

Systematic Review Orthognathic Surgery

The effect of orthognathic surgery on the temporomandibular joint and oral function: a systematic review

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Abstract. The objective of this systematic review was to examine the effect of orthognathic surgery (OS) on the temporomandibular joint and oral function. Electronic databases were systematically searched for studies published until October 2015. Articles were assessed against predefined inclusion criteria. The included papers were divided into four groups based on the type of OS performed. The following items were recorded: quality of evidence using the Oxford Centre for Evidence-Based medicine (CEBM) criteria, number of patients, presence/absence of controls, mean age at treatment, follow-up time, clinical examination findings, bite force, use of the Helkimo Index and Research Diagnostic Criteria for Temporomandibular Disorders, imaging findings, and patient questionnaire results. A total of 4669 articles were identified; 76 relevant articles were included in the review. These studies assessed a total 3399 patients and 380 controls, with a mean age of 25.4 years. The great variety of OS techniques, examination techniques, diagnostic criteria, and imaging techniques used in the articles studied, as well as the quality of the study designs, made it difficult to compare studies and to draw conclusions. However, looking at the different aspects studied in general, it can be stated that OS seems to have little or no harmful effect on the TMJ and oral function (level of evidence: levels II, III, and IV).

Key words: temporomandibular joint; oral function; mandibular movements; maximum mouth opening; orthognathic surgery; bilateral sagittal split osteotomy; vertical ramus osteotomy; Le Fort I osteotomy; bimaxillary osteotomy; imaging.

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Orthognathic surgery (OS) is a well-known surgical intervention to change and/or correct the facial-related structures. OS can roughly be divided into three

categories: maxillary surgery, mandibular surgery, and combined double-jaw surgery. The most discussed surgical strategies are the bilateral sagittal split

osteotomy (BSSO), vertical ramus osteotomy (VRO), mandibular midline distraction (MMD), surgically assisted rapid maxillary expansion (SARME), Le Fort

I osteotomy (LFI), and bimaxillary osteotomy (BIMAX).

The main indications for OS are to improve function (including malocclusion, mastication, speech, respiratory function, sleep apnoea, and ocular function), minimize the treatment time, and obtain stability following orthodontic treatment, which includes the prevention of relapse.^{1,2} Another indication for OS is to improve aesthetics, e.g. in cases of congenital dentofacial discrepancies, acquired dentofacial discrepancies, and growth disturbances, and to obtain harmony and balance in facial appearance.^{1,2}

OS is considered a low risk and successful procedure.² Successful outcomes in terms of oral function can be measured in many different ways, for example through the absence or presence of joint noises, mandibular movements, maximum mouth opening, pain on palpation, bite force, or patient satisfaction (on facial appearance and chewing ability). Qualifying and quantifying oral function is complex and there are few standardized procedures. Therefore, it would be interesting to identify the different outcomes of measuring oral function described and the effect of OS on the temporomandibular joint (TMJ) as reported in the literature. Prospective and long-term studies on the effects of OS on the TMJ, masticatory muscles, and function are still lacking. The aim of this study was to systematically review the scientific literature addressing the effect of OS on the TMJ and oral function.

Materials and methods

Search strategy

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were used in this review.³

An electronic search was conducted in seven databases: Embase, MEDLINE Ovid, Cochrane Central Register of Controlled Trials, Web of Science, PubMed (the subset as supplied by publishers), CINAHL (EBSCOhost), and Google Scholar. The search strategy combined terms for OS or mandibular or maxillary osteotomy with terms for TMJ or oral function. For the Embase, MEDLINE, and CINAHL searches, thesaurus terms were used alongside words in the title and/or abstract; in the other databases, only words in the title and/or abstract were used. The databases were searched from inception until October 2015. The search was limited to human studies, but no limitations on language were applied.

The full search strategies are given in [Appendix A](#). The reference lists of all relevant articles were screened for additional relevant sources.

Data collection and analysis

Two of the review authors (EtV and AtV) screened the titles and abstracts (when available) of all reports independently. For all studies that appeared to meet the inclusion criteria, or when data in the title and/or abstract were insufficient, the full-text version was obtained to allow a definitive decision to be made. Both authors read the full-text articles and each author made an independent decision as to whether the studies met the inclusion criteria. Any disagreement was resolved by discussion; when no agreement could be reached, an additional researcher was involved (MK) until consensus was reached.

Included studies had to describe the treatment of humans and had to be published in English. Articles focusing on topics other than treatment, on other conditions not specified as OS and involvement of the TMJ, on comorbidity, or on the treatment of craniofacial syndromes were excluded. Review articles, studies describing the same patients, abstracts or posters presented at meetings, and articles published before 1990 were also excluded.

The articles included in the review were divided into the following four groups based on the type of orthognathic intervention: BSSO, VRO, LFI, and BIMAX. Several papers reported more than one of these groups; these papers were included for all groups that were described separately.

The following items were recorded for all of the articles included: quality of evidence using the Oxford Centre for Evidence-Based Medicine (CEBM) criteria,⁴ number of patients, presence or absence of a control group, mean age at treatment, follow-up time, clinical examination (including mandibular movements, maximum mouth opening, and pain on palpation), use of the Helkimo Index,⁵ the Research Diagnostic Criteria for Temporomandibular Disorders⁶ (RDC/TMD), imaging (including computed tomography (CT), cone beam computed tomography (CBCT), magnetic resonance imaging (MRI), panoramic radiography, tomography, lateral radiography, transcranial radiography, and anterior–posterior radiography), and patient questionnaire results.

Results

After de-duplication, 2442 references were retrieved. The titles and abstracts

of the 2442 articles were screened. In the case where the abstract was missing and/or it was questionable whether the abstract met the above-mentioned criteria, the full-text article was retrieved so as to avoid excluding any article of possible relevance. A total of 2151 papers were excluded for various reasons. The remaining 291 articles were screened on reading the full-text. Another 215 articles were excluded. The full-text was not available for five papers. No additional relevant articles were identified through the reference list search. Therefore 76 articles were included in the review. The PRISMA flowchart showing the number of articles remaining at each stage of the sequence of identification, screening, and final inclusion is illustrated in [Fig. 1](#).³

An overview of all included studies is given in [Table 1](#). These papers were divided into the following four groups based on the type of orthognathic intervention: BSSO, VRO, LFI, and BIMAX; the items mentioned above were recorded ([Tables 2–5](#)).

Discussion

In almost all of the articles, the number of subjects studied was low. Combining the studies gave a total of 3399 patients and 380 controls. All control subjects in all groups were healthy subjects, with a complete dentition, little or no dental restoration, and a class I occlusion.^{7–18}

Clinical examination indexes mentioned in the articles included were the Helkimo index^{18–23} and the RDC/TMD Axis II²⁴; none of the other articles specifically described the index used to classify the data.

Mandibular movement and maximum mouth opening

Mandibular movements and maximum mouth opening were scored by many articles, especially for the BSSO and VRO groups.^{19–23,25–44} An initial decrease in maximum mouth opening at 1–6 months post-surgery was described in almost all papers. The causes of this decrease in maximum mouth opening included intermaxillary fixation, jaw repositioning in combination with orthodontic treatment changing the position of the teeth, and the formation of scar tissue and/or inflammation.⁴⁵ Approximately two-thirds to three-quarters of all patients in the BSSO and IVRO groups showed no difference in mandibular movements and maximum mouth opening after a follow-up period of 1–2 years. A small group showed a

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