Journal of Cranio-Maxillo-Facial Surgery 42 (2014) 976–982

Contents lists available at ScienceDirect

Journal of Cranio-Maxillo-Facial Surgery

journal homepage: www.jcmfs.com

Influence of BSSO surgical technique on postoperative inferior alveolar nerve hypoesthesia: A systematic review of the literature

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ARTICLE INFO

Article history:
Paper received 21 August 2013
Accepted 3 January 2014

Keywords:
Bilateral sagittal split osteotomy
BSSO
Chisels
Inferior alveolar nerve
Neurosensory disturbance
Nerve injury

ABSTRACT

Objective: The aim of this study was to evaluate the influence of different splitting techniques, namely, "mallet and chisel" versus "spreading and prying", used during bilateral sagittal split osteotomy (BSSO) on postoperative hypoesthesia outcomes.
Study design: We systematically searched the PubMed and Cochrane databases (from January 1957 to November 2012) for studies that examined postoperative neurosensory disturbance (NSD) of the inferior alveolar nerve (IAN) after BSSO.
Results: Our initial PubMed search identified 673 studies, of which, 14 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).
Conclusion: 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.

1. Introduction

Bilateral sagittal split osteotomy (BSSO) is a successful and common treatment for mandibular hypo- and hyperplasia. The intraoral osteotomy was first described by Schuchart (Schuchart, 1942), later by Mathis (Mathis, 1956), and became a regular procedure after modifications developed by Trauner and Obwegeser were introduced in 1957 (Trauner and Obwegeser, 1957). The BSSO technique was further modified by Dal Pont in 1959 (Dal Pont, 1959, 1961), Hunsuck in 1968 (Hunsuck, 1968), and Epker in 1977 (Epker, 1977). Despite being routinely performed, BSSO is known to give rise to various complications. The most commonly observed complications include inferior alveolar nerve (IAN) impairment and unfavorable splitting of the mandible, also known as a bad split. IAN impairment leading to permanent anesthesia of the lower lip is probably the most frequently observed complication of BSSO having the most serious impact on the patient's daily life (Phillips et al., 2010; Rustemeyer and Gregersen, 2012).

Multiple studies have reported persistent hypoesthesia of the IAN after BSSO, with incidences ranging from 0% to 82% (Poort et al., 2009) with the use of various tests. Neurosensory disturbance (NSD) of the IAN is a considerable morbidity for patients, especially given the elective nature of this surgery. IAN disturbance is caused by iatrogenic damage, especially from incorrect splitting techniques or osteotomies. Nerve damage may also result from excessive nerve manipulation (after soft tissue dissection at the medial aspect of the mandibular ramus), nerve laceration, incorrect placement of position or lag screws during segment fixation, large mandibular advancement, impingement by bony spiculae, or bad splits (Leira and Gilhuus-Moe, 1991; August et al., 1998; Al-Bishri et al., 2004; Borstlap et al., 2004; Panula et al., 2004; Gasperini et al., 2013). Iatrogenic damage of the nerve may also be a

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http://dx.doi.org/10.1016/j.jcms.2014.01.019

secondary consequence of surgery-induced hypoxia and odema, which frequently results in a combination of neuropraxia and partial axonotmesis (Becelli et al., 2004; Borstlap et al., 2004). Thus, surgical techniques should be discussed and critically evaluated to minimize potential complications of BSSO.

The type of BSSO splitting technique used may also be a factor affecting the incidence of postoperative hypoesthesia; however, such a correlation has yet to be shown. Even early on, surgeons worried about the potential for chisels to cause IAN injury during BSSO. Therefore, these surgeons used a thin cement spatula instead of a chisel, which seemed to reduce the incidence of postoperative NSD (Fiamminghi and Aversa, 1979; Munro, 1980; Rajchel et al., 1986). More recently, a number of studies have described the use of chisels to split the mandible; specifically, the chisel is driven along the inner surface of the buccal cortex (Fig. 2a and b). These studies, in which chisels were employed, report rather high incidences of postoperative NSD, ranging from 31% to 60% per patient (Ylikontiola et al., 2000; Yamamoto et al., 2002; Kim et al., 2011) and 17% per side (Schultze-Mosgau et al., 2001). In contrast, other studies emphasize that techniques involving prying and spreading are safer for splitting the mandible compared with "mallet and chisel" methods (Wolford et al., 1987; Precious et al., 1998; Mehra et al., 2001; van Merkesteyn et al., 2007).

The aim of this systematic review was to assess the influence of the type of BSSO splitting technique utilized, namely, "mallet and chisel" or "spreading and prying," on postoperative hypoesthesia outcomes.

2. Materials and methods

A search of PubMed (including the Cochrane database) was performed, limited to the time interval from January 1957 to November 2012, using the following search strategy: (("orthognathic surgical procedures"[Mesh] OR "orthognathic surgical procedures"[tiab]) OR ("bsso" OR "bilateral sagittal split osteotomy" OR "mandibular osteotomy" OR "mandibular advancement" OR "mandibular setback")) AND nerve* with an English language restriction. A second search was performed using the following strategy: ((bsso) OR (bilateral sagittal split osteotomy) OR (mandibular osteotomy) OR (bssro) OR (mandibular advancement) OR (mandibular setback) OR (orthognathic surgery)) AND ((nerve injury) OR (nerve damage) OR (inferior alveolar nerve) OR (trigeminal nerve)) AND (English [lang]). To expand our search, we also evaluated studies identified through the "related citations" option in PubMed and through manual searches of the references of selected studies.

Studies were selected for inclusion based on the criteria listed in Table 1. When the title and abstract either fulfilled the inclusion criteria or did not provide sufficient information to determine whether the study was eligible for inclusion, the full-text article was retrieved. Subsequently, the Materials and Methods and Results sections were read and scored. The main outcome extracted was the frequency of NSD of the IAN in BSSO patients as assessed through both clinical and subjective methods after 1 year. Additionally, studies were categorized according to the BSSO splitting technique employed.

3. Results

3.1. Study inclusion

From the initial PubMed search, 77 studies were found to be eligible for evaluation in their full-text form (Fig. 1). The different parameters required in order for a study to be included in our analysis are shown in Table 1. After strict application of these inclusion criteria, 14 studies were selected for analysis in our systematic review. Most reports identified in our PubMed searches were excluded due to either insufficient description of the exact splitting technique utilized ($n = 22$) or to an insufficient number of patients included in the study ($n = 28$). Additional reasons for exclusion included a follow-up period of less than 1 year ($n = 5$), failure to properly report the incidence of NSD ($n = 6$), absence of rigid fixation ($n = 5$), measurement of NSD by electrophysiologic tests ($n = 2$), and use of nonhuman subjects ($n = 1$). One study was excluded as it evaluated the same patient population as another report, and several articles did not meet multiple inclusion criteria.

3.2. Findings

Of the 14 studies included, only 2 explicitly described using the "mallet and chisel" method along the inside of the buccal cortex (Fig. 2a and b). The incidences of postoperative NSD in these studies were 40% per side (Westermark et al., 1998a, 1998b) and 30.1% per patient (Bruckmoser et al., 2013). Only 1 study explicitly stated that

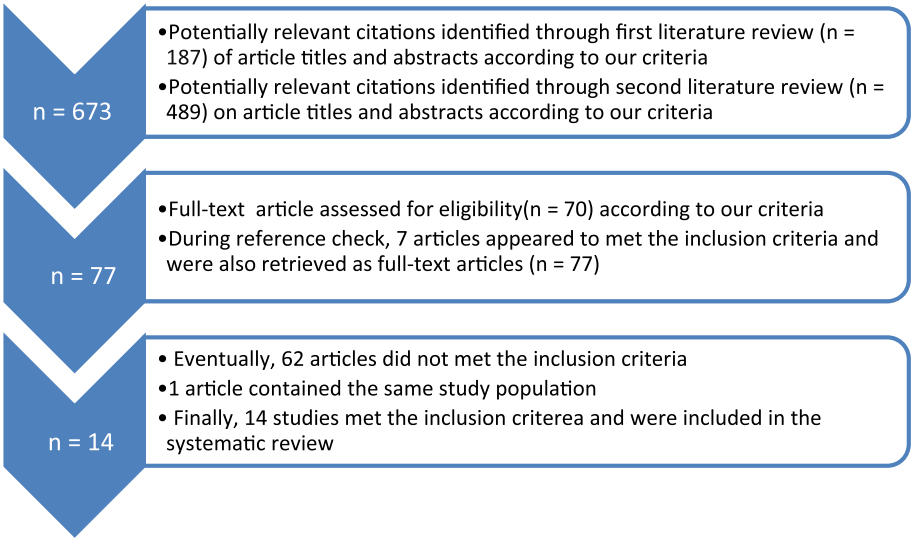

Fig. 1. Flow chart summarizing the literature search for the systematic review.