Use of Bone Grafts or Modified Bilateral Sagittal Split Osteotomy Technique in Large Mandibular Advancements Reduces the Risk of Persisting Mandibular Inferior Border Defects

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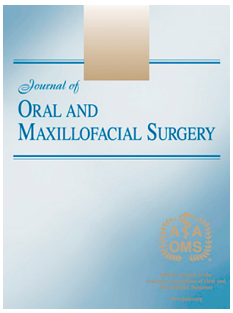

"The Use Of Bone Grafts Or Modified BSSO Technique In Large Mandibular Advancements Reduces The Risk Of Persisting Mandibular Inferior Border Defects"

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"The Use Of Bone Grafts Or Modified BSSO Technique In Large Mandibular Advancements Reduces The Risk Of Persisting Mandibular Inferior Border Defects."

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Abstract

Purpose

Healing of the inferior border of the mandible may be compromised in large advancements, leaving an unaesthetic defect at the inferior border. The objective of this article is to compare different bilateral sagittal split osteotomy (BSSO) techniques in order to prevent the incidence of lower border mandibular defects.

Patients and Methods

The authors undertook a retrospective multicenter cohort study comparing three BSSO techniques for advancements greater than 5 millimeters: **Traditional Non-Grafted BSSO Technique (group A), Traditional Grafted BSSO Technique (group B) and Modified BSSO Technique (group C).** The space created by the mandibular advancement was measured. The presence or absence of a defect was determined one year post-surgery by clinical and radiographic assessment. The bone defect outcome was associated with potential risk predictors (age, sex, side of sagittal split osteotomy, and magnitude of mandibular advancement) by logistic regression analysis.

Results

A total of 1002 operative sites in 501 patients were included in the study. Age 26,8 SD (11), sex (310 female, 191 male) and mandibular advancement (9,3mm right side, 10mm left side) were similar between the groups. ($p>.05$) The proportion of

post-surgical lower border mandibular defects were: group A 54,5%, group B 1,3% and group C 10,6%. The Traditional Grafted BSSO Technique, and Modified BSSO Technique were significantly more effective in preventing the incidence of mandibular lower border defects compared with Traditional Non-Grafted BSSO Technique. (*p<.05)*

Conclusion

Surgeons are advised that there is a significant proportion of mandibular lower border defects with the Traditional Non-Grafted BSSO Technique.

The use of bone grafts or the modified BSSO technique in mandibular advancements greater than 10 mm significantly reduces the risk of persisting mandibular inferior border defects.

Introduction

The bilateral sagittal split osteotomy (BSSO) is the most widely used technique in mandibular orthognathic surgery. It allows mandibular movements in the sagittal, vertical and transversal directions, obtaining good results with limited complications.(1-3) In a BSSO, the mandibular body is separated from the proximal fragment and moved to the planned position, creating a gap between segments. The size of this space is proportional to the advancement and/or mandibular rotation movements required by the patient's maxillomandibular discrepancy. Healing of these surgeries usually proceeds without complications, but in some cases a persistent defect occurs in the osteotomy site at the inferior border.(4) Though not widely described, this complication can be a visible and/or palpable defect along the inferior border of the mandible, commonly leading to patient complaints. The prevention of mandibular lower border defects is an important issue in planning a BSSO.

Agbaje et al. described a modified BSSO technique that reduces the incidence of mandibular lower border defects.(5) Other authors use the traditional BSSO technique in grafting the advancement gap, but there is no evidence of the reduction on the incidence of mandibular lower border defects.

The purpose of this study was to compare different BSSO techniques in order to reduce the incidence of lower border mandibular defects. The investigators hypothesize that the use of bone grafts or the modified BSSO technique in mandibular advancements reduces the risk of persisting mandibular inferior border defects. The specific aims of the study were to estimate and compare the incidence of lower mandibular defects in three different groups: Traditional Non-

Grafted BSSO Technique, Traditional Grafted BSSO Technique and Modified BSSO Technique.

Materials and Methods

Study Design and Sample

To address the research purpose, the investigators designed and implemented a retrospective multicenter cohort study comparing three different BSSO techniques: Traditional Non-Grafted BSSO Technique (group A), Traditional Grafted BSSO Technique (group B) and Modified BSSO Technique (group C).

The study population was composed of all patients who underwent BSSO advancements at a) Clínica Alemana de Santiago, Chile, between January 2009 and August 2014, b) St John's Hospital in Genk, Belgium, between July 2012 and March 2013, and c) the University Hospital of Leuven (UZ Leuven) in Leuven, Belgium, between January 2013 and September 2014. There was not determining factor and no randomization in choosing the BSSO technique in each case.

The protocol study was previously approved by the respective ethics committee.

To be included in the study sample, patients requiring orthognathic surgery (maxillomandibular surgery or mandibular surgery only), with correction of mandibular retrognathism by means of symmetrical or asymmetrical mandibular advancements greater than 5 millimeters. Patients were excluded as study subjects if bad splits were reported during the BSSO or if they presented a medical condition that may impact in surgery results. (diabetes, kidney disorders or an immunocompromised condition).

Study Variables

The primary predictor variable was the BSSO technique. Three groups were defined: **Traditional Non-Grafted BSSO Technique (group A), Traditional Grafted BSSO Technique (group B) and Modified BSSO Technique (group C).**

Group A was comprised of all patients that received traditional BSSO and no grafting of the gap between segments. No modified BSSO technique was performed in this group.

Group B patients were all treated with traditional BSSO and grafting with Puros particulate allograft ® plus platelet-rich plasma (PRP) in the gap between fragments, with a collagen membrane (Collatape®) as graft protection.

(Figure 1, 2, 3)

Group C patients were all treated with modified BSSO technique described by Agbaje et al. (5) and no grafting of the mandibular gap.

In all three groups two straight plates with four monocortical screws on each side of the sagittal split osteotomy were installed.

The study's primary outcome was the presence of an inferior mandibular border defect. The criteria for diagnosing these defects included one of the following: 1) a visible or palpable defect that caused patients discomfort, 2) a defect that required correction in a second surgical intervention, 3) a conspicuous defect evaluated in the panoramic image one year post-surgery that was not present in the preoperative image and which presented itself as a clear alteration in the continuity of the inferior border that caused patients discomfort.

Inferior border irregularities or increased radiolucency without cortical discontinuation was not considered pathologic in the absence of subjective

complaints. The evaluators were calibrated in each medical center by the observation of clinical images of patients with and without mandibular osseous defects and panoramic radiographs with and without mandibular defects.

Other variables described previously as potential risk predictors by Agbaje were registered. (age, sex, magnitude of the mandibular advancement and side of the sagittal split osteotomy. The advancement after BSSO was determined from standardized linear measurements made on panoramic radiographs taken between week 1 and 3 postoperatively. (4)

Modified BSSO technique (5)

The sagittal osteotomy of the inferior border is executed with a standard Mectron Piezosurgery insert (OT7; Mectron, Carasco, Italy). After completion of the vertical cut through the outer cortex of the mandible at the level somewhere between the first and second molar, a bevel is made—with a round drill—medial to the vertical cut at the inferior border of the mandible to allow the placement of the piezosurgery insert as parallel to the inferior border as possible. The piezosurgery insert is placed against the bevel and is gently driven into the inferior border with the purpose to divide the inferior border into a lingual side and a buccal side. Care needs to be taken not to drive the tip too lingually. The tip is inserted until the first black dot disappears in the bone, which is at a depth of about 7 to 10 mm. This allows the initiation of an inferior border split in which the lingual border at the gap remains in the tooth-bearing fragment, whereas the buccal side of the inferior

border remains part of the buccal fragment (proximal segment), avoiding the emergence of an unfavorable split

Data Collection Methods

Data were extracted from the clinical records and images of the patients who met the selection criteria following the protocols of anonymization, protection, confidentiality and information security according to parameters established by the Office of Extrainstitutional Research of the National Institutes of Health (NIH). An anonymous database was created, using codes to protect the identity of patients.

Data Analyses

Continuous variables were described by mean and standard deviation, categorical variables were described using frequencies and proportions. The bone defect outcome was associated with risk predictors by logistic regression analysis. A bone defect prognostic model based on the logistic regression analysis was obtained evaluating capacity of discrimination by the area under the ROC curve. By weighing the value of the variables involved in the model by their respective Odds Ratio and the evaluation of the sensitivity and specificity, a prognostic score was obtained. A significance of 5% was considered and all statistical analyses were performed using Stata Statistical Software (Release 14. College Station, TX: StataCorp LP.)

Results

The results are summarized in Table 1. A total of 1002 operative sites in 501 patients were included in the study (Age, sex and mandibular advancement were similar between the groups *p>.05*). The proportion of post-surgical lower border mandibular defects were: group A 54,5%, group B 1,3% and group C 10,6%. All mandibular defects that we consider in this study produced clinically alteration in the continuity of the inferior border (visible or palpable defect) that caused patients discomfort with a radiographic correlation. (See criteria for diagnosing mandibular border defects in Material and Methods section). Traditional Grafted BSSO Technique, and Modified BSSO Technique were significantly superior in preventing the incidence of mandibular lower border defects compared with Traditional Non-Grafted BSSO Technique. (*p<.05)*

Traditional Grafted BSSO Technique was superior to Modified BSSO Technique in preventing mandibular lower border defects. Additionally, the length of the advancement and age increased the risk of a persisting osseous defect of the inferior border at the osteotomy gap after BSSO (*p<.05), see Table 2, 3 and 4.*

The rate of infection was similar between groups: Traditional Non-Grafted BSSO Technique 5%, Traditional Grafted BSSO Technique 6, 5% and Modified BSSO Technique 5, 3%. (*p>.05)*

Discussion

The main purpose of this article was to identify and compare different BSSO techniques in minimizing inferior mandibular defect. We hypothesize that the use of

bone grafts or the modified BSSO technique in mandibular advancements reduces the risk of persisting mandibular inferior border defects. The specific aims of the study were to estimate and compare the incidence of lower mandibular defects in three different groups: Traditional Non-Grafted BSSO Technique, Traditional Grafted BSSO Technique and Modified BSSO Technique.

Traditional Grafted BSSO Technique and Modified BSSO Technique presented significantly less incidence of mandibular lower border defects compared with Traditional Non-Grafted BSSO Technique. The magnitude of the mandibular advancement and the age of the patients increased significantly the risk of mandibular defects. The sex and the site of the BSSO were not associated with increased risk of mandibular defects.

Agbaje et al. studied 400 post-op sites in 200 patients, and reported post-surgical defects in over a third of the sites (Traditional BSSO). The risk factors reported were: total inclusion of the inferior border in one or the other fragment of the BSSO, the scale of the mandibular advancement, and the patient's age.(4) This research group also reported recently a new modified BSSO technique (same modified technique was studied in the present article) that reduced significantly the risk of mandibular lower border defects.(5) The article included 408 surgical sites with modified BSSO technique in 204 patients in which the lingual border at the gap remained in the tooth-bearing fragment; whereas, the buccal side of the inferior border remained part of the buccal fragment (proximal segment). The modified technique prevents that the full thickness of the lower border from being included in

the buccal fragment. (5) The results of this study showed that in cases in which the advancement is more than 10 mm and /or the patient is older than 30 years, the risk of mandibular defect increased significantly. These results are concordant with our study using the bone defect prognostic model described in study variables (materials and methods). They confirmed previous findings that identified the magnitude of the mandibular advancement and the age of the patients as risk factors. In fact, only three grafted surgical sites (1% of the total grafted sites included) on two patients showed inferior border defects in their 1-year postoperative panoramic images.

The first patient was a 30-year-old man who had presented with a left inferior border defect from a Class II skeletal deformity. The post-surgical bone gap at the inferior border on both sides was 11.5 mm with a CCW rotation of 6.7 degrees. The second patient, a 39-year-old woman with a Class II skeletal deformity, presented with bilateral defects (Figure 4). The inferior border post-surgical bone gap was 7.3 mm on the right side and 11.6 mm on the left side, with a counterclockwise rotation of 11.2 degrees. Both patients presented the all three risk factors: a) age, b) magnitude of the advancement, and c) the full thickness of the lower border included in the buccal fragment.

Currently, until this article, there was no evidence or report that compared the use of grafted BSSO versus no grafted BSSO or modified BSSO. Our results showed

that traditional grafted BSSO technique, and modified BSSO technique were significantly superior in preventing the incidence of mandibular lower border defects compared with traditional non-grafted BSSO technique. Grafted BSSO technique presented the lowest proportion of mandibular notching complications. This technique is not technically complex, but the main disadvantages of grafting the mandibular osteotomies are increased surgical time and costs. On the other hand, the modified BSSO technique is another excellent alternative that showed good results, but one may need more surgical training in order to perform the technique properly, and the incidence of mandibular defects is higher than in the grafted BSSO technique. In our protocol we used particulate allograft bone, PRP and collagen membranes in the grafted BSSO group. We find it straightforward to manipulate, with predictable results when it is properly applied. Additionally, it avoids taking a graft from a donor site, thereby reducing morbidity while still obtaining successful results. The dental and maxillofacial literature speaks widely on the use of collagen membrane as a protective barrier for bone grafts (6, 7) showing that the use of membranes is associated with lower resorption rates for particulate grafts, because the membrane acts as a barrier to keep the graft in place during the healing process.(8, 9)

The literature describes a 7% of infection rate after orthognathic surgery. Studies show that risk factors that may be associated with a higher incidence of infection after orthognathic surgery include longer surgery; short-term antibiotic prophylaxis; extraction of a third molar during surgery; greater number of osteotomies performed; older age; smoking; poor oral hygiene; and a compromised immune

system. (10) Our findings showed similar rate of infection to those described in the literature. In this study the grafted group was associated with a higher incidence of infection 6,5%. However the differences were not significant with Traditional Grafted BSSO Technique (5%) and Modified BSSO Technique(5,3%).

The weaknesses of this study are those associated with any observational multicenter study. Additionally, other variables that could play an important role in choosing which BSSO technique to perform were not analyzed in this article (general complications, surgery duration, bad splits, and costs). It would be desirable to perform a randomized clinical trial incorporating the mentioned variables in order to confirm the results, recommendations and to reduce risk of bias. Neverthenless, we believe that due previous findings and the considerable sample size studied, it is unlikely to find significant variations in future results.

In conclusion, the use of bone grafts or the modified BSSO technique in mandibular advancements significantly reduces the risk of persisting mandibular inferior border defects. Both BSSO techniques are appropriate to reduce complications of lower mandibular healing.

Reference

1. Dimitroulis G. A simple classification of orthognathic surgery complications. Int J Adult Orthodon Orthognath Surg. 1998;13(1):79-87.

2. Steel BJ, Cope MR. Unusual and rare complications of orthognathic surgery: a literature review. J Oral Maxillofac Surg. 2012;70(7):1678-91.

3. Kim SG, Park SS. Incidence of complications and problems related to orthognathic surgery. J Oral Maxillofac Surg. 2007;65(12):2438-44.

4. Agbaje JO, Sun Y, Vrielinck L, Schepers S, Lambrichts I, Politis C. Risk factors for the development of lower border defects after bilateral sagittal split osteotomy. J Oral Maxillofac Surg. 2013;71(3):588-96.

5. Agbaje JO, Gemels B, Salem AS, Anumendem D, Vrielinck L, Politis C. Modified Mandibular Inferior Border Sagittal Split Osteotomy Reduces Postoperative Risk for Developing Inferior Border Defects. J Oral Maxillofac Surg. 2016;74(5):1062.e1-9.

6. Louis PJ. Bone grafting the mandible. Oral Maxillofac Surg Clin North Am. 2011;23(2):209-27, v.

7. Hammerle CH, Jung RE, Yaman D, Lang NP. Ridge augmentation by applying bioresorbable membranes and deproteinized bovine bone mineral: a report of twelve consecutive cases. Clin Oral Implants Res. 2008;19(1):19-25.

8. Rasmusson L, Meredith N, Kahnberg KE, Sennerby L. Effects of barrier membranes on bone resorption and implant stability in onlay bone grafts. An experimental study. Clin Oral Implants Res. 1999;10(4):267-77.

9. Stavropoulos F, Dahlin C, Ruskin JD, Johansson C. A comparative study of barrier membranes as graft protectors in the treatment of localized bone defects. An experimental study in a canine model. Clin Oral Implants Res. 2004;15(4):435-42.

10. Brignardello-Petersen R, Carrasco-Labra A, Araya I, Yanine N, Cordova Jara L, Villanueva J. Antibiotic prophylaxis for preventing infectious complications in orthognathic surgery. Cochrane Database Syst Rev. 2015;1:Cd010266.

Figure 1. Collagen membrane (Collatape®) in the lower border of the jaw to support the graft.

Figure 2. Puros particulate allograft ® plus platelet-rich plasma (PRP) in the gap between fragments.

Figure 3. Puros particulate allograft ® plus Collagen membrane (Collatape®).

Figure 4. Panoramic view. 39-year-old woman with bilateral lower mandibular border defects 1 year after surgery.

Table 1	Group A Traditional Non-Grafted BSSO Technique	Group B Traditional Grafted BSSO Technique	Group C Modified BSSO Technique	Total	p value
Age	27,6 SD (10.9)	25,8 SD (9,4)	26,6 SD (12.6)	26,8 SD (11)	p>.05
Gender	Female 124 Male 76	Female 89 Male 61	Female 97 Male 54	Female 310 Male 191	p>.05

Table 2	No Defect	Defect	Total		
Advancements mean	Right 10,4mm Left 11,6 mm	Right 8,2 mm Left 9,2mm	Right 9,3 mm Left 9,3 mm	Right 9,3 mm Left 10 mm	p>.05
Total Patients	200	150	151	501	

Table 3	No Defect	Defect	p value
Age	24,9 SD(10,4)	**32 SD(11,5)**	26,8 SD (11)
Gender	149 male 225 female	42 male 85 female	191 male 310 female
Advancements mean	7,6 mm	**11,8 mm**	9,6 mm
Right Side BSSO	445	56	501
Left Side BSSO	388	113	501
Total Patients	374	127	501

Group A **Traditional Non-Grafted BSSO Technique**	91	109	**p<.05**
Group B **Traditional Grafted BSSO Technique**	148	2	p>.05
Group C **Modified BSSO Technique**	135	16	P>.05
Total	374	127	

Traditional Grafted BSSO Technique and Modified BSSO Technique were significantly superior in preventing the incidence of mandibular lower border defects compared with Traditional Non-Grafted BSSO Technique. (*p<.05) The results between Traditional Grafted BSSO Technique versus Modified BSSO were not statistically significant- (p>.0.5)*

Table 4	Odds Ratio	95% CI	P value
Group A **Traditional Non-Grafted BSSO Technique**	53	11.6-237.8	*p<.05*
Group B **Traditional Grafted BSSO Technique**	*Reference Group*	-	-
Group C **Modified BSSO Technique**	5	0.96-21.6	*p> .05*
Age	1.1	1.04-1.10	*p<.05*
Lenght advancement. Right Side (mm)	1.14	1.03-1.25	*p<.05*
Lenght advancement. Left Side (mm)	1.1	1 -1.2	*p<.05*