International Journal Dental and Medical Sciences Research
Volume 8, Issue 3, May-June 2026 pp: 162-171 www.ijdmsrjournal.com ISSN: 2582-6018

Postoperative Neurosensory Assessment After Bilateral Sagittal Split Osteotomy -A Prospective Cohort Study

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Date of Submission: 25-05-2026 Date of Acceptance: 05-06-2026

I. INTRODUCTION

The Bilateral Sagittal Split Osteotomy and Vertical Ramus Osteotomy are the most frequently carried out osteotomies for the correction of mandibular deformities, based on the findings of research studies [1]. The treatment approach for mandibular deformities has not altered since the original description by Schuchardt in 1942 and the subsequent improvements by Obwegeser together with Trauner and DalPont and Hunsuck and Epker [2,3,4]. The treatment approach is mainly for young patients who have functional as well as aesthetic demands. The BSSO approach is safe and flexible, but it also has some common difficulties. The inferior alveolar nerve parasthesia is one of the common complication arising from BSSO. After the BSSO procedure, the incidence of neurosensory impairment is variable; it has been found that up to 85% of patients have transient changes, and 5-15% have permanent changes [5]. Due to the fact that some disturbances of sensory perception, such as hypoesthesia, paresthesia, or dysesthesia, may have a profoundly negative effect on the quality of life of the patient, they must be considered in the preoperative evaluation as well as in the postoperative assessment [6].

Neurosensory assesment is required to ensure accurate measurements of nerve function and recovery post-BSSO surgery [7].This case series evaluates postoperative neurosensory outcomes in 10 consecutive patients who underwent BSSO, with emphasis on early detection, pattern of recovery, and clinical implications.

AIM :

To evaluate postoperative neurosensory changes and recovery following Bilateral sagittal split osteotomy (BSSO)at different postoperative follow-up intervals, and to assess the progression of sensory recovery over time.

II. METHODOLOGY

Sample - Ten consecutive patients undergoing BSSO for mandibular deformities.

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Inclusion Criteria:

- Patients undergoing isolated BSSO
- No preoperative neurosensory deficit
- Minimum followup of 3 to 6 months

Surgical Procedure:

All procedures were performed under general anesthesia using a standardized BSSO technique with careful identification and preservation of the inferior alveolar neurovascular bundle. Fixation was achieved using miniplates and monocortical screws.

The neurosensory assessment was performed on postoperative 1stweek, 1st month, 3rd month, 6thmonthusing:

- Two-point discrimination test
- Light touch using cotton wisp method

The postoperative pain was assesed using Visual analog scale (VAS)

Pre-treatment pictures:

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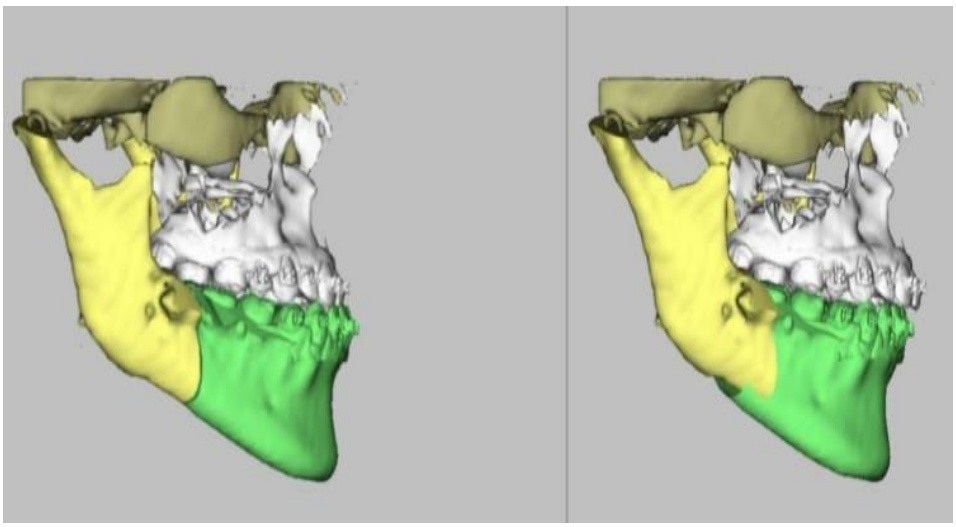
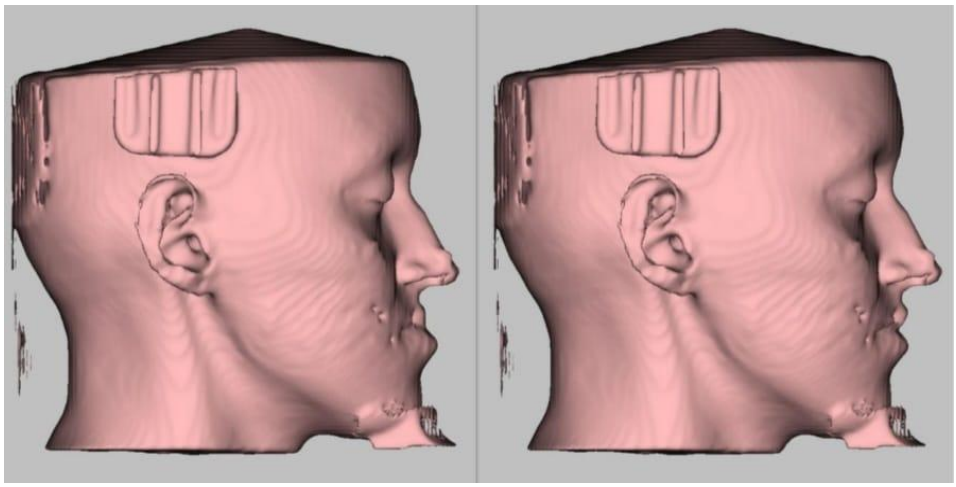


Virtual surgical plan:



Post-treatment pictures:

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III. STATISTICAL METHODS :

Statistical analysis was performed using **SPSS statistical software (IBM corp., Armonk, USA, version 27).** Continuous and ordinal data were summarized using median and interquartile range (IQR) while categorical variables were expressed as frequency and percentage. Intragroup comparison of repeated ordinal outcomes including two-point discrimination scores and visual analogue scale (VAS) pain scores measured at postoperative intervals (1 week, 1 month, 3 months and 6 months) was performed using the Friedman test. Post-hoc pairwise comparisons between follow-up intervals were conducted using the Wilcoxon signed-rank test with Bonferroni adjustment to control for multiple comparisons with the adjusted level of significance set at $p<0.008$ (0.05/6).

For categorical binary data obtained from the pin-prick sensation test (normal or diminished), intragroup comparison across follow-up periods was performed using Cochran's Q test. Post-hoc pairwise comparisons were analysed using the McNemar test with Bonferroni correction ($p<0.008$). Statistical significance was considered at $p<0.05$ for overall comparisons and at $p<0.008$ for Bonferroni-adjusted pairwise comparisons.

IV. RESULTS :

Postoperative neurosensory changes following BSSO were assessed using two-point discrimination test, pin-prick sensation test, and visual analogue scale (VAS) at four postoperative follow-up intervals. Two-point discrimination scores across the four postoperative follow-up periods were analysed using the Friedman test for intragroup comparison. The median (IQR) score was 0.5 (2) at 1 week, which remained 0.5 (1) at 1 month, followed by a reduction to 0 (0) at both 3 months and 6 months, indicating gradual improvement in sensory function over time. The overall comparison demonstrated a statistically significant difference with a Friedman test statistic of 14.302 ($p=0.003$). These findings suggest progressive recovery of neurosensory function in the postoperative period following bilateral sagittal split osteotomy **(Table 1).**

Table 1: Intragroup comparison of two-point discrimination scores across postoperative follow-up performed using Friedman test

Time points	Median (IQR)	Friedman Test statistic	df	p value
Post-op 1 week	0.5 (2)	14.302	3	0.003**
Post-op 1 month	0.5 (1)			
Post-op 3 months	0 (0)			
Post-op 6 months	0 (0)			

*$p<0.05$ is statistically significant
**$p<0.01$ is statistically highly significant

Post-hoc pairwise comparisons of two-point discrimination scores were performed using the Wilcoxon signed-rank test with Bonferroni adjustment ($p<0.008$). The comparisons between

postoperative intervals showed Z values ranging from -2.236 to -1.000 with corresponding p-values of 0.157, 0.038, 0.038, 0.025, 0.034 and 0.317. Although some comparisons demonstrated lower p-values on unadjusted analysis, none of these remained statistically significant after Bonferroni correction ($p<0.008$), indicating that the improvement observed across time was reflected in the overall test rather than in individual pairwise differences **(Table 2).**

Table 2: Post-hoc pairwise intragroup comparison of two-point discrimination scores performed using Wilcoxon signed-rank test (Bonferroni-adjusted)

Time points	Z	p value
Post-op 1 month vs Post-op 1 week	-1.414	0.157
Post-op 3 months vs Post-op 1 week	-2.070	0.038
Post-op 6 months vs Post-op 1 week	-2.070	0.038
Post-op 3 months vs Post-op 1 month	-2.236	0.025
Post-op 6 months vs Post-op 1 month	-2.121	0.034
Post-op 6 months vs Post-op 3 months	-1.000	0.317

Bonferroni adjusted significance level $p < 0.008$ (0.05/6)
None of the pairwise comparisons remained significant after Bonferroni correction ($p<0.008$)

Pin-prick sensation was evaluated as normal or diminished and analysed across postoperative intervals using Cochran's Q test. At 1 week postoperatively, normal sensation was observed in 6 patients (60%), while 4 patients (40%) demonstrated diminished sensation. At 1 month, the frequency of normal sensation increased to 7 patients (70%) with diminished sensation observed in 3 patients (30%). By 3 months, 9 patients (90%) exhibited normal sensation and only 1 patient (10%) had diminished sensation, whereas at 6 months all patients (10, 100%) demonstrated normal sensation with complete resolution of diminished responses. The overall change in sensory status across the follow-up period was statistically significant with Cochran's Q statistic of 8.571 ($p=0.036$) **(Table 3).**

Table 3: Intragroup comparison of pin-prick sensation across postoperative follow-up performed using Cochran's Q test

Time points	Normal N (%)	Diminished N (%)	Cochran's Q statistic	df	p value
Post-op 1 week	6 (60%)	4 (40%)	8.571	3	0.036*
Post-op 1 month	7 (70%)	3 (30%)			
Post-op 3 months	9 (90%)	1 (10%)			
Post-op 6 months	10 (100%)	0 (0%)			

*$p<0.05$ is statistically significant
**$p<0.01$ is statistically highly significant

Post-hoc pairwise comparison for pin-prick sensation between postoperative time points was performed using the McNemar test with Bonferroni correction ($p<0.008$). The computed p-values for available comparisons were 1.000 for 1 week versus 1 month, 0.250 for 1 week versus 3 months, and 0.500 for 1 month versus 3 months. Comparisons involving the 6-month follow-up could not be computed due to the absence of discordant pairs, as all patients exhibited normal sensation at this time point. None of the pairwise comparisons demonstrated statistical significance after Bonferroni adjustment **(Table 4).**

Table 4: Post-hoc pairwise intragroup comparison of pin-prick sensation performed using McNemar test (Bonferroni-adjusted)

Time points		Normal N (%)	Diminished N (%)	McNemar statistic	p value

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Post-op 1 week vs Post-op 1 month	Normal N (%)	6 (100%)	0 (0%)	Not applicable	1.000
	Diminished N (%)	1 (25%)	3 (75%)		
Post-op 1 week vs Post-op 3 months	Normal N (%)	6 (100%)	0 (0%)	Not applicable	0.250
	Diminished N (%)	3 (75%)	1 (25%)		
Post-op 1 week vs Post-op 6 months	Normal N (%)	6 (100%)	0 (0%)	Exact McNemar not computed (no discordant pairs)	—
	Diminished N (%)	4 (100%)	0 (0%)		
Post-op 1 month vs Post-op 3 months	Normal N (%)	7 (100%)	0 (0%)	Not applicable	0.500
	Diminished N (%)	2 (66.7%)	1 (33.3%)		
Post-op 1 month vs Post-op 6 months	Normal N (%)	7 (100%)	0 (0%)	Exact McNemar not computed (no discordant pairs)	—
	Diminished N (%)	3 (100%)	0 (0%)		
Post-op 3 months vs Post-op 6 months	Normal N (%)	9 (100%)	0 (0%)	Exact McNemar not computed (no discordant pairs)	—
	Diminished N (%)	1 (100%)	0 (0%)		

Bonferroni adjusted significance level p < 0.008 (0.05/6)
None of the pairwise comparisons remained significant after Bonferroni correction (p<0.008)

Postoperative pain intensity was evaluated using the visual analogue scale and analysed across follow-up using the Friedman test for intragroup comparison. The median (IQR) VAS score at 1 week was 1.5 (3), which decreased to 0 (0) at 1 month and remained 0 (0) at both 3 months and 6 months, indicating substantial reduction in pain following the early postoperative period. The overall difference across follow-up intervals was statistically significant with a Friedman test statistic of 15.000 (p=0.002), demonstrating significant reduction in pain scores during recovery **(Table 5).**

Table 5: Intragroup comparison of postoperative pain (VAS) across follow-up performed using Friedman test

Time points	Median (IQR)	Friedman Test statistic	df	p value
Post-op 1 week	1.5 (3)	15.000	3	0.002**
Post-op 1 month	0 (0)			
Post-op 3 months	0 (0)			
Post-op 6 months	0 (0)			

*p<0.05 is statistically significant
**p<0.01 is statistically highly significant

Post-hoc pairwise comparisons of VAS scores were performed using the Wilcoxon signed-rank test with Bonferroni correction (p<0.008). Comparisons between 1 week and later postoperative periods (1

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month, 3 months, and 6 months) showed Z values of -2.070 with p-values of 0.038 for each comparison. Comparisons among the later follow-up periods showed Z=0.000 with p=1.000, reflecting identical scores. However, none of the comparisons reached statistical significance after Bonferroni adjustment **(Table 6).**

Table 6: Post-hoc pairwise intragroup comparison of postoperative pain (VAS) performed using Wilcoxon signed-rank test (Bonferroni-adjusted)

Time points	Z	p value
Post-op 1 month vs Post-op 1 week	-2.070	0.038
Post-op 3 months vs Post-op 1 week	-2.070	0.038
Post-op 6 months vs Post-op 1 week	-2.070	0.038
Post-op 3 months vs Post-op 1 month	0.000	1.000
Post-op 6 months vs Post-op 1 month	0.000	1.000
Post-op 6 months vs Post-op 3 months	0.000	1.000

Bonferroni adjusted significance level $p < 0.008$ (0.05/6)
None of the pairwise comparisons remained significant after Bonferroni correction ($p<0.008$)

The box-and-whisker plot illustrates the distribution of two-point discrimination scores across the postoperative time points, showing higher variability during the early follow-up period and clustering of values at zero by 3 and 6 months, indicating progressive recovery of neurosensory function **(Figure 1).**

Figure 1: Box and whisker plot for two point discrimination score across various post-operative time points

The bar graph demonstrates a gradual increase in the proportion of patients with normal pin-prick sensation from 60% at 1 week to complete recovery (100%) by 6 months, with a corresponding decline in diminished sensation across the follow-up period **(Figure 2).**

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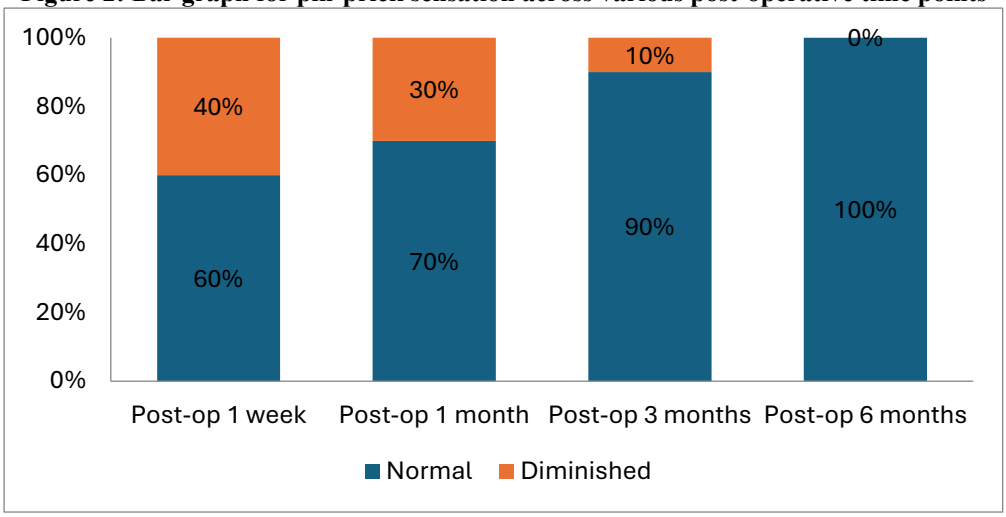
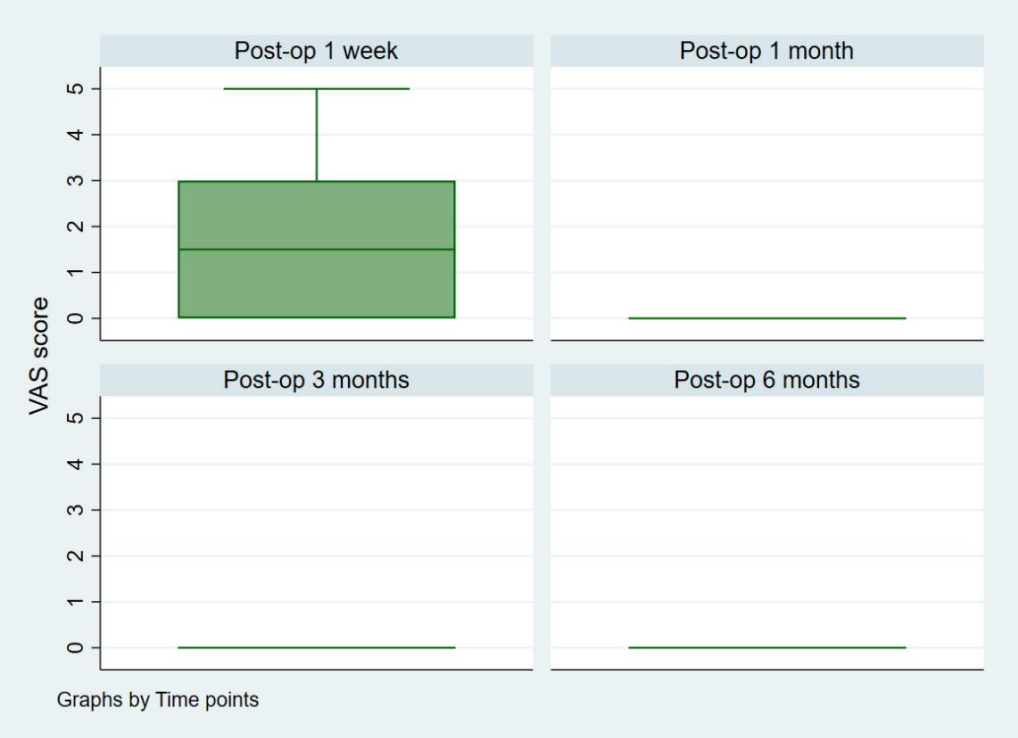
Figure 2: Bar graph for pin-prick sensation across various post-operative time points



The box-and-whisker plot for VAS scores shows wider dispersion at 1 week and complete clustering at zero from 1 month onward, reflecting rapid resolution of postoperative pain and stabilization of pain scores during later follow-up **(Figure 3).**

Figure 3: Box and whisker plot for VAS score across various post-operative time points



V. Discussion:

Bilateral Sagittal Split Osteotomyremains the most widely performed mandibular orthognathic procedure due to its versatility, broad bony contact, and stable fixation outcomes. However, neurosensory disturbance of the inferior alveolar nerve continues to be its most frequent postoperative complication [8]. The present case series evaluated postoperative neurosensory outcomes in 10 consecutive patients and demonstrated a high incidence of immediate postoperative sensory alteration with substantial recovery over time.

In our cohort, 80% of patients experienced neurosensory alteration in the immediate postoperative period. This finding is consistent with

previously reported literature, where early postoperative NSD ranges between 60–90%. The high initial incidence is attributable to unavoidable manipulation of the IAN during medial osteotomy, sagittal splitting, and mobilization of the distal segment. Edema within the mandibular canal and transient conduction block further contribute to early sensory changes.

Importantly, progressive recovery was observed during follow-up, with the majority of patients demonstrating significant improvement by 3 months and near-complete recovery by 6 months. Only one patient exhibited persistent mild hypoesthesia at the final follow-up. This pattern strongly suggests that most neurosensory deficits following BSSO are neuropraxic in nature, characterized by temporary demyelination without axonal discontinuity. Peripheral nerve recovery through remyelination and resolution of inflammatory edema likely explains the favorable outcomes observed.

Several factors influence neurosensory prognosis after BSSO [9]. Patient age is an important determinant, as younger individuals exhibit enhanced neural regenerative capacity. The magnitude of mandibular advancement or setback may also affect nerve stretch and compression. Intraoperative variables such as proximity of the mandibular canal to the buccal cortex, difficulty of sagittal split, and need for nerve manipulation play critical roles. In our series, adherence to a standardized surgical protocol, controlled splitting technique, and use of monocortical miniplate fixation likely minimized direct nerve trauma and compression, contributing to satisfactory recovery [10].

The method of neurosensory assessment also significantly influences reported incidence rates. Objective tests such as two-point discrimination and light-touch evaluation provide measurable data, whereas subjective patient-reported outcomes reflect functional perception [11]. The combined use of both modalities in this series allowed for a comprehensive evaluation of sensory recovery and improved documentation reliability.

From a clinical perspective, although most deficits are transient, altered sensation of the lower lip and chin can affect speech, mastication, oral competence, and patient satisfaction [12]. Therefore, thorough preoperative counseling regarding the possibility of temporary paresthesia is essential. Structured postoperative neurosensory monitoring not only reassures patients but also serves medico-legal documentation purposes.

VI. Limitations

The main limitation of this study is the small samplesize and relatively short follow-up period. Additionally, advanced quantitative sensory testing or electrophysiological evaluation was not performed, which may have provided more detailed functional assessment. Larger prospective studies with standardized neurosensory grading scales and longer follow-up are warranted to better define predictors of persistent deficits.

VII. Conclusion

These 10 cases demonstrates that postoperative neurosensory disturbance following BSSO is common in the immediate postoperative period but largely transient. With meticulous surgical technique and structured follow-up, permanent sensory deficits are uncommon, BSSO remains a safe and reliable procedure, where functional recovery of the inferior alveolar nerve can generally be expected within six months in the majority of patients.

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