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Sagittal split osteotomy with or without third molar removal: A prospective cohort study on inferior alveolar nerve disturbances

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Abstract

Objective: The aim of this study is to evaluate whether the simultaneous removal of mandibular third molars during sagittal split osteotomy (SSO) influences the incidence and severity of postoperative neurosensory disturbances of the inferior alveolar nerve (IAN).

Material and methods: In this prospective cohort study, 172 SSO procedures were analyzed at the Department of Oral and Maxillofacial Surgery, AZ Vitaz Hospital, Belgium. Patients were divided into two groups: those with no third molars present (Group I, *n* = 117) and those undergoing simultaneous third molar removal during SSO (Group II, *n* = 55). Neurosensory function was evaluated at 1 day, 1 week, 3 weeks and 6 weeks postoperatively using objective (Medical Research Counsel (MRC) scale, two-point discrimination, static light touch, sharp/blunt discrimination) and subjective measures. Logistic regression and ANCOVA were used to assess associations between third molar status and neurosensory outcomes.

Results: In both groups, high sensory recovery rates were achieved six weeks after surgery: 91% and 95%, respectively. There were no statistically significant differences between the groups in terms of the duration required to reach functional sensory recovery ($p = .650$), final MRC score distribution ($p = .702$), two-point discrimination scores, or static light touch or sharp/blunt discrimination. Entrapment of the IAN occurred more frequently in patients with third molars (69.1% vs. 53.8%), but this difference was not statistically significant ($p = 0.058$). Entrapment and patient age were significant predictors of neurosensory complaints. No adverse outcomes occurred in either group.

Conclusions: Simultaneously removing mandibular third molars during SSO does not significantly impact postoperative neurosensory outcomes. Age and inferior alveolar nerve (IAN) entrapment are more critical risk factors for altered sensation. These findings support the safety of removing third molars at the same time as orthognathic surgery.

Keywords: sagittal split osteotomy, third molars, inferior alveolar nerve, neurosensory disturbance, orthognathic surgery

Introduction

The optimal timing of third molar (M3) removal in relation to orthognathic surgery is still a topic of debate. Some authors recommend extracting the third molars (M3s) six to nine months prior to sagittal split osteotomy (SSO), as the presence of M3s can increase the risk of unfavorable fractures and cause technical difficulties. In contrast, simultaneous removal can reduce the need for multiple surgeries and facilitate better exposure of impacted molars, which could potentially reduce overall treatment time [1].

A meta-analysis found no significant association between the presence of M3s and complications such as nerve entrapment in the proximal segment, infection, the need to remove a plate, or 'bad' splits [2, 3].

A common complication of SSO is neurosensory disturbance of the inferior alveolar nerve (IAN) following surgery. Nerve positioning in the proximal segment, which is observed in 10–60% of cases, often necessitates manipulation, thereby increasing the risk of nerve injury. While some literature suggests that the presence of M3s correlates with higher rates of proximal segment attachment, paradoxically, lower rates of neurosensory deficit have been reported when M3s are present and removed simultaneously. These findings conflict with our clinical experience [3-9].

This study aimed to investigate the incidence and potential risk factors of IAN injury following SSO, paying particular attention to the role of the presence of M3s at the time of surgery. The study also aimed to compare these findings with those reported in the existing literature [10]. Our hypothesis is as follows: the presence of impacted mandibular M3s during SSO leads more frequently to the need for dissection or bony release of the IAN resulting in a higher incidence of postoperative hypo- or dysesthesia in the IAN region.

Materials and methods

Study Design and Setting

A prospective cohort study was conducted at the Department of Oral and Maxillofacial Surgery at AZ Nikolaas Hospital in Sint-Niklaas, Belgium. Ethical approval was obtained from the hospital's Institutional Review Board.

Participants

All patients undergoing orthognathic surgery between December 2023 and April 2024 were screened. The inclusion criteria comprised patients undergoing bilateral SSO, either as a standalone procedure or as part of bimaxillary surgery. Exclusion criteria included:

- Pre-existing IAN damage,
- History of previous SSO or mandibular fracture,
- Removal of mandibular M3s within six months of surgery,
- Failure to attend follow-up assessments.

Groups

The participants were divided into two groups:

- Group I: patients undergoing SSO without M3s present (either congenitally absent or removed at least six months prior to surgery).
- Group II: patients undergoing SSO with the simultaneous removal of mandibular M3s.

Surgical procedure

All surgeries were performed by one of six experienced oral and maxillofacial surgeons, with residents providing assistance. The Hunsuck modification of the Obwegeser–Dal Pont technique was performed under general anesthesia with nasotracheal intubation. A horizontal osteotomy was performed above the lingula, and a vertical incision was made between the first and second molars using a Lindemann burr. Mandibular splitting was then achieved using chisels. If present, the M3 was removed after the osteotomy was completed. Fixation was performed using one miniplate and four monocortical screws.

Primary outcome variables

The primary endpoint was the duration required to achieve objective functional sensory recovery of the IAN, as assessed at postoperative days 1, 1 week, 3 weeks and 6 weeks.

Objective evaluations were therefore conducted in three mental nerve territories: the vermilion, labial and mental skin areas (Figure 1).

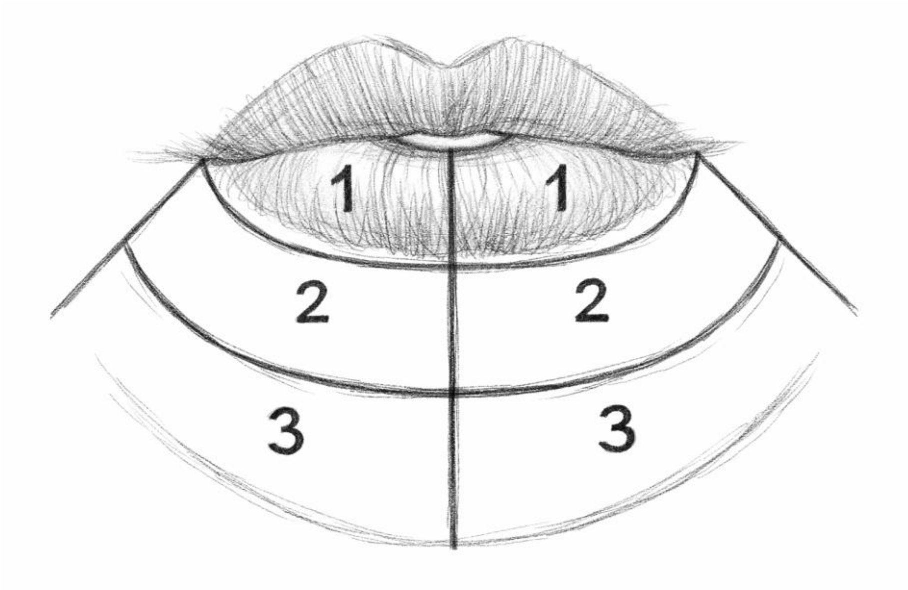

Fig. 1. Tested areas of mental nerve distribution: 1, vermillion; 2, labial skin; 3, mental skin [10]

Three standardised tests were employed (Table 1):

- **Two-point discrimination (2-PD)**: A blunt graduated calliper was incrementally opened until consistent discrimination (≥80%) of two points was achieved.
  The measured distance at each location was subtracted from the corresponding baseline (preoperative) value. If the postoperative value was lower than the preoperative measurement, the resulting difference was adjusted to 0 mm to avoid negative values in the dataset.
- **Static light touch detection (LT)**: Conducted using a 3.22 Semmes-Weinstein monofilament applied perpendicular to the skin.
- **Sharp/Blunt Discrimination (SB)**: Random application of sharp and blunt stimuli requiring ≥80% correct identification.

Table 1. Objective neurosensory tests and assessment details

Test	Purpose	Instrument	Assessment criteria
Two-Point Discrimination (2-PD)	Assess spatial tactile acuity	Blunt graduated caliper	Consistent discrimination of two points (≥80%)
Static Light Touch (LT)	Detect light cutaneous touch	Semmes-Weinstein 3.22 monofilament	Positive response 4 out of 5 times (≥80%)
Sharp/Blunt Discrimination (SB)	Distinguish nociceptive vs blunt stimulus	Sharp and blunt mechanical probe	Correct identification 4 out of 5 times (≥80%)
Functional Sensory Recovery (FSR)	Global neurosensory function	Composite (2-PD, LT, SB + MRC scale)	Defined as MRC score ≥ S3

Patients underwent testing with their eyes closed and their lips relaxed. The examiners were blinded to the previous results and group allocation. A global neurosensory recovery score was calculated from these tests based on the British Medical Research Council (MRC) grading system. Functional sensory recovery (FSR) was defined as an MRC score of at least S3 (Table 2).

Table 2. Objective neurosensory tests and assessment details

Score	Parameter	FSR
S0	No sensation	No
S1	Pain sensation (deep)	No
S2	Pain sensation (superficial)	No
S2+	Pain and touch sensation with hyperesthesia	No
S3	As S2+, withouth hyperesthesia, with 2-PD >15mm	Yes
S3+	As S3, 2-PD 7-15mm	Yes
S4	As S3+, 2-PD 2-6mm	Yes

Abbreviations: FSR (functional sensory recovery); 2-PD (2-point discrimination)

As patients with established functional sensory recovery were not routinely monitored beyond this point, the last available measurement for each patient regarding 2-PD, LSS, SB, subjective assessment and the MRC scale was used to evaluate the final 2-PD scores and static light touch (LT) or sharp/blunt (SB) discrimination at the six-week time point.

Secondary outcome variables

Secondary outcome measures included recording subjective, patient-reported neurosensory complaints at each postoperative time point (day 1, week 1, week 3 and week 6). In addition, secondary surgical variables were recorded:

- The presence of an unfavourable fracture during SSO
- The degree of IAN entrapment and manipulation at the time of splitting
- The total time required to achieve the mandibular split.

Additional data collected included patient age and gender; magnitude of mandibular movement; and surgeon experience (categorized as staff or resident).

Statisitical analysis

The data were collected in a Microsoft Excel database (Microsoft Inc., Redmond, WA, USA). The data were analyzed using JASP software (version 0.19.1.0, JASP Team, Amsterdam, the Netherlands). As the assumptions for independent sample t-tests were violated (Shapiro–Wilk normality test or Brown–Forsythe test for equality of variances), Mann–Whitney U tests were used to compare continuous variables describing both groups.

Categorical variables were compared using chi-square tests. Logistic regression and ANCOVA models were employed to evaluate the associations between the presence of M3s, neurosensory outcomes and the following covariates: age, sex, magnitude of mandibular movement, surgical duration, surgeon experience and IAN entrapment. Statistical significance was set at $p < 0.05$.

Results

A total of 172 SSOs were included: 117 procedures were performed without M3s present (Group I), and 55 procedures involved the concurrent removal of M3s (Group II).

The mean patient age was significantly higher in Group I (22.5 ± 9.3 years) than in Group II (15.9 ± 1.7 years; $p < 0.001$). The gender distribution and surgical time were similar between groups (Group I = 12.0 ± 5.3, Group II = 12.0 ± 6.0, p = .991). The magnitude of mandibular movement was slightly higher in Group II, but this difference was not statistically significant (p = .163).

Functional sensory recovery

Functional sensory recovery (FSR; MRC ≥ S3) was assessed at four timepoints after surgery: day 1, week 1, week 3 and week 6. The rate of FSR increased progressively over time in both groups (Figure 2).

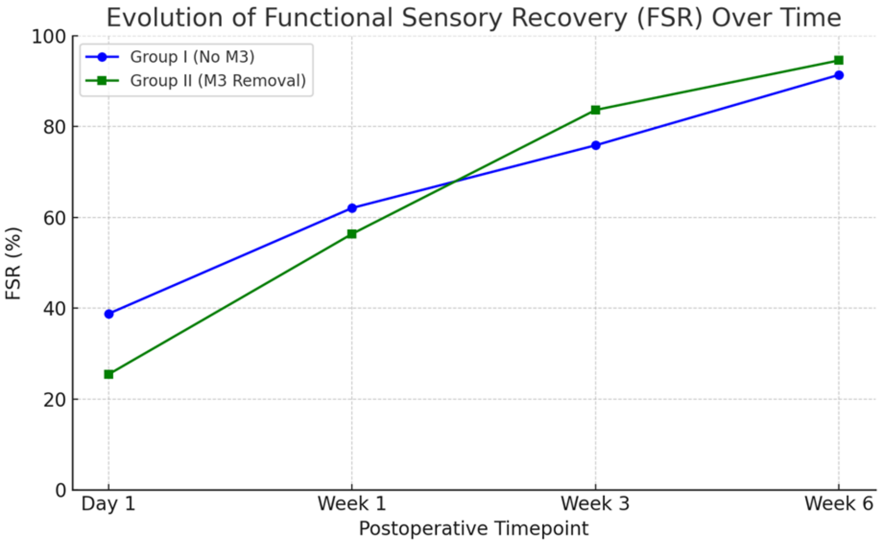

Fig. 2. Evolution of functional sensory recovery (FSR) over time in Group I and Group II.

In Group I (no M3s removal; n = 116), 45 patients (39%) had achieved FSR by day 1, rising to 72 patients (62%) by week 1, 88 patients (76%) by week 3 and 106 patients (91%) by week 6.

In Group II (M3s removal; n = 55), 14 patients (25%) achieved FSR by day 1, rising to 31 patients (56%) by week 1, 46 patients (84%) by week 3, and 52 patients (95%) by week 6. No statistically significant differences between the groups were observed at any timepoint ($p > 0.05$) (Table 3).

Table 3. Functional sensory recovery (FSR) over time

Timepoint	Group I (No M3s, n=116)	Group II (M3s Removal, n=55)
Day 1	39% (45/116)	25% (14/55)
Week 1	62% (72/116)	56% (31/55)
Week 3	76% (88/116)	84% (46/55)
Week 6	91% (106/116)	95% (52/55)

Analysis of the time taken to achieve functional sensory recovery, as measured by FSR = MRC ≥ S3, showed no significant difference between the two groups ($p = .650$). Most patients in both groups achieved an MRC grade of 3 or higher by the final follow-up.

Covariate analysis

Several patient-related and surgical covariates were included in a multivariate analysis to assess potential confounding variables influencing neurosensory outcomes (Table 4):

- **Gender**: No meaningful association with neurosensory recovery was found ($p = .973$)
- **Age**: A minimal, statistically non-significant effect was demonstrated ($p = .372$)
- **Magnitude of advancement/setback**: This variable approached statistical significance ($p = 0.105$), suggesting a potential trend towards influencing sensory recovery, though this was not definitive
- **Osteotomy duration**: No statistically significant association was found with recovery outcome ($p = .432$)
- **IAN entrapment**: Although a negative effect on recovery was observed, it was not statistically significant ($p = 0.103$); however, the trend aligns with clinical expectations
- **Operator**: (resident or staff): showed no statistically significant association with recovery outcome ($p = 0.707$).

These results suggest that none of the evaluated covariates had a statistically significant impact on the primary outcome of functional sensory recovery. This supports the robustness of the group comparisons.

Table 4. Multivariate analysis of covariates on functional sensory recovery (FSR)

Covariate	Effects on FSR	p-value
Gender	No meaningful association	0.973
Age	Minimal, not significant	0.372
Magnitude of advancement/setback	Trend toward significance	0.105
Osteotomy duration	Not significant	0.432
IAN entrapment	Negative trend, not significant	0.103
Operator (Resident vs Faculty)	Not significant	0.707

Two-Point discrimination (2-PD)

The mean 2-PD scores at six weeks were comparable between the two groups across all areas of the mental nerve distribution that were measured.
ANCOVA analysis revealed that the presence of M3s had no significant effect on the vermillion, labial skin or mental skin areas ($p = .823$, .231 and .284, respectively).

Static light touch (LT) and sharp/blunt discrimination (SB)

No significant differences were observed between groups for static light touch (LT) or sharp/blunt (SB) discrimination at six weeks. Logistic regression models adjusted for age, gender, duration, operator status, IAN entrapment and advancement showed no significant effect of third molar status on LT (vermillion $p = .367$; labial skin $p = .803$; mental skin $p = .858$) or SB (vermillion $p = .219$; labial skin $p = .335$; mental skin $p = .510$).

IAN entrapment

Although IAN entrapment occurred more frequently in procedures involving M3s (69.1%) than in those without (53.8%), this trend did not reach statistical significance ($p = .058$). Nevertheless, logistic regression analysis showed that IAN entrapment was a significant predictor of lower MRC scores after six weeks ($p < 0.001$).

Subjective neurosensory complaints

Six weeks after surgery, 'normal sensation' was reported by 36.4% of patients in Group I versus 34.5% in Group II. Non-disturbing paresthesia was reported by 28.2% and 27.3% of patients in Groups I and II, respectively, while disturbing complaints were reported by 35.5% and 38.2% of patients in Groups I and II, respectively. There was no significant difference in the distribution of subjective complaints between the two groups ($p = .116$), although an increased age and IAN entrapment were associated with poorer subjective outcomes.

Bad splits

No unfavorable intraoperative splits ('bad splits') were observed in either group.

Discussion

Unlike previous studies, including that of Doucet et al., our study found no statistically significant benefit in reducing IAN disturbance after SSO from simultaneous M3s removal. Comparable recovery rates were observed using both objective and subjective measures, including 2-PD, LT, SB and FSR, between patients who had M3s removed during SSO and those who did not [10].

Interestingly, although IAN entrapment was more prevalent among those with M3s, it did not result in poorer functional outcomes. This finding supports the hypothesis that the presence of M3s alone does not determine neurosensory recovery. Instead, entrapment itself and age were found to be significant predictors of poorer out-comes, which is consistent with previous studies. Our criteria for identifying entrapped nerves were very low, which may partly explain the higher entrapment rates. Our observations suggest that nerve decompression procedures can be performed more easily in younger patients, probably because they have comparatively reduced cortical bone density and increased osseous pliability. These anatomical differences may account for improved surgical access and facilitate smoother release [3, 6, 8].

Importantly, there were no adverse splits in either group, which further supports the safety of the procedure for simultaneous M3s removal during SSO. This contradicts concerns reported in previous literature regarding technical complications associated with impacted third molars at the osteotomy site [1, 5].
Unlike Doucet et al., we did not observe any significant impact of mandibular movement size, surgical time or operator experience on recovery. Our findings suggest that M3s removal during SSO is not harmful. Both groups achieved similar recovery rates, which aligns with de Souza et al.'s meta-analysis [4, 9, 10].

One of the most notable findings of our study was the occurrence of persistent subjective neurosensory complaints in patients who demonstrated normal results in objective tests. This discrepancy between patient-reported symptoms and clinical assessments is well documented in the literature [11-15]. For example, studies have shown that the subjective experience of sensory deficits may not always align with objective measurements, potentially due to psychological factors such as anxiety or individual pain perception thresholds [11-15]. In the context of nerve repair, patients have reported ongoing discomfort despite normal objective assessments, suggesting that subjective evaluations capture aspects of sensory experience that are not fully measured by clinical tests. These findings highlight the importance of incorporating both subjective and objective assessments in postoperative evaluations to ensure a comprehensive understanding of patient outcomes [11-15].

The simultaneous removal of M3s during SSO appears to be safe procedure, with no statistically significant increase or decrease in IAN neurosensory disturbances. However, IAN entrapment and patient age remain the strongest predictors of post-operative neurosensory deficits.

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Authors contribution:

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Blok Jorden	Data curation, Conceptualization
Maleux Olivia	Data curation
Politis Christophe	Data curation
Gorlé Dominique	Data curation
Berquin Kristof	Data curation
Snel Robin	Data curation, Conceptualization, Writing review and editing
Kalantary Sofia	Data curation

Ongena Sebastien	Data curation
Bral Alexander	Data curation
Lenaerts Vincent	Writing review and editing, Conceptualization, Supervision

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