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LOW MEDIAL CUT (POSNICK MODIFICATION) VERSUS TRADITIONAL BILATERAL SAGITTAL SPLIT OSTEOTOMY ON OSTEOTOMY SPLIT QUALITY AND COMPLICATIONS. A COMPARATIVE STUDY

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ABSTRACT

Aim: The aim of the study is to evaluate low cut medial osteotomy versus traditional sagittal split osteotomy regarding the Osteotomy duration, incidence of bad split and Postoperative neurosensory disturbance.

Patients and methods: Twelve eligible patients with skeletal class II deformity were enrolled to the current study to undergo sagittal split osteotomy (SSO) for mandibular advancement procedure. The patients were divided into two equal groups, low (Posnick/ study group) and high (traditional/ control group) SSO. Outcomes included intraoperative assessment of osteotomy split quality, duration and incidence of postoperative complications of bad split involving the neurosensory disturbance (NSD).

Results The mean age of patients was 22.5 year. The average osteotomy duration was 17.30 and 22.21 minutes for low/Posnick SSO and high/ standard SSO respectively. Regarding the incidence of bad split, the high SSO showed more incidence of bad split compared to Posnick (low) osteotomy. The incidence of immediate Postoperative NSD was similar for both groups. However, most of Posnick (study) group revealed complete nerve recovery at 6 months compared to the high SSO.

Conclusion Low cut / Posnick SSO is a valuable osteotomy technique. Compared to the traditional SSO, it showed shorter osteotomy duration and decreased incidence of bad split. It further results in complete neurosensory recovery on the extended (6 months) follow up period.

KEYWORDS: Low cut / Posnick, SSO, Sagittal split osteotomy, Mandibular advancement, bad split, neurosensory disturbance.

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INTRODUCTION

Sagittal split osteotomy (SSO) is a versatile, apparently most common surgical procedure for correction of mandibular deformity as a part of an orthognathic surgery. **Obwegeser HL., 2007& Posnick JC et al., 2016**

It was first described by Obwegeser and Trauner 1975. The traditional SSO simply place the medial cut superior to the lingula and the posterior extension with the retrolingular fossa and short of the posterior ramal border. This traditional technique showed several complications such as intraoperative lingual plate interference, condylar torqueing, and postoperative lower lip paraesthesia secondary to inferior alveolar nerve compromise that yielded from the bad split. Delayed bone healing, infection, pseudoarthrosis and bone sequestration of fragments are other complications which could be results of the bad split. **Marcus SK et al.,2008**

Then several modifications targeting the osteotomy design have followed. **Posnick JC et al., 2016** The aim of these modifications was to enhance the favorability of the osteotomy and minimize the risk of bad split and subsequent complications. **Böckmann R et al., 2015& Posnick JC et al., 2016 & Posnick JC, Kinard BE 2021**

Dal Pont's design modification has followed Obwegeser's traditional (high) osteotomy. It simply involves placing the vertical (lateral) osteotomy further anteriorly at the molar area to increase the surface area of contact between the segments. Meanwhile, the medial osteotomy extends to the posterior border of the ramus. **John B et al., 2023**

The second most popular modification is Hunsuck osteotomy; in which the medial (horizontal) cut was made further short of ramus posterior border, just posterior to the lingula. **John B et al., 2023.** Hunsuck osteotomy is assumed to result in less incidence of bad split with considerably shorter osteotomy duration than Dal pont osteotomy. **Zeynalzadeh F, et al., 2021**

Later, Wolford and Davis added additional osteotomy at the inferior border of the Ramus to complete the fracture. **Wolford LM & Davis WM Jr, 1990**

Despite the existence of the several former modifications, still the high medial osteotomy necessitates sufficient marrow space within the ramus to permit favorable osteotomy with subsequent decreased chance of bad split as documented by **Susarla SM et al, 2020.** In atypical ramus deformity with such insufficient marrow space, the low medial osteotomy is recommended.

The low split osteotomy was first introduced by Posnick. It comprises infralingular horizontal osteotomy just superior to the occlusal plane and quite short of the posterior ramal border, to end just behind the lingula. **Posnick JC et al., 2016**

Through literature, it was postulated that the low/Posnick medial osteotomy is associated with no bad split compared to the high medial Osteotomy. **Susarla SM et al.,2020**

Bad split has been defined variably through literature. It is defined as a crack propagation in an unfavorable direction whether in the distal or proximal segment. It represents 2% -20% of all unfavorable sequalae which are documented throughout the literature. **Panula K et al, 2001**

Posnick JC et al., 2016 defined the" bad split" as the split that either results in the separation of the condylar process from the proximal segment representing a third one or the condyle remain attached to the distal segment which necessitates additional osteotomy to separate it and fix it with the proximal segment.

Management of these fractures depends on its location. If large buccal part of the proximal segment is fractured, it is usually reduced and involved during fixation. On the other hand, if fracture occurs in the lingual part of the distal segment, it's rather left in place without fixation. Fractured coronoid process is usually removed to avoid ankylosis during healing. **Posnick JC et al., 2016**

The factors which augment the risk of bad split include patient's age, pattern of skeletal deformity and simultaneous extraction of the lower wisdom in SSO line. **Colelia G, Giudice A., 2003 & Doucet JC, et al., 2012**

The second most common complication of "bad split" other than the segment fracture, is the injury of the inferior alveolar neurovascular bundle. This either results in temporary or prolonged postoperative neurosensory disturbance (NSD) of the lower lip and chin. **Kanneth S et al., 2023** However the postoperative neurosensory defecit has shown to be more common in the elderly individuals. **Westermark A et al. 1999 & Espeland L et al., 2008.**

NSD usually follows the SSO procedure in 80-100% of the cases. **John R. Z, Greg K. E, 1992, Zuniga JR et al., 1998& Ylikontiola L et al, 2000** Several factors affect the incidence of NSD following the SSO procedure. They involve patient's age, degree of deformity, surgeon experience, extent of medial dissection and nerve manipulation intraoperatively. **Zeynalzadeh F, et al., 2021**

NSD is one of main concerns to be evaluated following SSO procedure. Several tests which assess the NSD exist. They include subjective and objective findings. The subjective one is in the form of numbness of the lip or chin. The objective assessment is performed by either two-point discrimination test, pin prick test, light touch or thermal test. **Alolayan AB, Leung YY., 2014 & Degala Set al., 2015**

The ostetomy duration was assessed briefly through literature. Onc study compared the split duration of Hunsuck SSO to the traditional one. **Zeynalzadeh F, et al., 2021 I**n another study, standard SSO was compared to high angled osteotomy. **Seifert, L.B. et al.,2023** No recent study has definitely compared Posnick osteotomy duration to the standard one.

Furthermore, studies that investigated the effect of low SSO on postoperative NSD; have correlated the decreased incidence of postoperative NSD with low SSO compared to the high SSO. **Susarla SM et al., 2020** So, the aim of the present study was to compare the effect of low/Posnick versus high sagittal split osteotomy on the split quality, duration and its complications.

PATIENTS AND METHODS

Patients with skeletal class II deformity and seek orthognathic surgery were investigated to find if they meet the inclusion criteria to be enrolled into this comparative study. Twelve subjects from the eligible sample who were suffering from skeletal Class II deformity that necessitates bilateral SSO, age more than 18 years and highly motivated were selected. Patients with history of IAN sensory impairment, mandibular fractures, degenerative joint disease or systemic/ bone disease, syndrome or those under any medication that might interfere with normal bone healing were excluded. The eligible patients were operated between November 2019 and December 2022.

Clinical photographs were obtained from all patients in frontal, profile, and occlusion views for documentation. Lateral cephalometric radiograph was requested for all patients as well as study model was obtained for proper treatment plan, and subjects were then referred for the presurgical orthodontic treatment for orthodontic preparations before surgical intervension.

All patients were underwent surgical mandibular advancement for correction of skeletal Class II deformity. According to position of osteotomy cuts the patients were randomly divided into two groups. Six patients of the eligible sample have undergone high medial sagittal SSO (**control group**), and the remainder six patient have undergone low/Posnick SSO (**study group**).

A dose of prophylactic antibiotic (Clindamycin 600 mg) and dexamethasone was prescribed on the preoperative day and one hour before the surgery and

continued every 12 hours postoperatively. Surgical mandibular advancement surgery via SSO was performed under general anesthesia for all patients. The Intraoral surgical site was prepared according to the standards of oral and maxillofacial operating room protocol. Local anesthetic solution with vasoconstrictor (Articaine 4% with Epinephrine 1:100,000) was infiltrated for the intraoral operative site for hemostasis and pain control.

Standard intra oral incision was followed by the same SSO design in both groups except for the medial osteotomy: **(Figure 1)**

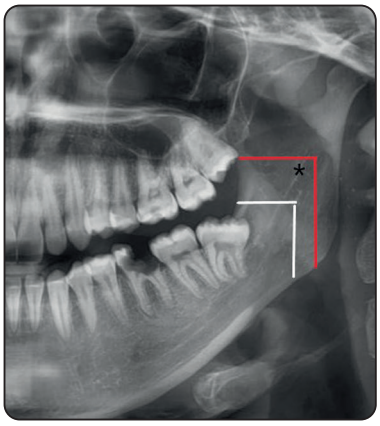

Fig. (1): Panoramic view of patient no. 3 of study group showing marking of the high SSO (red line): superior to the lingula and short of posterior Ramal border & low SSO (white line): just inferior and posterior to the lingula.

For the Control/high group: the horizontal medial osteotomy was performed superior to the lingula on the medial aspect of the ramus and short of the posterior border of the ramus (Hunsuck modification). **Zeynalzadeh F et al.,2021 (Figure 2)**

For the study/low group, The horizontal medial osteotomy was performed (via short oscillating saw) just superior to the occlusal plane of the mandibular molars and immediately below the lingula (to limit excess ramal lingual plate attached to the distal segment). The cut stopped short of the posterior aspect of the ramus (just behind the lingula) to avoid inclusion of the condylar part with the distal segment. The lateral component of osteotomy extends anteriorly according to the amount of displacement required (ideally between first and second molar). From the end of the lateral osteotomy, the vertical osteotomy begins with a curved connection with the lateral osteotomy to avoid buccal plate fragmentation on splitting. **(Figure 3)** The vertical osteotomy ends at the inferior border of the mandible through the buccal cortex only to avoid propagation of a bad split. The splitting then begins with straight osteotomes beginning with the medial and inferior border splitting with the osteotome inserted (maximum 5 mm through the cortex) and directed away from the inferior alveolar canal to avoid nerve damage.

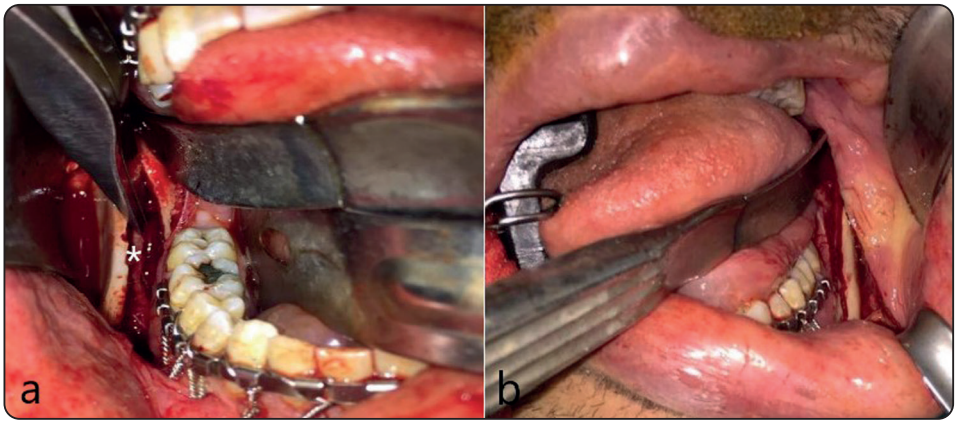

Fig. (2): Intraoperative view showing Traditional/ high sagittal split osteotomy, a) The right-side Osteotomy (asterisk on Inferior alveolar nerve while freely entering the distal segment), b) The left side Osteotomy in the same patient

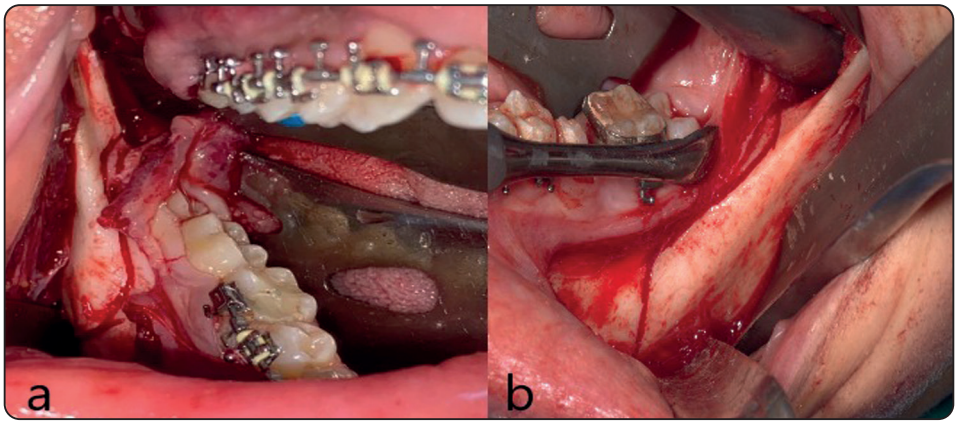

Fig. (3): Intraoperative view showing Posnick/ Low sagittal split osteotomy, a) The right-side Osteotomy (notice the low medial cut just superior to the occlusal plane& the rounded connection between the lateral and vertical cut), b) The left side osteotomy in the same patient

Osteotome manipulation is continued till complete sagittal split of the segments. Fixation of segments following the required advancement was attained through transbuccal trocar using three (2 mm diameter) bi-cortical screws (length:14-16mm near upper border,10-12 near the lower ramal border). **(Figure 4)** Flap reposition & suturing were then performed.

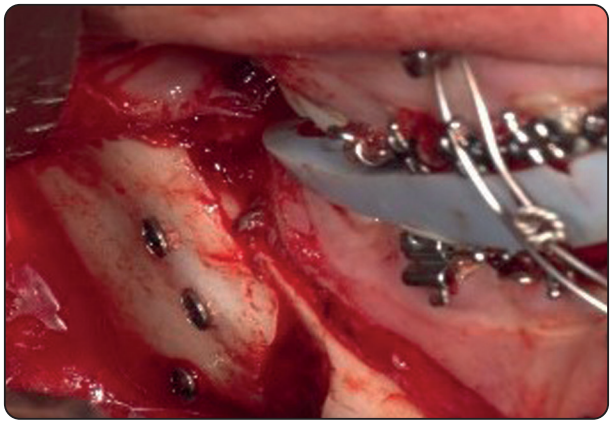

Fig. (4): Intraoperative view showing Posnick/ Low sagittal split osteotomy following advancement and fixation.

Patients were instructed to follow soft diet and restrain their physical activity (for 4 weeks at least) for the postoperative period, follow strict oral hygiene measures and to continue the preoperative antibiotics and analgesics 3 times/ day for 5 days.

Patients were followed up weekly for the first month and then monthly for additional five months to monitor healing, assess neurosensory function via pin prick and two point descrimination test. The patients were also examined for the presence of other complications like hematoma, dehiscence or infection. A six-months postoperative panoramic radiograph was requested from all patients for bone healing assessment. The patients were then guided to complete the orthodontist treatment for final occlusal refinement and adjustment. On the immediate and 6 months follow up visits, the NSD was assessed via 1: Subjective findings (presence of numbness in lower lip or chin), 2: Objective test (via two-point discrimination test, pin prick) and data obtained was recorded.

Statistical analysis

The main data obtained from the outcome variables was mainly descriptive in nature.

RESULTS

Twelve patients with skeletal class II deformity were enrolled to the current study from (2019-2022). The mean age of patients was 22.5 years and five out of total twelve subjects were females. Posnick SSO was associated with decreased incidence of bad split (one patient) compared to the standard SSO group (four patients). **(Table 1)**

TABLE (1) Demographic and clinical data of patients in both groups

	Patient no.	Age (yr)	Sex	Incidence of bad split
Low medial osteotomy gp	1	19	M	No
	2	23	F	No
	3	25	F	No
	4	22	F	No
	5	30	M	Yes
	6	21	M	No
High medial osteotomy gp	1	23	M	No
	2	20	M	Yes
	3	20	F	Yes
	4	24	M	No
	5	23	F	Yes
	6	20	M	Yes

(M=male, F= female)

The average osteotomy duration was 17.30 and 22.21 minutes for Posnick SSO and standard SSO respectively. **(Table 2)**

TABLE (2) The mean of Osteotomy and split duration in both groups

Group	Osteotomy duration.
Low medial osteotomy gp	Mean 17.30 min.
High medial osteotomy gp	Mean 22.21 min.

All patients (except one in Posnick group) exhibited a degree of NSD on the immediate follow up date. At 6 months follow up period, a complete recovery of NSD was reported in 83% and 50% of the study and the control group respectively as revealed by light touch and pin prick test.

The intraoperative location of inferior alveolar canal or presence of postoperative complications including existence of NSD were also documented. **(Table 3).**

Through the assessment of twenty-four osteotomies in twelve patients, Posnick (low) osteotomy allowed better visualization of the inferior alveolar nerve with decreased medial dissection which together with the decreased bad split incidence resulted in increased postoperative neurosensory recovery in the study (Posnick) group compared to the control (standard) group at 6 months.

TABLE (3): The location of IAN following splitting & presence of Postoperative neurosensory disturbance or other complications in both groups

Group	Patients no	Nerve location during surgery	Postoperative NSD		Other Complications
			Immediate (3 days)	6 months post-op	
Low medial osteotomy gp	1	In proximal segment	Yes	No	Nerve stretching
	2	In proximal segment	Yes	No	NA
	3	In proximal segment	No	No	NA
	4	In proximal segment	Yes	No	NA
	5	In distal segment	No	No	NA
	6	In proximal segment	Yes	Yes	Buccal plate fracture
High medial osteotomy gp	1	Not seen	Yes	No	NA
	2	In distal segment	Yes	Yes	Lingual plate fracture
	3	Not seen	Yes	No	Na
	4	In distal segment	Yes	Yes	Partial nerve injury
	5	In distal segment	Yes	No	Condylar torquing
	6	Not seen	Yes	Yes	Lingual plate fracture

NSD: neurosensory disturbance, NA: nothing identified

DISCUSSION

Individuals with skeletal class II deformity commonly seek surgical correction for optimum esthetics and chewing function. **Espeland L et al., 2008** The design of SSO utilized in the current study; either Posnick or Hunsuck medial horizontal osteotomy are both modifications of Obwegeser SSO which was first introduced in 1957. **Hunsuck EE 1968**

In the current study, the effect of the medial cut placement (superior versus inferior to the lingula) on the osteotomy duration, incidence of bad split and neurosensory function was investigated.

It was postulated that the low medial (Posnick) osteotomy is associated with decreased incidence of bad split, subsequent decreased distal lingual plate interference and inferior alveolar NSD. This fact was adopted by several studies. **T.W. Neal et al.,2021 & John B et al.,2023**

The frequency of bad split following SSO through literature ranged from 1-23%. **Chrcanovic BR, Freire-Maia B, 2012& Mohammadali Aarabi et al.,2014 and Min Hou et al.,2016** Through literature, various complications have been reported to follow the SSO procedure. **Verweij JP et al.,2016** Among which, buccal, lingual plate fracture, condylar torquing, partial nerve injury which have been encountered with the control group of the present study.

Unfavorable fracture that results from the bad split rather commonly involves the buccal plate of the proximal segment, lingual plate of the distal segment or even coronoid process as reported in literature. However, these complications are rarely responsible for the impaired healing or unfavorable postoperative sequalae. **Posnick JC et al., 2016** For the study (Posnick) group, only accidental buccal plate fracture was encountered during splitting and it was fixated with segments at the end of procedure.

Regarding NSD, it was equally encountered for both groups at the immediate Postoperative period, while obvious recovery at 6 months was yielded in 83% & 50% of the study and control group respectively

Neurosensory function has been variably assessed through literature following sagittal split osteotomy procedure. **Antony PG et al., 2017** That issue is significant as the path of the inferior alveolar nerve within the mandibular canal runs through the course of low medial horizontal osteotomy. Accidental partial injury or even complete severance of the nerve has been reported in literature. However, complete recovery of the nerve usually follows the surgery from few weeks up to 6 months Postoperatively. **Alolayan AB et al., 2014& John B et al.,2023**

The neurosensory recovery is usually facilitated with medications. However, it's better avoided by decreased nerve manipulation during splitting and results are usually considered satisfactory when NSD undergoes recovery within 6 months of the surgery. **Antony PG et al., 2017**

In addition, the preoperative corticosteroid prescription doesn't seem to play a role in reduction of the Postoperative NSD but rather decrease the edema only. **Semper-Hogg W et al., 2017**

To overcome the risk of Postoperative neurosensory disturbance (NSD), researchers have investigated and correlated the position and course of the inferior alveolar canal using preoperative cone beam CT (CBCT) with the postoperative sequalae of mandibular advancement procedure. Their results regarding NSD was similar in both groups (with and without Preoperative CBCT) at 6 months but most patients of CBCT group showed complete recovery at 1 year Postoperative. **Kanneth S et al., 2023**

Besides, CT was investigated also for assessment of condylar displacement following SSO procedure**. Yin Q et al., 2019& Hupp LC, et al., 2023**

Beside the forementioned common complications of traditional SSO, other complications do exist. They involve edema, condyle torquing, temporomandibular joint dysfunction, sequestration or infection. **Verweij JP et al.,2016** Only one patient of the control group of the present study experienced condylar torquing.

Another factor that might contribute to the incidence of bad split, is the simultaneous extraction of mandibular wisdom during splitting. **Zeynalzadeh F et al., 2021** However no sufficient evidence to support this nor presence of such condition was encountered in the present study.

On the other hand, it was stated that the osteotomy design modifications have no effect on bad split incidence but rather the location of the buccal end of the lateral cut. **Möhlhenrich SC et al., 2017**

Moreover**, Rao JKD.2023** has stated that freeing the IAN from the proximal segment is not necessary as long as the required amount of mandibular advancement is 6 mm or less. This is to guarantee decreased nerve manipulation between the segments with subsequent reduction of NSD risk. This fact come along with that the infralingular low medial osteotomy implied by Posnick, leaves the IAN in the proximal segment and doesn't necessarily result in NSD as compared to the high SSO.

CONCLUSION

Low cut / Posnick SSO is a valuable osteotomy technique. Compared to the traditional SSO, it showed shorter osteotomy duration and decreased incidence of bad split. It further results in complete neurosensory recovery on the extended (6 months) follow up period.

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