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Risk factors for common complications associated with bilateral sagittal split osteotomy: A literature review and meta-analysis



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ABSTRACT

The most common complications that are associated with bilateral sagittal split osteotomy are: bad splits, postoperative infection, removal of osteosynthesis material, and neurosensory disturbances of the lower lip. Particularly in elective orthognathic surgery, it is important that surgeons inform their patients about the risk of these complications and attempt to minimize these risks. The purpose of this literature review and meta-analysis is to provide an overview of these common complications and their risk factors.

After a systematic electronic database search, 59 studies were identified and included in this review. For each complication, a pooled mean incidence was computed. Both the pooled study group and the pooled 'complication group' were analysed.

The mean incidences for bad split (2.3% per SSO), postoperative infection (9.6% per patient), removal of the osteosynthesis material (11.2% per patient), and neurosensory disturbances of the lower lip (33.9% per patient) are reported. Regularly reported risk factors for complications were the patient's age, smoking habits, presence of third molars, the surgical technique and type of osteosynthesis material. This information may help the surgeon to minimize the risk of these complications and inform the patient about the risks of complications associated with bilateral sagittal split osteotomy.

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1. Introduction

Bilateral sagittal split osteotomy (BSSO) is an orthognathic surgical technique used to treat mandibular deformity. It was first described by Trauner and Obwegeser in 1957. Soon after its introduction, several important and widely used modifications had been suggested by Dal Pont (1961), Hunsuck (1968), and Epker (1977). Since then, this well-designed and valuable technique has become an important cornerstone of maxillofacial surgery. Nevertheless, it is associated with several complications, such as unfavourable fracture patterns (bad splits), postoperative infection, the need for postoperative removal of osteosynthesis material, and neurosensory disturbances (NSD) of the lower lip (White et al., 1969;

Guernsey and DeChamplain, 1971; Behrman, 1972; Coghlan and Irvine, 1986; Lindquist and Obeid, 1988).

Because of the elective nature of BSSO, it is important to reduce the risk of complications as much as possible. Furthermore, pre-operative counselling and informing the patient are considered to be of paramount importance in surgery. The surgeon therefore should know the general incidence of common complications associated with the procedure and should be aware of the possible risk factors for these complications. This allows for patient-specific counselling prior to performing BSSO and enables surgeons to evaluate their work critically and maximize the chance of success.

The aim of this review is to provide an evidence-based overview of the incidence of common complications associated with BSSO and to discuss the risk factors related to these complications. This review includes the occurrence of bad splits, postoperative infection, removal of symptomatic osteosynthesis material, and permanent neurosensory disturbances of the lower lip. The impact of common risk factors, such as the patient's age, gender, smoking

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habits, the presence of mandibular third molars, and concomitant procedures, were analysed and discussed. This information could help surgeons to prevent these complications.

2. Material and methods

This review was registered on <http://www.crd.york.ac.uk/PROSPERO> as CRD4201502034 and conducted in accordance with the PRISMA statement (Moher et al., 2010).

2.1. Study identification

An electronic search of Pubmed, Embase, and World of Science databases was performed. Keywords were used with their truncations and the corresponding Medical Subject Heading (MeSH) terms in various combinations. Keywords included: risk, risk factors, complication, intra-operative complications, postoperative complications, orthognathic surgery, mandibular advancement, sagittal ramus split, sagittal split osteotomy, BSSO, bad split, unfavourable fracture, lingual split pattern, lingual fracture line, infection, device removal, removal of osteosynthesis material, screws, plates, inferior alveolar nerve, neurosensory disturbances, hypoesthesia, and sensory function.

Prospective and retrospective original research papers describing clinically observed intra-operative or postoperative complications associated with BSSO (bad splits, infection, removal of osteosynthesis material, and neurosensory disturbances) were included. In vitro studies and animal studies were excluded. Letters to the editor and conference abstracts were excluded because of the lack of detail in the description of materials and methods. Non-English articles were also excluded.

This review aimed to analyse BSSO performed according to modern surgical techniques. Therefore, articles published before 1985, using less modern techniques, were excluded. Postoperative infection and removal of hardware were investigated after BSSO with rigid fixation, using titanium osteosynthesis material. Studies that investigated other non-standard fixation techniques or that used bioresorbable fixation materials were excluded. If the operative technique was not clear, or if different orthognathic operative techniques were analysed together without identifying the BSSO-specific outcome, the paper was excluded.

In order to prevent inclusion of small, less coherent studies, the minimum number of patients for inclusion in this review was 25 subjects (50 SSOs) for assessing short-term complications (bad splits, infection, and removal of osteosynthesis material) and 50 subjects (100 SSOs) with a minimal follow-up of 1 year for assessing long-term complications (neurosensory disturbances). With regard to neurosensory disturbances, studies using subjective tests (such as questionnaires, light-touch detection, etc.) were included, as these are reported to show the highest sensitivity for detecting neurosensory disturbances. Studies using only quantitative analyses of NSD (i.e., threshold tests) were excluded.

2.2. Data extraction

Articles that were identified through the electronic database search were first screened based on title and abstract. If the title or abstract mentioned one of the aforementioned postoperative complications associated with BSSO, the full-text article was obtained. Studies that met the inclusion criteria were analysed. The reference lists of the included studies were searched for possible additional relevant papers.

All data were recorded in an individual summary of the study and subsequently entered in a database. Demographic data of the patient groups were collected, including the number of patients,

their mean age (with age range), distribution of gender, and smoking habits. Details of the surgical procedure, including the presence of mandibular third molars, the surgical technique used, and the method of fixation applied, were also noted. The incidence of different complications (bad splits, infection, removal of osteosynthesis material, and neurosensory disturbances) were recorded. Intra-operative complications (bad splits) were reported as the incidence per SSO. Postoperative complications were reported both as the incidence per SSO and the incidence per patient. When a specific risk factor for one of the abovementioned complications was discussed in the study of interest, this was recorded in the summary of this study, and is subsequently reported in this review.

2.3. Quality assessment of the studies

The methodological index for non-randomized studies (MINORS) tool was used to assess the quality of the selected studies (Slim et al., 2003). Information regarding the methodological items for non-randomized studies was recorded on predesigned forms. This included the aim of the study, the method for inclusion and follow-up of patients, the protocol used for data collection, the method used for evaluation of the endpoints, the risk of bias, and the study size, including loss to follow-up. For comparative studies, the equivalence of the compared groups and statistical analyses were also evaluated. Each item was scored as 0 (not reported), 1 (reported but inadequate) or 2 (reported and adequate). The maximum MINORS score was 16 points for non-comparative studies and 24 points for comparative studies.

2.4. Meta-analysis

The patient groups of the included studies were analysed. A subdivision was made based on the four complications of interest (bad splits, infection, removal of osteosynthesis material, and NSD of the lower lip). Data from the study groups were pooled to compute a mean pooled incidence for each complication. A Forest plot was computed for the reported incidence of bad split per SSO, and for the incidences of infection, removal of osteosynthesis material, and NSD per patient.

For each study group, the mean age of the patients, distribution of gender, presence of third molars, and smoking habits were reported. Surgical specifications, such as the surgical technique and the type of fixation material used, were also noted in the database when they were reported in the included studies.

The distribution of age, gender, presence of third molars, and smoking was reported for the pooled study group and for the 'complication-group' in order to facilitate a simple comparison of the distribution of possible risk factors for each complication. The individual studies and their findings regarding risk factors for complications of interest are discussed.

3. Results

3.1. Literature search

The initial database search identified 2537 articles. From these papers, 2443 could be excluded based on the title or abstract. The full-texts of 94 possibly relevant articles were then obtained. Searching the reference lists of these papers revealed no additional eligible articles. After strict application of the exclusion criteria, a total of 59 articles were included for analysis in our review. These papers were then subdivided based on the four complications of interest. Ten papers described more than 1 subject of interest. A

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