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Functional and radiographic long-term results after bad split in orthognathic surgery

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Abstract. Bilateral sagittal split osteotomy (BSSO) is a standard procedure in orthognathic surgery. The aim of the present study was to perform a matched pair analysis (bad sagittal split versus regular sagittal split) regarding the functional and radiographic long-term results after BSSO. Of 110 cases of mandibular hypoplasy treated with BSSO, 7 cases of bad sagittal splits (Group A) were selected, clinically examined and matched to 7 cases where no bad split occurred (Group B). The Research Diagnostic Criteria for Temporo Mandibular Disorders (RDC/TMD), condylar morphology scale (CMS) and ramus height measurements using orthopantomograms were carried out in the follow-up period to observe the clinical and functional status and condylar resorbtion or remodelling. The mean follow-up time was 28.6 months. The RDC/TMD examination did not show a higher incidence of temporomandibular dysfunction, including pain or clicking in the bad split group. Patients without a bad split showed statistically significant ($p < 0.05$) better mouth opening. The CMS measurements were comparable in both groups. When compared with regular splits, bad splits, if treated in an appropriate manner, have a good chance of functional success, although, some mandibular movements can be compromised.

Keywords: temporomandibular dysfunction; orthognatic surgery; sagittal split osteotomy; complications.

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Sagittal split osteotomy (SSO) of the mandible is a very versatile surgical procedure to advance or set back the mandible. It became popular after studies by Trauner and Obwegeser in 1957[24,25] and the later modification of Dal Pont in 1961[3]. This technique has been a standard procedure in orthognathic surgery for over four decades[28].

Ongoing efforts to reduce the complications associated with the procedure led to several modifications[3,4,7,9,11,29,30]. Despite all improvements, the procedure still presents a certain degree of technical difficulty and can cause some intra-operative complications, such as severe nerve injuries, bleeding or unfavorable fractures, known as bad splits[26]. The term 'bad split' describes an unfavorable or irregular fracture of the mandible, located at the proximal or distal fragment in the course of the SSO[8,18]. In this study, only bad splits that needed extra or modified rigid fixation and might later influence mandibulary movements and temporomandibular joint (TMJ) function were included.

A bad split after SSO, if not properly treated, can cause infections, bone fragment sequestration, delayed bone healing and pseudoarthrosis[8,19]. Postoperative instability or dysfunction of the mandible with consecutive TMJ dysfunction may occur[12,18]. In case of a bad split the sur-

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Table 1. Description of the selected matched pairs and variables

		Age (Years)	Gender	Diagnostic	Procedure	Location of bad split	Presence of third molar
1	Bad split	33	Female	Mandibular Hypoplasy	BSSO Obwegeser Dal Pont	Condylar process	No
	Normal split	30	Female	Mandibular Hypoplasy	BSSO Obwegeser Dal Pont		No
2	Bad split	25	Female	Mandibular Hypoplasy	BSSO Obwegeser Dal Pont	Buccal plate	Yes, removed in surgery
	Normal split	20	Female	Mandibular Hypoplasy	BSSO Obwegeser Dal Pont		Yes, removed in surgery
3	Bad split	43	Female	Mandibular Hypoplasy	BSSO Obwegeser Dal Pont	Buccal plate	Yes, removed in surgery
	Normal split	38	Female	Mandibular Hypoplasy	BSSO Obwegeser Dal Pont		No
4	Bad split	25	Female	Mandibular Hypoplasy	BSSO Obwegeser Dal Pont	Buccal plate	No
	Normal split	22	Female	Mandibular Hypoplasy	BSSO Obwegeser Dal Pont		No
5	Bad split	35	Male	Mandibular Hypoplasy	BSSO Obwegeser Dal Pont	Buccal plate	No
	Normal split	28	Male	Mandibular Hypoplasy	BSSO Obwegeser Dal Pont		No
6	Bad split	30	Male	Mandibular Hypoplasy	BSSO Obwegeser Dal Pont	Buccal plate	No
	Normal split	28	Male	Mandibular Hypoplasy	BSSO Obwegeser Dal Pont		No
7	Bad split	38	Male	Mandibular Hypoplasy	BSSO Obwegeser Dal Pont	Buccal plate	No
	Normal split	35	Male	Mandibular Hypoplasy	BSSO Obwegeser Dal Pont		No

geon should finish the SSO and stabilize the fragments, including the unfavorable fracture, following the rules of rigid fixation. The correct position of the condyle must be ensured[6].

The objective of this matched pair study with patients who underwent bilateral sagittal split osteotomy (BSSO), was to compare the functional and radiographic outcomes after regular and irregular split osteotomies.

Methods

A total of 110 patients treated by BSSO were selected for this study. Bad splits occurred in 12 cases (10%). All selected BSSO procedures followed the technique introduced by Trauner and Obwegeser and modified by Dal Pont[3,24,25]. The material used was a 2-mm titanium mini plates and screws system from KLS Martin (Tutligen, Germany).

Both, residents and specialists in maxillofacial surgery performed the procedures. In the bad split group, 4 procedures were performed by residents and 3 by specialists. In the normal split group, 40 procedures were performed by residents and 63 by specialists.

From the bad split group, 7 patients (Group A) could be matched to 7 normal split cases (Group B) regarding: diagnosis, age, gender, presence of third molars and follow-up time (Table 1). These pairs were matched in order to compare two groups with the same characteristics but with different surgical outcomes and observe if the bad splits had any influence on the mandibulary function at the postoperative follow up.

The patients in both groups were invited for a follow-up examination (mean 28.6 months) including the Research Diagnosis Criteria for Temporo Mandibular Dysfunction (RDC/TMD) protocol[10,11,14] and orthopantomograms for condylar morphology scale (CMS) measurements and ramus height (Fig. 1)[1].

The RDC/TMD protocol uses a standard questionnaire, including anamnesis and a measurement form. The following measurements were recorded: unassisted mouth opening; maximum unassisted mouth opening; maximum assisted mouth opening; vertical incisal overlap; laterotrusion; midline deviation; protrusion; joint sound or clicking; palpation of the TMJ; palpation of masticatory muscles; palpation of the preauricualr region.

Alterations of the condyle morphology, such as resorptions, were radiographically assessed following the CMS, according to Borstlap et al.[1]. This measurement protocol included the parameters broadest condylar dimension (B) and smallest condylar dimension (S). Additionally to the CMS, the ramus height (H) was measured (Fig. 1). The CMS was determined using the preoperative and 6-month (at least) follow-up postoperative orthopantomograms (mean follow-up time 28.6 months). Both sides of each mandible were evaluated separately.

The group of 7 bad splits were also compared with the 103 normal splits, to observe statistical significance regarding age, presence of third molar and gender. The measured values were statistically analysed with Student's *t*-test, the Mann–Whitney-*U*-test and the χ^2 test (SPSS software version 12.0.1 GmbH, Munich, Germany).

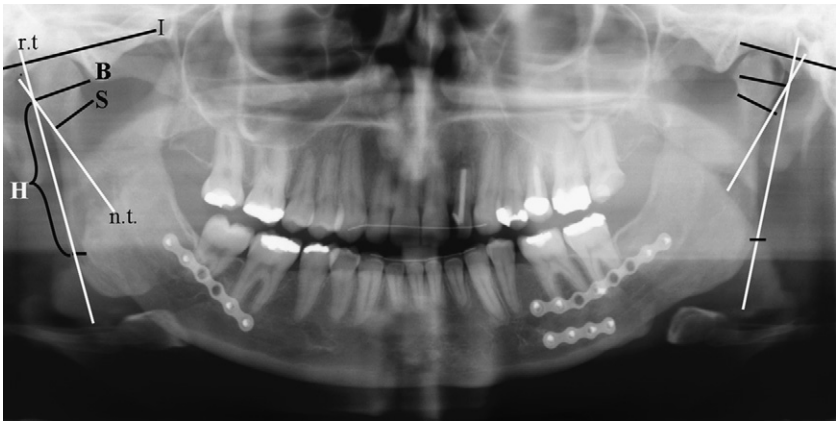

Fig. 1. Tracing of the orthopantomograms, for Condylar Morphology Scale (CMS) and ramus height analysis. Auxiliary lines n.t. = neck tangent and r.t. = ramus tangent (in white) were used. The following measurement parameters were recorded: H = ramus height; B = broadest condylar dimension, perpendicular to r.t.; S = smallest condylar dimension, perpendicular to n.t. (Borstlap et al.[1]).