Incidence of long-lasting neurosensory disturbances after bilateral sagittal split osteotomy: a questionnaire study

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Abstract

Introduction
The aim of the present study was to highlight the incidence and patients’ subjective perception of neurosensory disturbance and the degree of satisfaction after bilateral sagittal split osteotomies, at least 3 years after surgery.

Materials and Methods
The sample population consisted of all 52 consecutively operated subjects who had undergone bilateral sagittal split osteotomies between the years 2003 and 2008 at the Department of Maxillofacial Surgery at Örebro University Hospital. Patients were contacted by a letter and asked to complete a questionnaire about perceived sensory changes after the operation and their satisfaction with the result of the operation.

Discussion
The lack of standard methods for evaluating neurosensory disturbance is evident. Thus, the evaluation methods in the literature vary from strictly subjective to strictly objective. However, the most important factor, from the patient’s point of view, must be the patient’s own perception of the nerve impairment, not what the objective results indicate.

Results
Thirty-seven subjects (71%) returned the questionnaire and of these 19 subjects (51%) had long-lasting NSD. Still, 89% were satisfied with the result of the operation.

Conclusion
Half of the operated subjects had long-lasting neurosensory disturbance. However, the majority of the patients (89%) were satisfied with the result of the operation despite sensory disturbances of some degree. It appears that neurosensory disturbance is not the main determining factor of patient satisfaction and seems outbalanced by pre-operative information and results of function and aesthetics.

Introduction
The bilateral sagittal split osteotomy (BSSO), described as early as in 1957, is the most frequently used procedure to correct mandibular skeletal discrepancies by lengthening or shortening the mandible. Neurosensory disturbances (NSDs) of the lower lip and chin following this procedure are commonly due to lesions of the inferior alveolar nerve and its terminal branch, the mental nerve. This can be caused by surgical oedema, stretching, pressure, the split itself and the possible compression of the nerve during fixation

The symptoms of a nerve lesion are usually varying degrees of numbness of the lower lip and chin. Although the nerve impairment is of purely sensory nature, and consequently no motor deficit occurs, the problem concerns the patient, as anyone who has had an inferior alveolar nerve block for dental anaesthesia can well understand. This sensory deficit is not only an unpleasant sensation, but may also affect the patient’s ability to talk and masticate efficiently without traumatising the involved area.

Discussion
There are many published studies of NSD in patients undergoing orthognathic surgery, but there are a few studies evaluating the patients’ own perception, which could differ from the surgeon’s judgement, and often is underestimated by clinicians when compared to the patients’ subjective symptoms.

Most studies on the outcome of sensory function after BSSO have used the final follow-up for evaluation (2–2.5 years). The aim of the present study was to descriptively highlight the incidence and patients’ subjective perception of sensory impairment in the lower lip and chin and the degree of satisfaction after mandibular orthognathic surgery with BSSO at least 3 years after surgery.

Materials and Methods
The study protocol was approved by the Regional Ethical Review Board in Uppsala, Sweden, which follows the guidelines of the Declaration of Helsinki.

All the patients (n = 52, 23 men and 29 women) who had an up-to-date address and had undergone BSSO, between the years 2003 and 2008, at the Department for Maxillofacial Surgery at Örebro University Hospital, Örebro, were contacted by a letter and were asked to participate in this study. The records of these patients were reviewed at the Department of Orthodontics in Örebro County.

Subjects with craniofacial syndromes, facial trauma, pre-existing NSD and out-of-date home addresses were not considered eligible for the study. Seven subjects fulfilled the exclusion criteria.

The youngest patient in this study was 21 years old. The observation
Research study

Figure 1: The relationship between the age of the patients and the incidence of short-term (< 1 year) and long-lasting neurosensory disturbance, NSD (>1 year). One patient with long-lasting NSD did not specify her age group in the questionnaire.

period between the years 2003 and 2008 indicates a follow-up from 3 up to 8 years post-operation in this study. The operation technique used for BSSO at the Department for Maxillofacial Surgery was standardised, using rigid fixation for stabilising the osteotomy sites.

Questionnaires, an information letter explaining the aim of the study and an informed consent letter were mailed to all 52 patients, who were asked to sign the consent letter as an agreement of participating in the study. A contact telephone number was also provided for those who required any further information and a stamped addressed envelope was enclosed to facilitate the return of the questionnaire and the consent letter. Two reminder letters were sent 2 and 4 months later to those who did not return the questionnaire.

The main outcome variable was sensory alteration. The main independent variables that could influence the association in focus were sex, age at the time of operation and type of operation.

Questionnaire
The questionnaire used in this study was a slightly modified version of a questionnaire earlier used by Al-Bishri et al. and could therefore be considered validated (Appendix 1). The modifications of the questionnaire concerned two additional questions regarding patients’ sex and civil status.

Patients were asked about perceived sensory changes in the lower lip and chin area after the operation, the duration of these alterations and their satisfaction with the result of the operation. If NSD persisted more than 1 year, it was interpreted as long-lasting disturbance. On a visual analogue scale, VAS, the patients could mark the severity of the altered sensation from no discomfort to intolerable discomfort. To evaluate the NSD, the grades of the VAS were interpreted into: 0–2, no discomfort; 2–4, mild discomfort; 4–6, moderate discomfort; 6–8, moderate-to-severe discomfort; 8–10, severe discomfort.

To evaluate eventual age differences, patients were divided into three groups: 21–30 years, 31–40 years and > 40 years.

Statistics
Statistical calculations using Chi-square test was performed to evaluate group differences, with statistical significance set as $P < 0.05$.

Results
Of 52 subjects, 37 (71%) signed the consent letter, completed and returned the questionnaire (Table 1). Twenty-eight subjects returned the questionnaire after the first dispatch and an additional nine subjects after the first (four subjects) and second (five subjects) reminder letter. The returned questionnaires reported perceived sensory alteration in the lower lip and/or chin area in 26 subjects (70%) up to 1 year after the operation which persisted in 19 (51%)
subjects and therefore considered long-lasting. Nine of these 19 subjects had bilateral sensory disturbances. One patient did not fill in her age group in the questionnaire and in one other patient, when examining the patient’s records it was unclear which type of operation the patient had undergone. These patients were excluded from analyses when relevant data were concerned.

No significant differences were found between the sex, age at time of operation and the type of operation with the NSD in this study (Figures 1–3).

Thirty-three patients (89%) were satisfied with the result of the operation and would also recommend the surgery to others.

Of 37 responding subjects, most had some disturbance, and in many patients this was long-lasting (>1 year). However, the degree of discomfort varied much between patients with disturbance. Still, 24 of 34 stated no or mild/moderate discomfort, even patients with long-lasting disturbances (Figure 4).

**Discussion**

NSD following orthognathic surgery has been extensively described for BSSO, but its reported prevalence varies. Immediate postoperative paresthesia is common, with reports of 80–100% incidence. Follow-up of BSSO patients has shown a prevalence of 0–85% 1 or 2 years post-operatively. In this study, the incidence of self-reported, long-lasting NSD was 51%, 3 to 8 years post-operatively.

The incidence of NSD in this material was rather high. Because of the standardised operation technique and usage of rigid fixations in all three types of mandibular corrections, one could speculate that the skills of the operators could have had some bearing and impact on the NSD incidence in this study even though the aim of this study was not to speculate on the reasons for this high incidence.

The lack of standard methods for evaluating NSD is evident. Thus, the evaluation methods in the literature vary from strictly subjective to strictly objective. And some researchers have reported that patients could report a higher incidence of NSD with subjective assessments. Cunningham et al. found that more than 70% of 101 patients subjectively reported neurosensory problems, but objective assessment identified NSD in less than 60% of the patients. They concluded that patients seem to over-report NSD. No matter which objective test is used to identify a sensory defect, assessment of inter-examiner reliability is important, as the ability of the objective test to discriminate between impaired and unimpaired sensation may vary depending on the examiner. On the other hand, it appears as if some patients can adapt and report normal neurosensory function, even though objective testing indicates continued neurosensory deficit.

A positive correlation between subjective evaluation and objective assessment of the nerve impairments in the lower lip has also been reported.

As mentioned earlier, the differences shown in the literature can be explained by the lack of a standard method to evaluate neurosensory function.

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**Table 1 Patient characteristics**

<table>
<thead>
<tr>
<th>Subjects n = 37</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td>Median (range)</td>
</tr>
<tr>
<td>28 (21–58)</td>
<td></td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
</tr>
<tr>
<td>Men, n (%)</td>
<td>14 (38)</td>
</tr>
<tr>
<td>Women, n (%)</td>
<td>23 (62)</td>
</tr>
<tr>
<td><strong>Type of correction with BSSO</strong></td>
<td></td>
</tr>
<tr>
<td>Advancement, n</td>
<td>11</td>
</tr>
<tr>
<td>Set-back, n</td>
<td>15</td>
</tr>
<tr>
<td>Open-bite closure, n</td>
<td>9</td>
</tr>
</tbody>
</table>

*In two patients, it was unclear which kind of operation the patients had undergone; the question was not answered.*

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**Figure 2:** The correlation between gender and NSD.

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However, the most important factor, from the patient's point of view, must be the patient's own perception of the nerve impairment, not what the objective results indicate. The aim of the current study was not to determine factors associated with the causes of NSD such as skills of the operators, type of mandibular movement or other elements influencing risk for damage to the inferior alveolar nerve, but we wanted to focus on the patients' own perception of the NSD and the operation they had undergone.

Lee et al.\textsuperscript{14} illustrated the patients' emotions after orthognathic surgery when it came to emotions associated with the altered sensations. In that study, the majority of patients were disappointed and few were upset or angry. In our study, the majority of the patients were satisfied with the results of the surgery and proclaimed either no discomfort or mild-to-moderate discomfort despite their symptoms and altered sensations. This could be due to the extent of detailed information, which all orthognathic surgery patients in Orebro county receive before the surgery about the risks of the operations. Our results are however in accordance with the results reported by Wijbenga et al.\textsuperscript{7} where over 90% were satisfied with the final results of the BSSO and would also recommend it to another person.

No significant correlations were found between the sex and the direction of mandibular movement with the NSD in this study, which coincides with the results reported by Al-Bishri\textsuperscript{9} and Fridrich et al.\textsuperscript{10}. No significant correlation could be found between the age of the patient at operation and the incidence of NSD in the current study. In other earlier studies, an association between patient's age and NSD has been reported.\textsuperscript{3,4,15,16} The difference between the studies as to age could be due to the size of the material in this study, which was rather small to allow any definite conclusions.

According to the limitations of the current study (overall 71% response rate), it can be concluded that the incidence of the patient's perception of long-lasting NSD in this material was as high as 51%, which should be taken into consideration when informing patients prior to operation. Even if we extrapolate the result of this study according to Cunningham et al.\textsuperscript{8} which concluded that the objective assessment of NSD showed a 10% lower incidence objectively compared to the subjective evaluation, the incidence in this study would be 41% which is still a high number and exceeds the 25% incidence rate informed to the patients in the most

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maxillofacial clinics in Sweden. Consequently, the information given to the orthognathic patients at the present time informs them of a 25% risk of NSD post-operatively.

However, the majority of the patients were satisfied with the result of the operation despite sensory disturbances of some degree in their lower lip and chin. It appears that NSD is not the main determining factor of patient satisfaction and seems outbalanced by pre-operative information and results of function and aesthetics.

This study has some limitations. The lack of objective assessment of NSD is one. But as described earlier, there is a dearth of reliable standard methods for evaluating NSD. The other limitation in this study is the 71% overall response rate. This is the downside of the questionnaire studies, and it is almost impossible to achieve a higher response rate than 80%.

Conclusion
Half of the operated subjects had long-lasting NSD. However, the majority of the patients (89%) were satisfied with the result of the operation despite sensory disturbances of some degree. It appears that NSD is not the main determining factor of patient satisfaction and seems outbalanced by pre-operative information and results of function and aesthetics.

Abbreviations list
BSSO, bilateral sagittal split osteotomy; NSD, neurosensory disturbance.

References
Appendix 1
Questionnaire
1. Have you experienced any sensory disturbance after the operation in:
   ( ) Upper lip ( ) Lower lip
   ( ) Chin ( ) Cheek
   ( ) Teeth ( ) Tongue
   ( ) No sensory changes
2. In which side is your sensation altered?
   ( ) Right ( ) Left
   ( ) Both
3. If you have/had any sensory disturbance, when did this begin?
   ( ) Immediately after the operation
   ( ) Sometime after the operation
   Comments............................................
4. Would you describe the sensory disturbance as?
   ( ) Anaesthesia ( ) Pinching
   ( ) Tickling ( ) Painful
   ( ) Burning ( ) Other
   Comments............................................
5. Does the changed sensation cause any problems for you?
   ( ) Always
   ( ) At touching
   ( ) When chewing
   ( ) When talking
   ( ) When eating
   ( ) Other
   Comments............................................
6. Has the sensory change made you bite yourself by mistake in the
   ( ) Lip ( ) Cheek
   ( ) Tongue
7. Has the sensory change made you burn yourself on the lip or tongue?
   ( ) Yes ( ) No
   Comments............................................
8. How would you describe the discomfort you experience as a consequence of the altered sensation?
   Indicate with an (x) on the line below.
   0................................................................
   5................................................................
   10 No discomfort
9. For how long have you had the altered sensation?
   ( ) Less than 1 month
   ( ) 6 months
   ( ) 1 year
   ( ) More than 1 year but normal now
   ( ) More than 1 year and still altered
10. In which side is your sensation still altered?
    ( ) Right ( ) Left
    ( ) Both
11. Are you satisfied with the result of the operation?
    ( ) Yes ( ) No
    Comments............................................
12. With your experience, would you recommend this kind of treatment?
    ( ) Yes ( ) No
    Comments............................................
13. Are you a
    ( ) Woman ( ) Man
14. Born in year............
15. Status
    ( ) Single ( ) Married
    ( ) Cohabiting