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ORIGINAL ARTICALE

ASSESSMENT OF NEUROSENSORY DISTURBANCES AFTER BSSO MANDIBULAR SETBACK: LOW MEDIAL CUT VS. HIGH MEDIAL CUT (RANDOMIZED CONTROLLED TRIAL)

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ABSTRACT

This study aimed to evaluate the incidence of neurosensory disturbance (NSD) following two modifications of bilateral sagittal split mandibular osteotomy (BSSO)—low medial cut (Posnick modification) and high medial cut (standard)—in the immediate postoperative period and after a minimum follow-up of six months. Twenty patients with skeletal Class III deformity requiring mandibular setback were randomly divided into two equal groups. Subjective and objective testing for inferior alveolar nerve function was performed. The results showed that all patients (except four in the Posnick group) exhibited some degree of NSD immediately postoperatively. However, at the 6-month follow-up, a complete recovery of NSD was reported in 74% of the low medial cut group and 35% of the high medial cut group. The low medial cut (Posnick) osteotomy demonstrated a shorter average osteotomy duration (20.30 minutes) compared to the high medial cut (27.21 minutes) and allowed for better visualization of the inferior alveolar nerve with decreased medial dissection.. The study concludes that the low medial cut (Posnick) SSO is a valuable osteotomy technique, offering shorter osteotomy duration, decreased incidence of bad split, and better neurosensory recovery in the extended follow-up period compared to the traditional BSSO.

Keywords*:* neurosensory disturbance, bilateral sagittal split mandibular osteotomy, the Dalpont osteotomy, the Hunsuck osteotomy

INTRODUCTION

Bilateral sagittal split mandibular osteotomy (BSSO) is an established surgical procedure for the correction of mandibular deformities, including mandibular deficiency, excess, and/or asymmetry[1]. Since Obwegeser initially introduced the sagittal ramus osteotomy (SRO) over 60 years ago, several useful modifications have been described. Most alterations in osteotomy design were introduced to enhance the favorability of splitting and for osteotomy healing, as described first by Dalpont and later by Hunsuck.

The Dalpont osteotomy modification extends a vertical osteotomy anteriorly into the molar region, allowing for a longer buccal plate extension. This improves bony overlap and healing when the mandible is advanced extensively. The Hunsuck osteotomy (BSSO) modification terminates the medial (horizontal) osteotomy just posterior to the lingula. This design induces the posterior osteotomy to propagate into the

retrolingual fossa rather than to the posterior border to the condyle [2].

Specifics of the Hunsuck modification include placement of the medial ramus osteotomy cut 'high,' just a few millimeters above the lingula, superior and lateral to the entrance point of the inferior alveolar nerve (IAN) into the mandibular foramen. This might preserve neurovascular bundles. A potential disadvantage of the Hunsuck modification technique is propagation of the medial osteotomy superiorly toward the condyle or fragmentation and iatrogenic fracture of the ramus [3].

To reduce the frequency of unfavorable osteotomy propagation toward the condyle, a third SRO refinement was suggested by Posnick. This is a modification to the medial horizontal osteotomy that keeps the cut both low (close to the mandibular occlusal plane and below the lingula) and short (terminating the cut anterior to the lingula) 3. This design modification allows for splitting of the BSSRO with the posterior osteotomy line propagating anterior to and below the lingula. This modification virtually eliminates the possibility of propagation toward the condyle and, in so doing, avoids a 'bad split' [4].

Despite being a safe and versatile procedure, BSSO does have a few common complications. Neurosensory disturbance (NSD) of the inferior alveolar nerve is one such common complication. With a wide variation of BSSO techniques among different surgeons, variations in methods and timing of subjective and objective evaluation, and the method of fixation, the incidence of NSD with BSSO reported in the literature varies from 9% to 85% [17].

The purpose of this study was to evaluate the incidence of NSD following two modifications of BSSO (high and low medial cut) in the immediate postoperative period and after a minimum follow-up of six months using both subjective and objective testing.

2. MATERIALS AND METHODS

This study was conducted on twenty patients with facial skeleton deformity requiring orthognathic surgery, specifically mandibular setback using bilateral sagittal split osteotomy. Age of the patients was between 18 and 30 years. All patients were free from any systemic disease that might affect normal bone healing. Patients with any systemic disease that might affect normal healing, Intra-bony lesions or infections that might interfere with surgery, Previous orthognathic surgeries and Patients with all types of facial clefts were excluded from the study. All patients were recruited from outpatient clinics at the Faculty of Dentistry, Cairo University, Egypt. All participants were informed about the study and provided written consent to participate. All operations were performed at the Department of Oral and Maxillofacial Surgery, Cairo University.

Interventions

The participants were randomly divided into two equal groups, with ten patients in each group:

- **Intervention group:** Patients who underwent mandibular setback using low medial cut BSSO osteotomy.
- **Control group:** Patients who underwent mandibular setback using high medial cut BSSO osteotomy.

Methods

Preoperative Clinical Measures

A thorough preoperative assessment of all patients was carried out, including history taking, clinical, photographic, and radiographic examinations, in addition to dental cast analysis.

Preoperative Radiographic Examination

- Preoperative panoramic radiograph.
- Preoperative lateral cephalometric radiograph.
- Preoperative Computed Tomography (CT) scans of the head and neck region were acquired for all patients utilizing a multi-slice CT machine.

Surgical Procedures

An intraoral vestibular lateral ramus incision was performed to expose the buccal and lingual aspects of the ramus osteotomy region.

- Medial Osteotomy line for the intervention group was anterior to the lingula and at the level of the occlusal surface

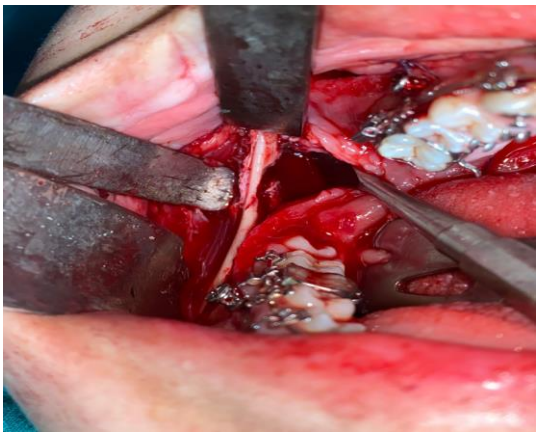

Figure. 1. Low cut medial osteotomy).

- Medial Osteotomy line for the control group was above the lingula

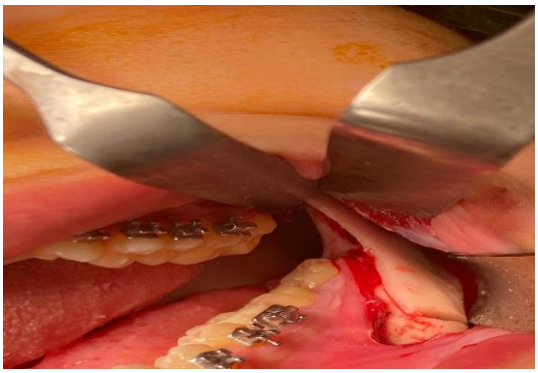

Figure. 2. high cut medial osteotomy).

Buccal extension for both groups was through the external oblique ridge, with vertical and oblique cuts terminating at the lower first molar.

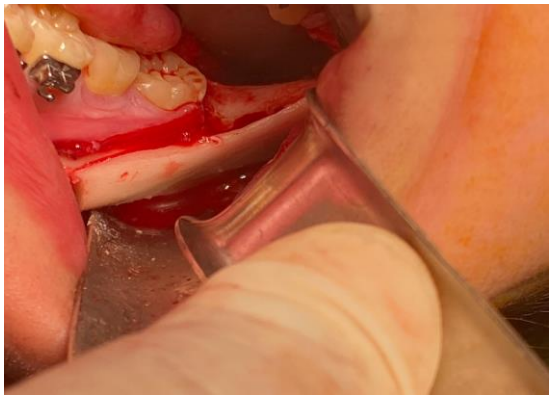

Figure 3. Buccal osteotomy extension).

Postoperative Care

Postoperative instructions: Cold compresses in the form of ice packs were applied for 20 minutes every hour for the first 24 hours postoperatively to minimize edema. All patients were kept on the antibiotic, analgesics, ant edematous and anti-emitting drugs regimen until they were discharged from the hospital:

Postoperative Radiographic Examination

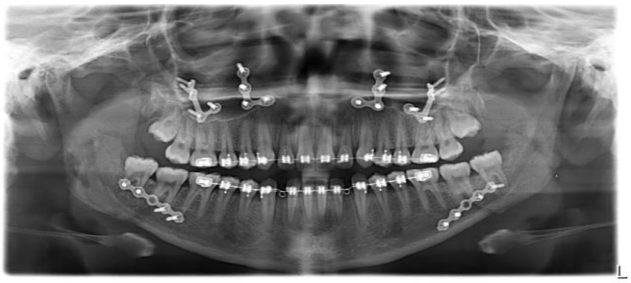

Figure 4. Postoperative panoramic(high medial cut).

Figure 5. Postoperative panoramic radiograph (low medial cut).

Postoperative Computed Tomography (CT) scans of the head and neck region were acquired for all patients utilizing a multi-slice CT machine.

Figure 6. Postoperative CT coronal cuts of low medial cut osteotomy.

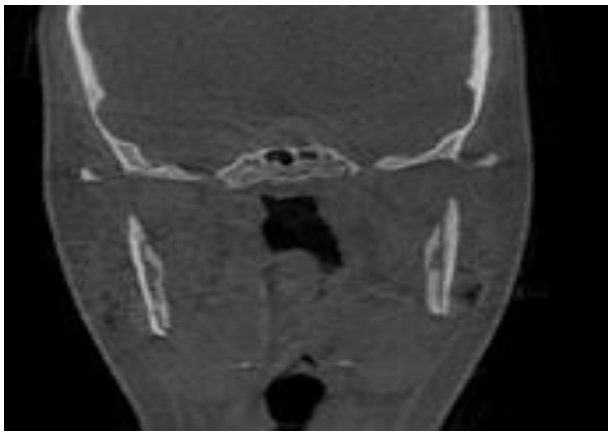

Figure 7. Postoperative CT coronal cuts of high medial cut osteotomy.

Assessment of Neurosensory Disturbances

All patients included in the study were assessed using objective and subjective testing for inferior alveolar nerve function after a minimum of 6 months of follow-up.

Subjective evaluation was carried out using the questionnaire described by Al-Bishri et al. Patients were queried about perceived neurosensory changes along the distribution of the inferior alveolar nerve. A visual analogue scale (VAS) graded from 0 (no discomfort) to 10 (intolerable discomfort) was included for evaluation. To evaluate the effect of the neurosensory disturbance, the grades of the VAS were interpreted as follows: 0–2 mild discomfort, 2–4 mild to moderate discomfort, 4–6 moderate discomfort, 6–8 moderate to severe discomfort, and 8–10 severe discomfort.

Objective testing was done using cotton swabs and pinprick testing. The chin and lip region was tested on either side, and a positive response in at least 3 of 4 applied stimuli was considered normal [6].

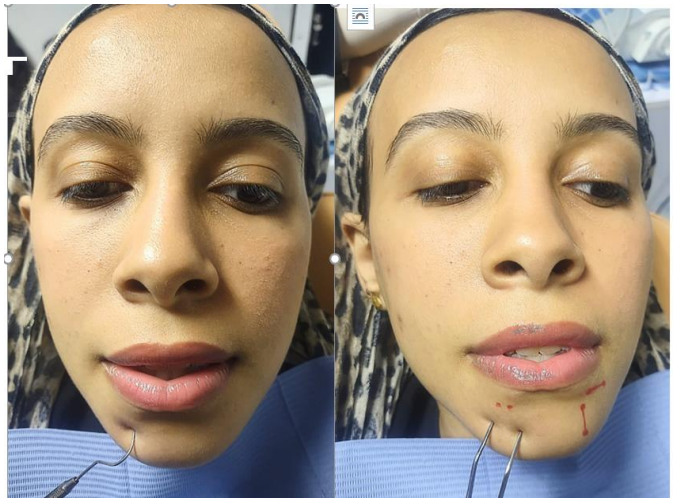

Figure. 8 two point discrimination and pinprick testing.

None of the patients had sensory disturbance prior to surgery. However, objective testing was not carried out prior to the surgical procedure. Medical records of the patients were used to assess the incidence of neurosensory disturbance in the immediate postoperative period.

Statistical Analysis

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

3. RESULTS

Twenty patients with skeletal Class III deformity were enrolled in the current study from 2021 to 2024. The mean age of patients was 22.5 years, and nine out of the total twenty subjects were females (Table 1).

Table 1. Patient Demographics

Patient No.	Age (yr)	Sex	Group
1	18	Male	Low medial osteotomy
2	20	Male	Low medial osteotomy
3	24	Female	Low medial osteotomy
4	19	Male	Low medial osteotomy
5	25	Female	Low medial osteotomy
6	22	Male	Low medial osteotomy
7	23	Male	Low medial osteotomy
8	22	Male	Low medial osteotomy
9	24	Female	Low medial osteotomy
10	23	Male	Low medial osteotomy
1	25	Male	High medial osteotomy
2	23	Male	High medial osteotomy
3	22	Male	High medial osteotomy
4	18	Female	High medial osteotomy
5	19	Female	High medial osteotomy
6	25	Female	High medial osteotomy
7	19	Female	High medial osteotomy
8	23	Male	High medial osteotomy
9	25	Female	High medial osteotomy
10	23	Female	High medial osteotomy

The average osteotomy duration was 20.30 minutes for the Posnick SSO (low medial osteotomy group) and 27.21 minutes for the standard SSO (high medial osteotomy group) (Table 2).

Table 2. Mean Osteotomy and Split surgery Duration in Both Groups

Group	Osteotomy Duration (minutes)
Low medial osteotomy group	20.30 (+or-) 3
High medial osteotomy group	27.30 (+or -) 5

All patients (except four in the Posnick group) exhibited a degree of neurosensory disturbance (NSD) on the immediate follow-up date. At the 6-month follow-up period, a complete recovery of NSD was reported in 74% and 35% of the study and control groups, respectively, as revealed by light touch and pinprick tests. The intraoperative location of the inferior alveolar canal or the presence of postoperative complications, including NSD, were also documented (Table 3).

Through the assessment of twenty osteotomies in ten patients, the Posnick (low) osteotomy allowed better visualization of the inferior alveolar nerve with decreased medial dissection. This, 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 month.

Table 3. 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 Immediate (3 days) / VAS	Postoperative NSD 6 months post-op / VAS	Other Complications
Low medial osteotomy group	1	Proximal seg.	Yes / (5)	No / (0)	NA
	2	Proximal seg.	Yes / (7)	Yes / (3)	NA
	3	Proximal seg.	Yes / (4)	No / (0)	NA
	4	Proximal seg.	Yes / (7)	Yes / (3)	NA
	5	Proximal seg.	Yes / (8)	Yes / (3)	NA
	6	Proximal seg.	Yes / (3)	No / (0)	NA
	7	Proximal seg.	Yes / (3)	No / (0)	NA
	8	Proximal seg.	Yes / (3)	No / (0)	NA
	9	Proximal seg.	No / (0)	No / (0)	NA
	10	Proximal seg.	No / (0)	No / (0)	NA
High medial osteotomy group	1	Distal seg.	Yes / (8)	No / (0)	NA
	2	Distal seg.	Yes / (7)	No / (0)	NA
	3	Distal seg.	Yes / (8)	Yes / (4)	Bad split

NSD: neurosensory disturbance, NA: nothing identified

4. DISCUSSION

Individuals with skeletal Class three deformities commonly seek surgical correction for optimal 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 [7].

The effect of medial cut placement (superior versus inferior to the lingula) on osteotomy duration, incidence of bad split, and neurosensory function has been investigated in many studies. It was postulated that the low medial (Posnick) osteotomy is associated with a decreased incidence of bad split, subsequent decreased distal lingual plate interference, and inferior alveolar NSD. This fact was adopted by several studies [8]. A literature review and meta-analysis by Verweij et al. concluded that the incidence of NSD after 1 year of BSSO in recent literature ranges between 0.0% and 48.8%, with a mean of 21.7% per side. The wide range of NSD incidence after BSSO can be attributed to various factors such as age, sex, magnitude of movement, or type of fixation. In our study, we investigated the magnitude of mandibular movement as a risk factor for permanent NSD [11].

Regarding NSD, it was equally encountered for both groups in the immediate postoperative period, while obvious recovery at 6 months was yielded in 83% and 50% of the study and control groups, respectively [11].

Neurosensory function has been variably assessed through literature following sagittal split osteotomy procedures [7]. This 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 the literature. However, complete recovery of the nerve usually follows surgery from a few weeks up to 6 months postoperatively [4].

Neurosensory recovery is usually facilitated with medications. However, it is better avoided by decreased nerve manipulation during splitting, and results are usually considered satisfactory when NSD undergoes recovery within 6 months of surgery [Antony PG et al., 2017]. In addition, preoperative corticosteroid prescription does not seem to play a role in the reduction of postoperative NSD but rather decreases edema only [16].

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 sequelae of mandibular advancement procedures. Their results regarding NSD were similar in both groups (with and without preoperative CBCT) at 6 months, but most patients in the CBCT group showed complete recovery at 1 year postoperatively [18]. In a second study, Susarla and colleagues confirmed that when using the low and short medial cut, the IAN was retained within the proximal segment approximately 50% of the time. No difference in functional sensory recovery was found when the IAN was either freely entering the distal segment or when it was partially retained within the proximal segment and not further surgically manipulated to free it from the proximal segment [17]. Therefore, using a low medial cut in BSSRO could be a better alternative to traditional high medial cut BSSRO in terms of the incidence of bad splitting and neurosensory disturbance, but there is a gap in knowledge regarding the comparative effect of both techniques on TMJ changes.

Another factor that might contribute to the incidence of bad split is the simultaneous extraction of mandibular wisdom teeth during splitting [14]. On the other hand, it was stated that osteotomy design modifications have no effect on bad split incidence but rather the location of the buccal end of the lateral cut [10]. 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 aligns with the infralingular low medial osteotomy implied by Posnick, which leaves the IAN in the proximal segment and does not necessarily result in NSD as compared to the high SSO [19].

From results obtained from studies by Westermark et al. and Van Sickels et al., it was concluded that large advancements/setbacks (>7 mm) have been reported to increase the risk of NSD by increasing the difficulty of the procedure or the vulnerability of the patient by stretching the nerve [15]. The results of this study showed that NSD occurred in eight out of ten cases immediately postoperative and only in three cases after six months for the low medial cut group. Results for high medial cut BSSRO showed NSD for all cases immediately postoperative and six out of ten cases after six months. Results from this study showed that manipulations of the inferior dental bundle and both segments intraoperatively play a significant role, besides osteotomy design, in the occurrence of postoperative NSD.

5. 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 better neurosensory recovery in the extended (6 months) follow-up period.

DECLARATIONS

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare no conflict of interest.

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REFERENCES

1. Prasad V, Kumar S, Pradhan H, Siddiqui R, Ali I. Bilateral sagittal split osteotomy a versatile approach for correction of facial deformity: A review literature. Natl J Maxillofac Surg. 2021;12(1):8-12. doi: 10.4103/njms.NJMS_89_18
2. Böckmann R, Meyns J, Dik E, Kessler P. The modifications of the sagittal ramus split osteotomy: a literature review. Plast Reconstr Surg Glob Open. 2015;2(12):e271. Published 2015 Jan 8. doi: 10.1097/GOX.0000000000000127
3. Smith GI, Brennan PA, Oh SS, Markus AF. Modification of the Hunsuck sagittal split osteotomy using a nerve hook. Technical note. J Craniomaxillofac Surg. 2002;30(5):292-294. doi: 10.1016/s1010-5182(02)90302-1

4. Joseph B, Anirudhan A, Krishnan Kutty D, Ummer N, Anjana CM. Sub-lingula Osteotomy-A Novel Modification of Sagittal Split Osteotomy. J Maxillofac Oral Surg. 2025;24(1):98-102. doi: 10.1007/s12663-024-02395-y
5. Ettinger RE, Mercan E, Podolsky D, Susarla SM. Defining the Safe Zone for the Low Medial Horizontal Cut in the Sagittal Split Osteotomy. J Oral Maxillofac Surg. 2022;80(5):822-826. doi: 10.1016/j.joms.2022.01.003
6. Roychoudhury S, Nagori SA, Roychoudhury A. Neurosensory disturbance after bilateral sagittal split osteotomy: A retrospective study. J Oral Biol Craniofac Res. 2015;5(2):65-68. doi: 10.1016/j.jobcr.2015.04.006
7. Suojanen J, Leikola J, Stoor P. The use of patient-specific implants in orthognathic surgery: A series of 30 mandible sagittal split osteotomy patients. J Craniomaxillofac Surg. 2017;45(6):990-994. doi: 10.1016/j.jcms.2017.02.021
8. Abdel-Ghany H, Kadry W, Aboalnaga A, El-Gengehi M. Low medial cut (Posnick modification) versus traditional bilateral sagittal split osteotomy on osteotomy split quality and complications. A comparative study. Egyptian Dental Journal. 2023;69(3):1867-1876. doi: 10.21608/edj.2023.216538.2589
9. Aarabi M, Tabrizi R, Hekmat M, Shahidi S, Puzesh A. Relationship Between Mandibular Anatomy and the Occurrence of a Bad Split Upon Sagittal Split Osteotomy. Journal of Oral and Maxillofacial Surgery. 2014;72(12):2508-2513. doi: 10.1016/j.joms.2014.05.008
10. Möhlhenrich SC, Kniha K, Peters F, Ayoub N, Goloborodko E, Hölzle F, Fritz U, Modabber A. Fracture patterns after bilateral sagittal split osteotomy of the mandibular ramus according to the Obwegeser/Dal Pont and Hunsuck/Epker modifications. J Cranio maxillofac Surg. 2017;45(5):762-767. doi: 10.1016/j.jcms.2017.02.012
11. Obwegeser HL. Orthognathic surgery and a tale of how three procedures came to be: a letter to the next generations of surgeons. Clin Plast Surg. 2007;34(3):331-355.doi: 10.1016/j.cps.2007.05.014
12. Panula K, Finne K, Oikarinen K. Incidence of complications and problems related to orthognathic surgery: a review of 655 patients. J Oral Maxillofac Surg. 2001;59(10):1128-1136; discussion 1137. doi: 10.1053/joms.2001.26704
13. Posnick JC, Choi E, Liu S. Occurrence of a 'bad' split and success of initial mandibular healing: a review of 524 sagittal ramus osteotomies in 262 patients. Int J Oral Maxillofac Surg. 2016;45(10):1187-1194. doi: 10.1016/j.ijom.2016.05.003
14.Posnick JC, Kinard BE. Use of a 'low and short' medial cut limits sagittal ramus osteotomy interferences. Int J Oral Maxillofac Surg. 2021;50(12):1583-1587. doi: 10.1016/j.ijom.2021.02.021
15.Seifert LB, Langhans C, Berdan Y, et al. Comparison of two surgical techniques (HOO vs. BSSO) for mandibular osteotomies in orthognathic surgery—a 10-year retrospective study. Oral Maxillofac Surg. 2023;27:341–351. doi: 10.1007/s10006-022-01073-y
16.Semper-Hogg W, Fuessinger MA, Dirlewanger TW, Cornelius CP, Metzger MC. The influence of dexamethasone on postoperative swelling and neurosensory disturbances after orthognathic surgery: a randomized controlled clinical trial. Head Face Med. 2017;13(1):19. doi: 10.1186/s13005-017-0153-1
17.Susarla SM, Cho DY, Ettinger RE, Dodson TB. The Low Medial Horizontal Osteotomy in Patients With Atypical Ramus Morphology Undergoing Sagittal Split Osteotomy. J Oral Maxillofac Surg. 2020;78(10):1813-1819. doi: 10.1016/j.joms.2020.05.005
18.Kanneth S, Vinod VS, Mani V, George A, Thomas A. Assessment of Mandibular Canal Using Cone-Beam Computed Tomography (CBCT) and Its Relevance in Post-Operative Neurosensory Disturbances Following Bilateral Sagittal Split Osteotomy Setback. Cureus. 2023;15(3):e36004. doi: 10.7759/cureus.36004
19.Rao JKD. The inferior alveolar nerve at the proximal fragment during bilateral sagittal split osteotomy - Is there a need to reposition to distal fragment? J Oral Biol Craniofac Res. 2023;13(3):424-428.doi: 10.1016/j.jobcr.2023.04.001