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Evaluation of neurosensory disturbance after using separators vs using chisels in bilateral sagittal split osteotomy

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Abstract---Aim: To evaluate neurosensory disturbance after using separators Vs chisels in bilateral sagittal split osteotomy. Methods: A total of (18 patients) 36 sides indicated for BSSO randomly assigned to 2 equal parallel groups; 9 patients (18 sides) treated using chisels (control group) and 9 patients (18 sides) were treated by separators (intervention group). The neurosensory disturbance was assessed for each side. Result: After one year follow up in separator group showed neurosensory dysfunction by 11.1% while chisel group showed 44.4%. Conclusion: The use of separators (splitting forceps and elevators) led to a low percentage of persistent post-operative neurosensory dysfunction.

Keywords---bilateral sagittal split osteotomy, neurosensory dysfunction, chisels and separator.

Introduction

The bilateral sagittal split osteotomy (BSSO) was first introduced by Trauner and Obwegeser. ¹ Several modifications of this technique was reported, resulting in easy and predictable technique for correcting mandibular skeletal deformities.²

BSSO is a classical surgical technique. ³ and it is the preferred technique of surgical correction for mandibular skeletal class III, class II, and asymmetry.⁴

Many factors in BSSO operation led to neurosensory dysfunction (NSD) that patients may experience postoperatively. Damage of the inferior alveolar nerve

(IAN) during BSSO may happen during medial mandibular ramus dissection and retraction near the lingula,⁵ during the osteotomy cuts through cortical bone, during the separation of proximal and distal segments, when it's necessary to free the IAN from the proximal segment, or when positioning and fixating the proximal segment to distal segment. The degree of mandibular advancement and it's subsequent IAN stretching also cause NSD.⁶

NSD is the most common complication after BSSO. It's related to the surgical anatomy of this operation. Transient or temporary NSD of the IAN, and the lingual nerves, are expected complication because of these nerves are in proximity to the surgical site. The reported incidence of NSD using chisels at 1 year follow up after a systematic review, was 12.8%.⁷

Persistent post-operative NSD of the IAN is still the most important complication of this operation. The incidence has decreased because of the improvement within the techniques and the use of various instruments. However, papers still report persistent NSD of the IAN in from 10% of the patients up to 48%.⁵

Many tests were reported for evaluating NSD of the IAN. One of the simple methods reported was the tactile test based on subjective sensation reported by the patients. Many authors used this method in their assessment of post-operative NSD⁸⁹ Although more complicated tests were reported, that needs expensive tools as electrophysiological tests which correspond well with subjective NSD alteration .⁵

Mensink in 2007, performed BSSO as reported by Hunsuck (1968), without the use of chisels. Splitting forceps and elevators were used. Splitting was done with an elevator positioned in the vertical bone cut and the splitting forceps in the horizontal bone cut. Once the superior aspect of the mandible started to open, the elevator was repositioned at the inferior end of the vertical cut and splitting was completed. ¹⁰

Mensink in 2012 described the use of separators in BSSO according to Hunsuck, without the use of chisels. Splitting forceps and elevators were used. The cuts were made with a Lindemann bur. The inferior border was cut perpendicularly through the inferior cortex till it reached the medial cortex. Splitting was performed using an elevator positioned in the vertical cut and the splitting forceps in the horizontal bone cut. Once the superior aspect of the mandible started to split, the elevator was placed at the inferior border of the vertical cut, and splitting was completed. A chisel was only used when a small bridge of bone remained between the buccal and lingual cortices. When the IAN remained in the proximal segment, it was carefully dissected by blunt instrument.

Peerasak in 2017, they performed BSSO according to Dalpont and they used a Dautrey osteotome which was inserted into the mandible medulla, the osteotome was inserted into buccal cortex for the first 10 mm. The osteotome, located anterior and lateral to the IAN, the osteotome was twisted with moderate force to separate the proximal segment from the distal segment.¹¹

Choi in 2018 performed BSSO technique referred as (manual twist splitting technique), similar to that performed by Peerasak where the technique uses splitting and cleavage instead of the classical use of malleting (hammer and osteotome) to avoid direct nerve injury caused using the osteotomes.¹²

The risk of NSD is a major consideration when performing BSSO. The incidence of transecting the IAN was reported between 2 to 3.5% and the incidence of long-term NSD was reported from 10 to 30% of the patients, symptomatic or not. When the sagittal split osteotomy was performed with genioplasty, incidence of NSD was 70% of all patients after one year. The incidence of NSD immediately surgery was 91%.^{13,14}

J. O. Agbaje in 2015 performed a systematic review on incidence of IAN injury in BSSO and the method of assessment for NSD. The methods of assessment of the incidence of NSD after BSSO was reported. Most neurosensory measurements were based on subjective feelings of sensation during an objective stimulus which explains the wide range of results. The crude method, and the use of poorly controlled testing stimuli, made it unlikely that different testing methods would lead to the same results for all individuals. The incidence of NSD was higher in reports employing subjective tests than when objective tests.¹⁵

According to Colella, the higher incidence of NSD reported by subjective tests means that subjective tests provided sensory impairments that do not appear in the objective tests. so subjective tests are not specific and not reproducible and provide false-positive results which make subjective tests less accurate for proper diagnosis of NSD. To increase diagnostic accuracy, objective tests for sensory disturbances are preferred.⁷

The minimum distance before the patient can determine two separate points, measured in millimeters. Variety of instruments were used for TPD test, a sharpened Boley gauge or calipers. This test assesses the quantity and density of functional sensory receptors. If sharp points are used, the small, myelinated A-Delta and unmyelinated C fibers are assessed. If blunt points are used, the larger myelinated A-Alpha fibers are assessed. The minimal distance with which the patient can discriminate between two points is found by moving from proximal to distal. This distance is named threshold for discrimination.¹⁶

Results

Percentages of TBD sharp and blunt was calculated for chisel group and separator group and classified to the groups, normal (0-5mm), almost normal (6-10mm), reduced sensation (11-15), almost numb (16-20) and numb (more than 20) at the follow up intervals one week, one month, 3 months, 6 months and one year and their average was calculated.

NSD in this study will include the 3 groups reduced sensation, almost numb and numb, after one year, separators showed 5.5% in reduced sensation group while chisels showed 5.5% in almost numb group.

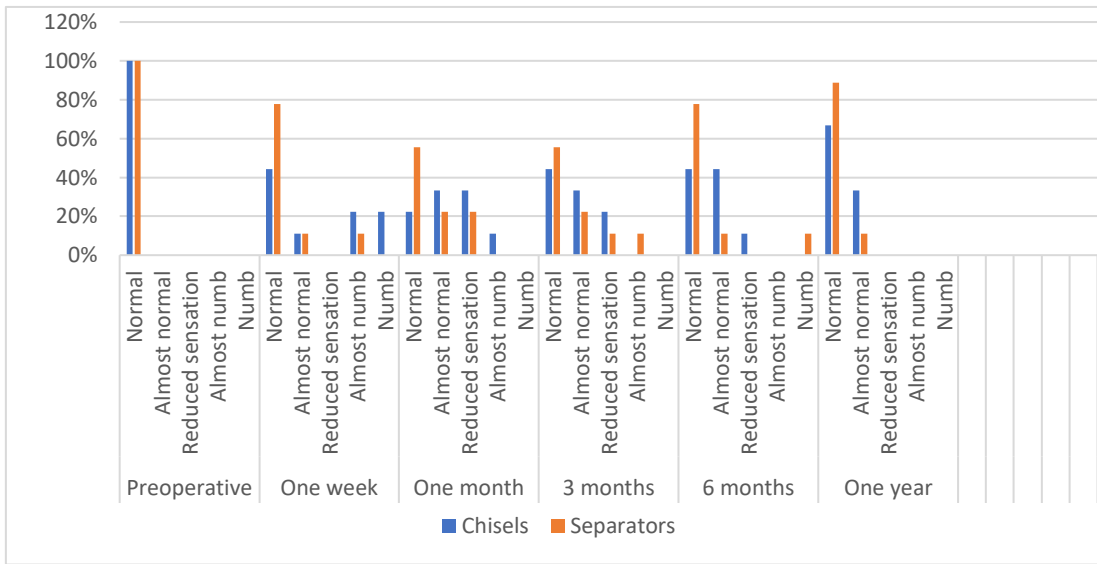


Figure 1: Bar chart showing percentage of two points' discrimination (Sharp) for different group.

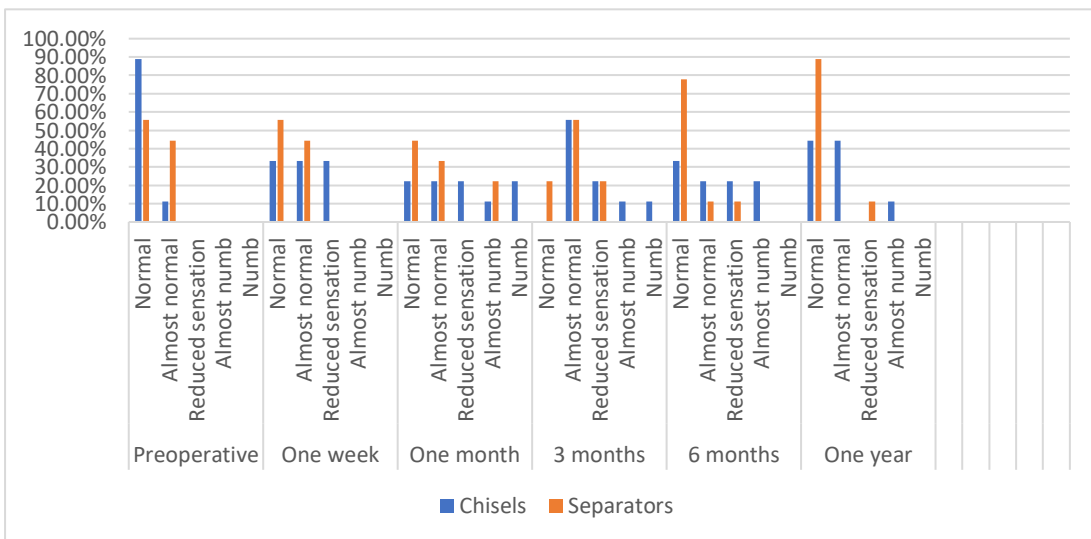


Figure 2: Bar chart showing percentage of two points' discrimination (Blunt) for different groups.

In TPD sharp, after one week, chisels group had significantly higher mean value than separators group ($p=0.025$). At other intervals, chisels group had a higher mean value yet the difference between both groups was not statistically significant

($p > 0.05$), which means that chisel group showed more neurosensory dysfunction but statistically wasn't different. Table (1)

Table (1): Mean and Standard deviation (SD) values for two points' discrimination (sharp) (mm) for different groups.

Time	Two points discrimination (sharp) (mm) (Mean±SD)		p-value
	Chisels	Separators	
Preoperative	2.33±0.56 ^C	2.67±0.61 ^A	0.217ns
One week	11.06±8.79 ^A	3.28±5.35 ^A	0.025*
One month	9.69±5.44 ^A	5.11±4.92 ^A	0.092ns
3 months	6.75±4.05 ^{AB}	6.50±5.89 ^A	0.479ns
6 months	5.78±3.24 ^{ABC}	5.50±7.42 ^A	0.181ns
One year	4.61±2.58 ^{BC}	2.83±1.30 ^A	0.072ns
p-value	<0.001*	0.288ns	

Different superscript letters indicate a statistically significant difference within the same vertical column*; significant ($p \leq 0.05$) ns; non-significant ($p > 0.05$)

In TPD blunt, after 6 months and one year, chisels group had significantly higher mean value than separators group ($p = 0.018$ and 0.029 respectively). At other intervals, chisels group had a higher mean value yet the difference between both groups was not statistically significant ($p > 0.05$). Table (2)

Table (2): Mean and Standard deviation (SD) values for two points' discrimination (blunt) (mm) for different groups

Time	Two points discrimination (blunt) (mm) (Mean±SD)		p-value
	Chisels	Separators	
Preoperative	4.33±0.75 ^C	4.94±0.95 ^A	0.210ns

Time	Two points discrimination (blunt) (mm) (Mean±SD)		p-value
	Chisels	Separators	
One week	6.56±4.71 ^{AB}	4.00±4.16 ^A	0.241ns
One month	12.50±8.17 ^A	7.61±5.79 ^A	0.143ns
3 months	11.83±5.97 ^A	7.72±3.85 ^A	0.100ns
6 months	9.50±5.06 ^{AB}	5.67±3.78 ^A	0.018*
One year	7.81±3.86 ^{AB}	5.06±3.43 ^A	0.029*
p-value	<0.001*	0.075ns	

Different superscript letters indicate a statistically significant difference within the same vertical column*; significant ($p \leq 0.05$) ns; non-significant ($p > 0.05$)

Discussion

All the patients admitted in this study were young patients with class III skeletal relationship which was treated by (BSSO). This technique was performed to obtain proper masticatory function, and decrease temporomandibular joint pain and enhance facial aesthetics and is also indicated in the treatment of obstructive sleep apnea.¹⁷¹⁸

The classical technique in BSSO was based on the use of chisels, using small osteotome to ensure the cuts and a large osteotome to complete the split. Surgeons worried about the use of chisels as it can cause injury to the IAN during BSSO. Therefore, a thin cement spatula osteotomes were used instead of a chisel, which reduced the incidence of postoperative NSD. A number of studies described the use of chisels to split the mandible; specifically, the chisel is driven through the inner surface of the buccal cortex.¹⁹²⁰ In our study, in the control group we used multiple cement spatula osteotomes directed toward the buccal cortex to decrease the incidence of post operative NSD.

A study was performed in 2007 that used the concept of spreading and prying rather than malleting and chiseling in performing the split in BSSO, they used Smith separator forceps and Smith separator elevator, and they found that this technique led to low percentage of persistent post-operative NSD. In our study we used the same instruments with the same technique and compared it with the use of malleting and chiseling in BSSO and recorded its effect on post-operative NSD.¹⁰

NSD was considered the most common complication after BSSO so post operative assessment of nerve function was necessary to obtain the possible techniques to decrease it.¹⁵²¹

Assessment was categorized as objective or subjective. An objective test is based on fact rather than feeling of the subject, while a subjective test is identified by the patient's perception of their own feelings and states, which are not observable by the assessor.²²²³

In our study we used TPD as a method of assessment of NSD. TPD test is one of the most widely used tests. It was also used to quantify the data. A major problem with the TPD test is the lack of standardization of applied pressure. So, in our study the force was very light just it would produce very small "blanching".²⁴²⁵

We used a caliper with sharp tips for sharp TPD and a caliper with blunt tips for blunt TPD. There was no statistically significant difference between different measuring tools like aesthesiometer, folded paper clip or disc criminator. So we used a caliper for availability and ease of use.²⁶

A retrospective study was performed and they found significant effects of age, the increase of age increases the incidence of NSD, the total operating time, the longer the operation the more likely the incidence of NSD and sex, males showed less NSD than females.²⁷ In our study all the patients were at the same age category (from 18 to 23) but male and female patients were included in the study which was considered a variable. The operations were equal in time, but the operations with incidence of complications needed more time for management.

In a study, they observed the IAN status during the surgery and they found that 60.9% of the nerves were exposed, 9.75% of the nerves were dissected from the proximal segment and 4.87% of the nerves were lacerated. No nerve was transected, and the continuity wasn't lost. NSD was more frequent when the IAN was exposed, dissected, or lacerated than when it had not been exposed.²⁸ In our study with use of separators the nerve was attached to the proximal segment in two cases which needed simple freeing the integrity of the nerve was maintained but needed slight manipulation to free it from the proximal segment which is considered another variable.

It was suggested that better surgical skills or experience would reduce the risk of NSD after orthognathic surgery. Kobayashi et al. reported a larger percentage of the patients with objective and subjective NSD of lower lip after BSSO performed by a group of "surgeons with little experience" which was reduced to the half the incidence in surgeries performed by experienced surgeons.²⁷

In 2007, a study was performed to assess the use of separators in BSSO and its effect on NSD. NSD was tested subjectively by asking the patients for sensory changes and by the light touch test (gently striking with a cotton tip). The results of NSD were 8%. They compared their results with the previous literature that used chisels and they found that chisels showed higher incidence of NSD,¹⁰ and it comes in agreement with our study.

In a review of literature in 2014 reported the effect of various surgical techniques on NSD "mallet and chisel" versus "spreading and prying". The incidence of NSD with separators was 8% and it was only reported in one paper in 2007 that solely used separators to split the mandible without the use of chisels. 11 studies with

undefined use of chisels showed average NSD by 18.4%. two studies that used cement spatula chisels along the buccal cortex and their average NSD incidence was 37.3%. This clearly illustrated the disadvantage of the “mallet and chisel” group, which implies that spreading and prying were safer in regard to the incidence of NSD. The study recommended A randomized clinical study to check the influence of chisels and separators during BSSO and its effect on NSD. This comes in agreement with our randomized clinical trial study. In the previous study NSD was evaluated based on asking the patient about NSD rather than testing. In the previous study and in our study, there was a significant difference between chisels and separators.

Conclusion

The use of splitting and praying technique by separators is superior to the malleting using spatula chisels which lead to lower post-operative hypoesthesia provided the use of appropriate technique.

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