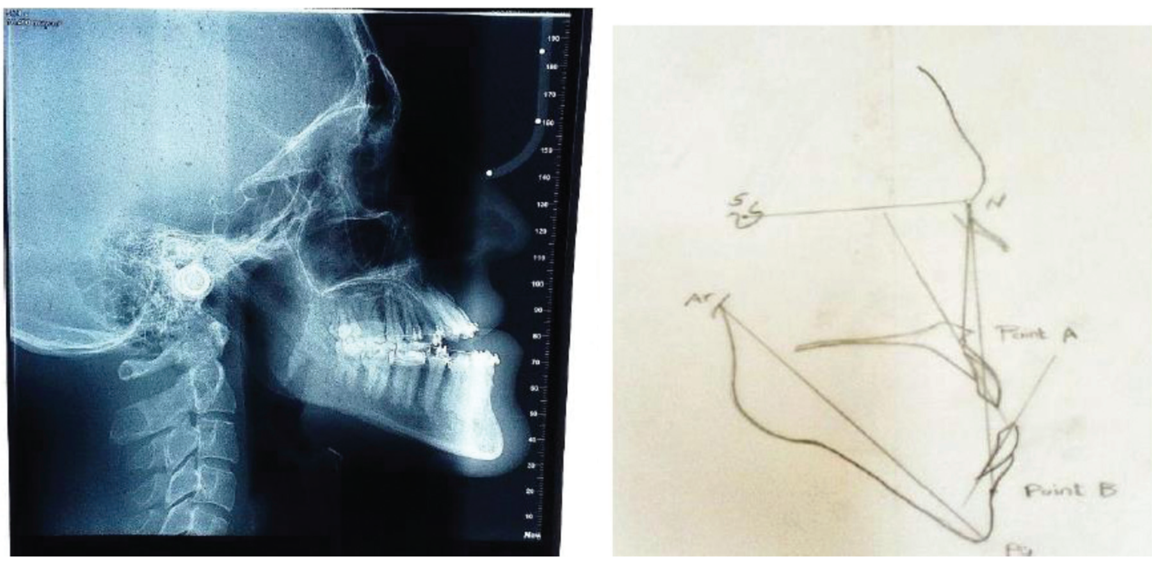
Panoramic radiograph and three-dimensional cone beam-computerized tomography that helps in assessing the deformity and the mandibular anatomy as the site of mandibular canal and site of the third molars.

Laboratory investigations: complete blood count, coagulation profile (prothrombin time and

Figure 1

Intraoral examination.

Figure 2



Cephalometry tracing and analysis.

concentration), liver function tests, kidney function tests, blood calcium level, random blood sugar, and hormonal profile (to exclude acromegaly).

Presurgical dental and orthodontic management: root canal treatment of carious teeth, dental scaling, management of periodontal and gingival problems, management of any intraoral infections by antibiotics covering aerobic and anaerobic microorganisms, besides fungal infections, extraction of unerupted or impacted teeth, especially the impacted third molars and persistence of good oral hygiene.

Prefabricated surgical splints: based on the result of clinical and cephalometric analyses, the patient problem is listed and a treatment plan is generated and applied by Mock surgery.

Patient counseling and consent: a formal written consent for the procedure, as well as for the need for medical photography, was explained to each patient and signed one day before the surgery and any inquiries, concerns, or doubts were discussed.

Operative technique

The operative technique was done according to the technique described by Trauner and Obwegeser in their original article in 1957 with Dal Pont modifications in 1961 [4,5].

An intraoral mucosal incision is made at the anterior border of the ramus and the external oblique mandibular ridge. A cuff of tissue should be preserved medial to the incision to facilitate closure.

Mucoperiosteal stripping buccally with partial elevation of the from the buccal side of the ramus. There was mucoperiosteal elevation at the lingual side of the ramus above the level of the lingula.

After completion of the soft tissue dissection, we start to perform the osteotomies. Using a fissure bur, starting at the lingual side of the mandibular ramus parallel to the occlusal plane and superior to the lingula, osteotomy starts from the posterior to the anterior horizontally in the ramus. The cut then turns downward along the external oblique ridge of the mandible to the level of the second molar. The final cut is then done vertically along the buccal surface at the level of the second molar down to the inferior border of the mandible. The cut must be made completely through the cortical bone till it reaches the inferior border. The osteotomy is then finished with small curved osteotomes; the curve of the osteotome should be directed buccally to avoid injury to the inferior alveolar bundle. It is important to insure that no twisting forces are utilized to prevent a bad split. As the split is opening, we check the position of the inferior alveolar nerve. Now, after the distal segment of the mandible has been completely free, the mandible is placed in the desired new position with the aid of prefabricated occlusal splints. If performing mandibular setback, the intervening bone is removed. The two segments are then fixed with a mini-plate and screws with three holes on either side of the osteotomy. The incisions are closed with absorbable sutures (e.g. 3/0 Vicryl) after copious irrigation and hemostasis.

Postoperative care and follow-up: all patients will be discharged with a set of instructions and a follow-up schedule.

The postoperative instructions include medical treatment with antibiotics against Gram-positive, Gram-negative, and anaerobic organisms for 10–14 days. Intensive oral hygiene is required by using mouthwash and teeth brushing. Nutrition based on soft diet and fluids for a month is recommended. Stop smoking if any. Stick to the follow-up schedule. Postoperative orthodontic management if needed to start after 4–6 weeks. The schedule of postoperative visits will be at 1 week, 1 month, 6 months, and 12 months postoperatively.

Factors to be assessed include mandibular position: SNB angle and mandibular length were assessed using a cephalogram. Maxillary position (if maxilla was operated upon): SNA angle was assessed using a cephalogram. type of occlusion: clinically and by cephalometry.

Statistical analysis

Statistical analysis was done using IBM SPSS statistics for windows, Version 21.0. Armonk, NY: IBM Corp. Statistical significance was accepted at a level of P value less than 0.05. Quantitative data was represented by mean and SD while qualitative data was represented by number and percentage. The study outcomes were analyzed using the χ^2 test.

Ethical considerations: this project was approved by the Committee of Medical Ethics, Faculty of Medicine, Assiut University.

Results

This study was conducted on 32 patients (64 sides); suffering from dentofacial deformities, visiting the outpatient clinic of the Maxillofacial Surgery Unit, Assiut University from January 2014 to December 2018.

Personal data: among them, 23 patients were females and nine were males. All patients were aged less than 30 years except two patients who were older than 30 years. Five patients were smokers and none was diabetic (Table 1, Figs 3 and 4).

Type of occlusion preoperative: of the 32 patients, 20 patients were suffering from class II malocclusion due to mandibular deficiency that needs mandibular advancement, while the other 12 patients suffered from class III malocclusion due to mandibular excess. They underwent mandibular setback (Table 2).

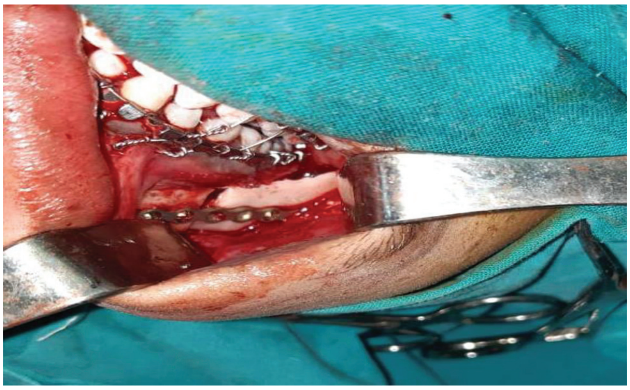
Type of surgical procedure: 16 patients underwent BSSO alone, while 12 patients underwent BSSO associated with LeFort I maxillary osteotomy and in four patients, BSSO was associated with subapical mandibular osteotomy (Table 3).

Overall incidence of postoperative complications (by side): permanent NSD – that lasts for more than 12 months – occurred in six sides out of the 64 sides. While postoperative relapse (that was diagnosed based on the follow-up of cephalometric parameters) occurred in eight sides (four patients). Wound infection happened on five sides during the whole period of follow-up. TMJ dysfunctions occurred as a permanent complication that lasted for more than 6 months in six sides (three patients) At the same time, no cases of osteomyelitis, nonunion of the osteotomy site, bending or fracture of the plates, nor airway obstruction were detected (Table 4, Figs 5 and 6).

Table 1 Personal data

	n (%)
Age (years)	
<30	30 (93.7)
>30	2 (6.3)
Sex	
Female	23 (71.9)
Male	9 (28.1)
Smoking	
No	27 (84.4)
Yes	5 (15.6)
Diabetes mellitus	
No	32 (100)
Yes	0

Figure 3



Fixation in the new position by miniplates and screws.

Table 2 Patients' classes of occlusion

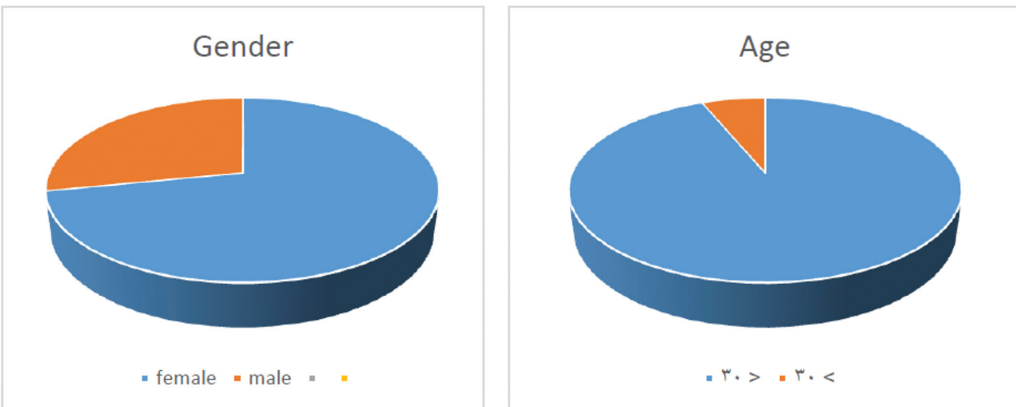
Class of occlusion	*n* (%)
Class II malocclusion	20 (62.5)
Class III malocclusion	12 (37.5)

Table 3 Type of surgical procedure

Procedure	*n* (%)
BSSO alone	16 (50)
BSSO+LeFort I osteotomy	12 (37.5)
BSSO+mandibular subapical osteotomy	4 (12.5)

BSSO, bilateral sagittal split osteotomy.

Figure 4



Age and sex distribution.

Postoperative relapse

Relapse according to follow-up time: postoperative relapse means a change in the occlusal relationship between the mandible and the maxilla that has gained after the surgery, or a change in the SNB angle of more than 2°.

The incidence of relapse according to follow-up time among the study group was as follows:

Table 5

Variables that may affect postoperative relapse:

The effect of age on relapse: our patients were divided into two groups according to the age to study the effect of age on relapse. It was observed that there is no statistically significant difference between the two groups with *P* value of 0.435 (Table 6, Fig. 7).

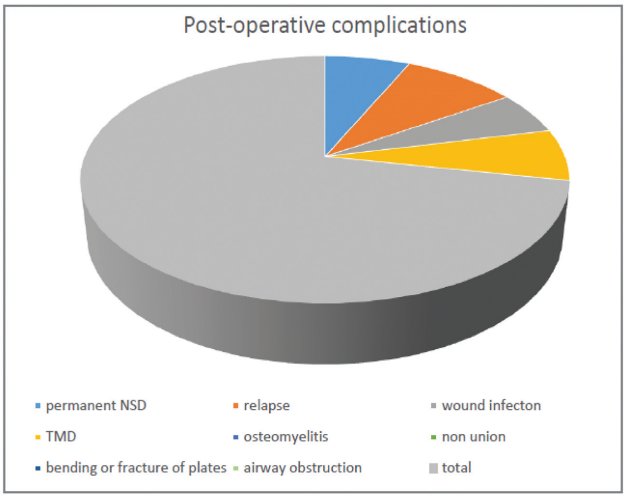
The effect of sex on relapse: to study the effect of sex on relapse, a study was done comparing the two groups (females and males). No statistically significant difference was found between the two groups (P=0.141) (Table 7, Fig. 8).

	Age		Sex		Direction of movement		Magnitude of movement	
	<0	>30	Male	female	Advancement	Setback	<7 mm	>7 mm
Relapse	8	0	4	4	6	2	2	6
No relapse	52	4	14	42	34	22	46	10
Total	60	4	18	40	40	24	48	16
Significance	Nonsignificant		Nonsignificant		Nonsignificant		Significant	

Table 4 Incidence of postoperative complications

Postoperative complications	*n* (%)
Permanent neurosensory disturbance	6 (9.4)
Relapse	8 (12.5)
Wound infection	5 (7.813)
TMJ dysfunction osteomyelitis	6 (9.4)
Nonunion	0
Bending or fracture of plates	0
Airway obstruction	0
Total	19 (29.687)

Figure 5



Postoperative complications.

Table 5 Relapse according to follow-up time

Follow up time	*n* (%)
T1 (48 h postoperative)	0
T2 (1-month postoperative)	2 (3.125)
T3 (6-month postoperative)	8 (12.5)
T4 (1-year postoperatively	8 (12.5)
Total	8 (12.5)

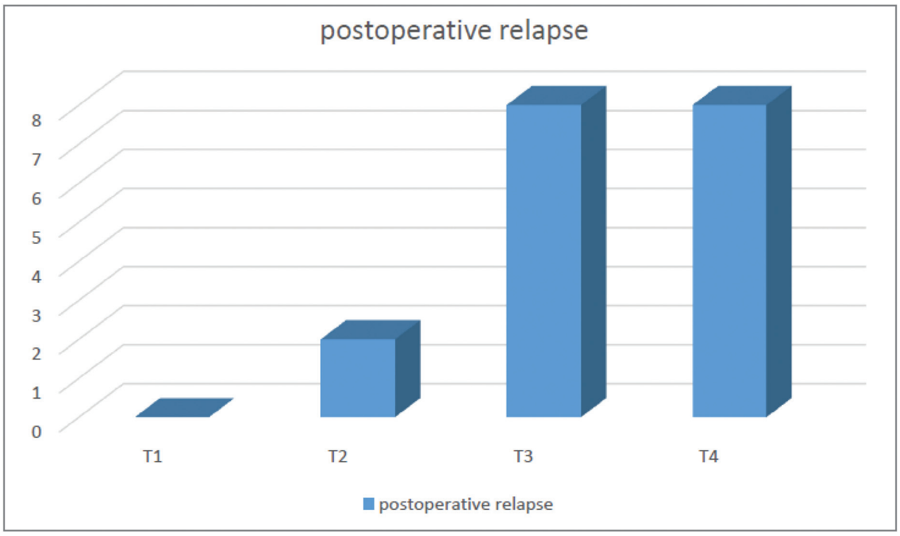
Table 6 The effect of age on relapse

Age	Relapse	No relapse	Total
<30 years	8	52	60
>30 years	0	4	4
Total	8	56	64

The effect of the direction of mandibular movement on relapse: to investigate the effect of the direction of mandibular movement on relapse, the patients were divided into two groups. The first group includes patients undergoing mandibular advancement and the second group includes patients undergoing mandibular setback. No statistically significant difference was found with *P* value of 0.435 (Table 8, Fig. 9).

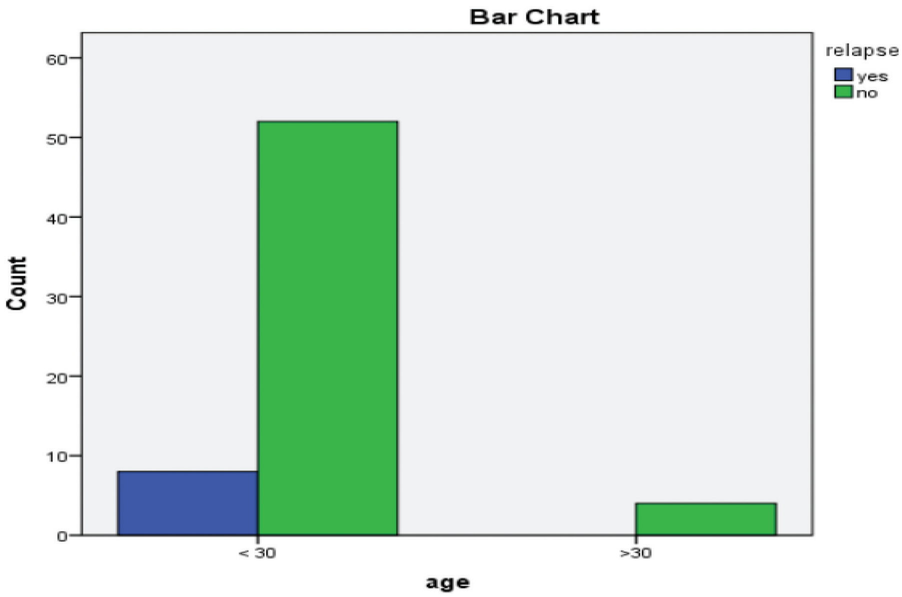
The effect of the magnitude of mandibular movement on relapse: to investigate the effect of the magnitude of mandibular movement on relapse, all patients were

Figure 6



Incidence of postoperative relapse according to the time of follow-up.

Figure 7



Bar chart showing the effect of age on relapse.

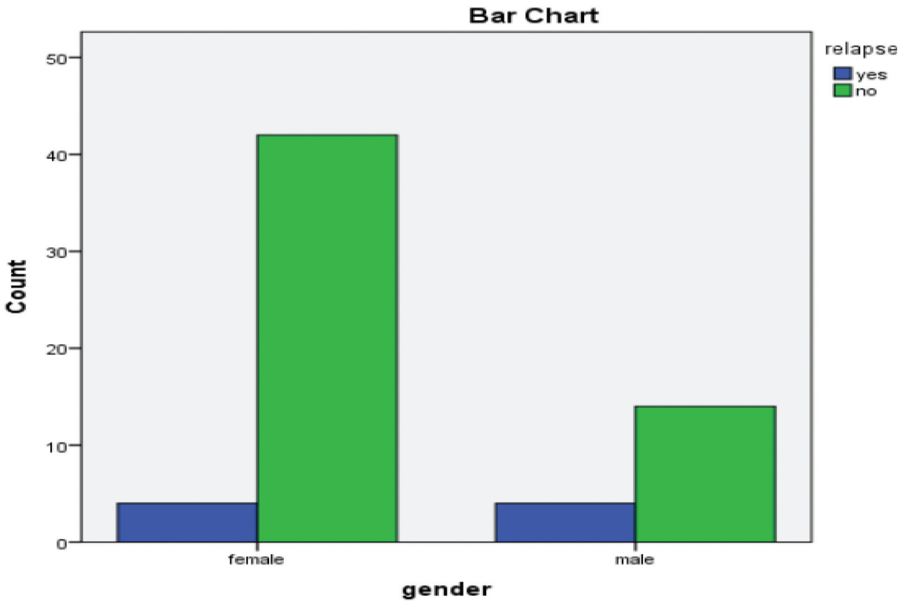
Table 7 Effect of sex on relapse

Sex	Relapse	No relapse	Total
Female	4	42	46
Male	4	14	18
Total	8	56	64

Table 8 Effect of the direction of mandibular movement on relapse

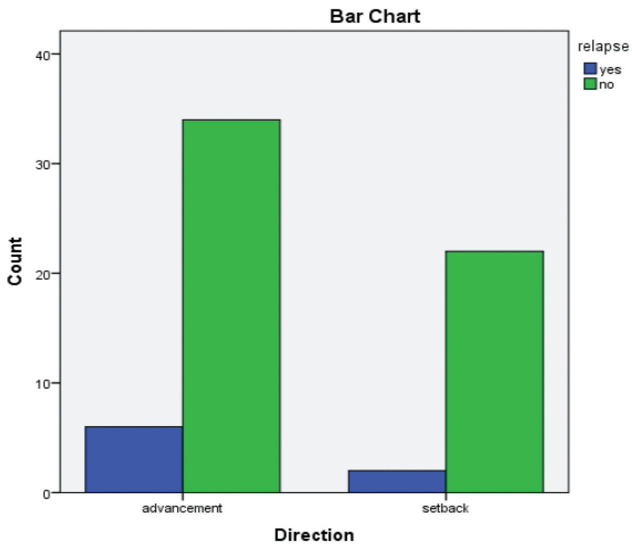
Direction of mandibular movement	Relapse	No relapse	Total
Mandibular advancement	6	34	40
Mandibular setback	2	22	24
Total	8	56	64

Figure 8



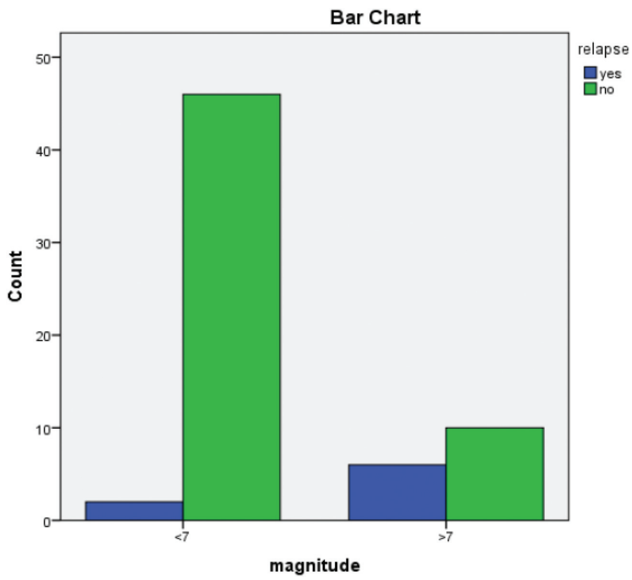
Bar chart showing the effect of sex on relapse.

Figure 9



Bar chart showing the effect of direction of mandibular movement on relapse.

Figure 10



Bar chart showing the effect of the magnitude of mandibular movement on relapse.

Table 9 Effect of the magnitude of mandibular movement on relapse

Magnitude of mandibular movement	Relapse	No relapse	Total
<7 mm	2	46	48
>7 mm	6	10	16
Total	8	56	64

divided into two groups. The first group includes patients having mandibular movement for a distance of less than 7 mm, while the second group includes patients having mandibular movement for a distance of more than 7 mm. Among the first group (48 patients), only two patients suffered from permanent NSD, while the second group contained six patients, who suffered from NSD. There is a statistically significant difference between the two groups (*P*=0.001) (Table 9, Fig. 10).

Case presentations

Case 1

Pre-operative:

Preoperative imaging studies:

Preoperative orthodontic management and Mock surgery:

Intraoperative:

Post-operative:

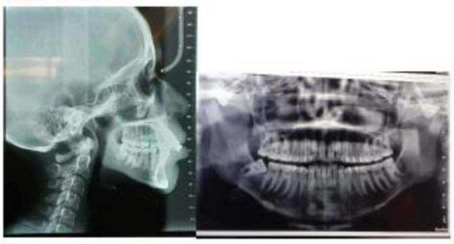
Preoperative VS Postoperative:

Pre -operative post -operative

Case 2

Preoperative:

Preoperative imaging:



Intraoperative:

Postoperative:

Preoperative VS Postoperative:

Pre -operative post -operative

Discussion

BSSO is an orthognathic procedure used to correct mandibular deformities. It is the most common mandibular surgical procedure used to correct class II and class III malocclusion [5]. This study aims at investigating the occurrence of relapse after BSSO compared with other research.

Despite technical advances and improved osteosynthesis materials, there is still a degree of skeletal relapse after mandibular setback surgery. It also has been reported that the relapse rates following mandibular setback surgery are among the highest for any surgical procedure [9]. In this study, we found that an incidence of relapse after 12 months equals 12.5% of all patients. This corresponds to the results obtained by Den Besten and colleagues where they estimated the incidence of postoperative relapse by 10.9%. Higher incidences have been reported in other studies as by Freihofer and colleagues, Wolford and colleagues, and Huand and colleagues, where they found relapse in up to 25% of the cases. [10–12]. This variation in the result may be due to different surgical techniques as those studies were conducted in the 70 and 80s [13]. Previous studies have reported that early postoperative relapse (<6 months after surgery) is often associated with malpositioning of the condyles during surgery, causing condylar sag and subsequent unfavorable displacement of the mandible. Late postoperative relapse (>6 months after surgery), however, is often related to the amount of mandibular setback [14,15]. In the present study, most of the relapse cases that occurred after 6 months of the surgery mostly contributed to the large mandibular movement. Several potential factors are suggested to explain the cause of relapse, but the most important ones are the magnitude of mandibular movement and the method of fixation (either cortical screws or miniplates and screws) [16]. Regarding the method of fixation, we have standardized the miniplates and screws as the method of fixation in our study. Therefore, the method of internal fixation will not be included as a separate variable in our study. As regards the effect of age on the incidence of relapse, in our study, age seemed to have no significant effect on the incidence of relapse (P value between the two age groups=0.435). This result matches the study by Den Besten and colleagues, where age had no significant effect on the incidence of relapse. Other studies have shown that younger patients have been reported to have a higher risk of late relapse compared with adults as in the study by Proffit and colleagues. They explained this by the more powerful action of the masticatory muscles or the osteotomized segments [17]. Relapse and magnitude of mandibular movement: As regards the effect of the magnitude of mandibular movement on relapse, we found a significantly positive association between the magnitude of mandibular movement and postoperative relapse. We divided our patients into two groups, the first group includes patients who have undergone mandibular movement for less than 7 mm, while the other group included the patients who have undergone mandibular movement for more than 7 mm. A statistically significant difference has been found between the two groups with *P* value less than 0.001. Multiple authors have reported a significant positive correlation between the magnitude of mandibular advancement and relapse. Borstlap and colleagues identified a relationship between the amount of mandibular advancement and horizontal relapse in a multicenter prospective study involving 222 patients. They found that 35 (16%) patients had a clinically significant relapse [18]. Joss and Thuer [19] reported horizontal relapse and concluded that the amount of mandibular advancement positively correlated with long-term relapse. Similarly, Maal *et al.* [20] performed a three-dimensional cone beam-computed tomography analysis and found a positive correlation between mandibular advancement and skeletal relapse within 1 year after BSSO. The magnitude of mandibular advancement seems to be the most critical contributor to relapse. Joss and Vassalli ranked it to be most important risk factor. Tabrizi *et al.* [21] found that 74% of relapse was related to the magnitude of mandibular advancement. In agreement with their findings, we found that the most affecting independent variable on relapse was the magnitude of mandibular movement [22]. The inherent instability of large advancement is often attributed to the smaller cross-sectional area of bone contact between mandibular segments [23]. In our study, to increase this area of bone contact after osteotomy, we performed the Dal Pont modification of osteotomy, thus decreasing the incidence of relapse.

Summary

BSSO is the most common orthognathic surgical procedure done for the correction of mandibular deformities. However, it is claimed to be associated with certain complications. The most common complications are inferior alveolar nerve neurosensory disturbance, postoperative relapse, wound infection, osteomyelitis, nonunion of the osteotomized segments, and airway obstruction.

This prospective study included 33 patients diagnosed with dentofacial deformities – class II or class III malocclusion – that will be operated upon through BSSO. Then, each patient will be assessed on four occasions to demonstrate the postoperative relapse. The follow-up intervals are T1 (48 h postoperative), T2 (1-month postoperative), T3 (6-month postoperative), and lastly T4 (1-year postoperative). At the end of the study, the incidence of relapse is 12.5%. The most contributing risk factors for postoperative relapse were the increased age of the patient and the increased magnitude of mandibular movement.

Conclusion

BSSO is an ideal orthognathic procedure that can be used for both mandibular advancement and setback. It is associated with some complications that can be diminished by avoiding the leading risk factors as avoiding older age groups (good patient selection) and avoiding large mandibular movements by utilizing the bimaxillary orthognathic approach.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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