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## **Bilateral sagittal split osteotomy by the splitter-separator technique: technical aspects, safety, and predictability**

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### **Citation**

Mensink, G. (2015, January 29). *Bilateral sagittal split osteotomy by the splitter-separator technique: technical aspects, safety, and predictability*. Retrieved from <https://hdl.handle.net/1887/31632>

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**Issue Date:** 2015-01-29

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## Summary



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**Chapter 1** starts with a general introduction about the bilateral sagittal split osteotomy (BSSO) in a historical perspective of this procedure. Two techniques are presented, the classic ‘mallet and chisel’ technique and the splitting of the mandible, prying and spreading, with sagittal splitters and separators. The advantages of the use of the sagittal splitters and separators over the chisel technique are stated. As in any surgery, complications occur during or after the BSSO procedure which are divided in this thesis, in neurosensory disturbances, possible relapse and bad splits during surgery. The most important and most often occurring is the neurosensory disturbances of the lower lip, which may occur due to nerve damage. The type of injury of the nerve could be, neuropraxia, axonotmesis and neurotmesis with respectively recovery within days and weeks and no total recovery. The different risks of injury during the BSSO are then discussed. Especially chiseling your way through the mandible without direct visualization of the inferior alveolar nerve is considered to cause high incidences of neurosensory disturbances (NSD) or post-operative hypoesthesia of the lower lip.

In **Chapter 2** a systematic review is described in which the available evidence was investigated to evaluate the influence of different splitting techniques, namely, “mallet and chisel” versus “spreading and prying,” used during BSSO on postoperative hypoesthesia outcomes. Eventually 14 publications met our inclusion criteria. From these 14 studies, 3 groups were defined: (1) no chisel use (4.1% NSD/site), (2) undefined chisel use (18.4% NSD/site), and (3) explicit chisel use along the buccal cortex (37.3% NSD/site). Study heterogeneity and a frequent lack of surgical detail impeded our ability to make precise comparisons between studies. However, the group of studies explicitly describing chisel use along the buccal cortex showed the highest incidence of NSD. Moreover, comparison of the study that did not use chisels with the 2 studies that explicitly described chisel use, revealed a possible disadvantage of the “mallet and chisel” group (4.1% versus 37.3% NSD/site). These results suggest that chisel use increases NSD risk after BSSO.

**Chapter 3** describes a prospective multi-center study on a group of 158 patients, aimed to determine the incidence of post-operative neurosensory disturbances of the IAN after BSSO procedures performed without the use of chisels. The percentage of BSSO split procedures that resulted in postoperative NSD was 5.1% after a follow-up period of 1 year. The percentage of patients (without genioplasty) who experienced post-operative NSD was 8.9%. The concomitant genioplasty in combination with BSSO was significantly associated with post-operative NSD. Peri-operative removal of the wisdom tooth or a Le Fort I procedure did not influence post-operative NSD.

We concluded that the use of splitting forceps and elevators without chisels leads to a lower incidence of persistent postoperative NSD after 1 year, after BSSO of the mandible, without increasing the risk of a bad split.

**Chapter 4** presents a retrospective study on a group of 18 patients to determine the amount of relapse after performing BSSO advancement in patients aged less than 18 years. A control group consisted of patients treated at 20 to 24 years of age. Cephalometric radiographs were used to determine the amount of relapse. For patients aged less than 18 years, the mean horizontal relapse after 1 year was 0.5 mm, being 10.9% of the perioperative advancement. For patients aged 20–24 years, the mean relapse was 0.9 mm, being 16.4% of the mean perioperative advancement. There were no significant differences between the age groups ( $p > 0.05$ ). We concluded that the BSSO procedure is a relatively stable procedure, even during adolescence.

**Chapter 5** describes the results of a pilot study on 10 cadaveric pig mandibles to analyze the splitting pathways of the (lingual) fracture lines during a BSSO. A BSSO was performed using splitters and separators. Special attention was paid to end the horizontal medial cut at the deepest point of the entrance of the mandibular foramen. Of all lingual fractures, 95% ended in the mandibular foramen. Forty percent of these fractures extended through the mandibular canal and 40% extended inferiorly along the mandibular canal. Almost all lingual fracture lines ended in the mandibular foramen, most likely due to placement of the medial cut in the concavity of the mandibular foramen. The mandibular foramen and canal could function as the path of least resistance in which the splitting pattern is seen. We concluded that a consistent splitting pattern was achieved without increasing the incidence of possible sequelae.

**Chapter 6** describes a study to determine the various lingual splitting patterns in 40 cadaveric human hemi-mandibles after a BSSO and the possible influence of the mandibular canal and the mylohyoid groove on the lingual fracture line. The investigators designed and implemented a case-series to compare the different lingual fracture lines. The primary outcome variable during this study was the lingual fracture pattern possibly influenced by independent variables: the mandibular canal, the mylohyoid groove and the dental status. Descriptive and analytic statistics were computed for each study variable. Most of the lingual fractures (72.5%) ended in the mandibular foramen. Only 25% of the fractures were a “true” Hunsuck fracture, while no bad splits occurred. Meanwhile, 35% of the lingual fractures ran more than half or entirely through the mandibular canal, while only 30% of the fractures ran along the mylohyoid groove. However, when the lingual fracture ran along this groove, it had a 6-fold greater chance of ending in the mandibular foramen. The hypothesis that the

mandibular canal and/or the mylohyoid groove will function as the path of least resistance was only partly confirmed. The use of splitters and separators did not increase the incidence of bad splits compared with the literature.

In **Chapter 7** a retrospective study on a group 427 patients study was presented which aimed to determine the incidence of bad splits associated with BSSO performed with splitters and separators. Furthermore, we assessed different risk factors for bad splits. The incidence of bad splits in this group was 2.0% per site. This is well within the range reported in the literature. The only predicting factor for a bad split was the removal of third molars concomitant with BSSO. There was no significant association between bad splits and age, sex, occlusion class, or the experience of the surgeon. We concluded that BSSO, performed with splitters and separators instead of chisels, does not increase the risk of a bad split and is therefore a safe technique with predictable results.

**Chapter 8** presents a case report of a BSSO in a reconstructed mandible. A 28-year old woman underwent a segmental mandibulectomy, due to a multicystic ameloblastoma in the left lower jaw. After primary plate reconstruction, final reconstruction was performed with a left posterior iliac crest cortico-cancellous autograft. After successful reconstruction the patient was analyzed for combined orthodontic-surgical treatment. Because of a pre-existing Class II malocclusion. Subsequently, after one year of orthodontic treatment, the BSSO was planned. The sagittal split was performed in the remaining right mandible and on the left side in the iliac crest cortico-cancellous autograft. Ten months later, oral rehabilitation was completed with implant placement in the neo-mandible as well. Follow-up showed a Class I occlusion, with good function. The patient was very satisfied with the functional and aesthetic results. This shows a BSSO can be performed in a reconstructed mandible, without side effects and with good functional and aesthetic results.

**Chapter 9** describes a case report to state the experiences of an oral and maxillofacial surgeon, who has undergone a combined orthodontic and orthognathic treatment.

