# Proximal segment positioning with high oblique sagittal split osteotomy: indications and limits of intraoperative mobile cone-beam computerized tomography

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**Objective.** The purpose of this study was to evaluate the indications and limits for intraoperative proximal segment positioning control by mobile cone-beam computerized tomography (CBCT).
**Study Design.** For mandible osteotomy in orthognathic surgery, the high oblique sagittal split osteotomy (HSSO) is our standard procedure. In 22 patients, positioning control of the proximal segment was performed during and after surgery to check this alternative osteotomy technique.
**Results.** The mean intercondylar distance increased 0.31 mm in all patients. No significant change of the condyle positions was found in the axial and coronal planes. In the sagittal plane a significant change was found. In 1 case, revision was required because of a lateral shifting of the condyles.
**Conclusions.** Intraoperative positioning control with CBCT is an effective and reliable method to avoid condyle malpositions. Only minor position changes occur when using HSSO in orthognathic surgery, without compromising temporomandibular joint function postoperatively. (Oral Surg Oral Med Oral Pathol Oral Radiol 2013;115:731-736)

One of the fundamental disadvantages in orthognathic surgery of the mandible after bilateral sagittal split osteotomy (BSSO) is the neurosensory disturbance of the inferior alveolar nerve. The risk for permanent numbness of the lower lip varies from 11.7% to 24% with BSSO according to the literature.[1-3] The reasons for such a high incidence for nerve damages are, on one hand, anatomic influences such as the mandible bone quality, and on the other hand, of course the surgical techniques described by Obwegeser and Dal Pont and various modifications.[4-6] Short and high sagittal osteotomies of the ascending ramus of the mandible were previously described.[7,8] The main concerns were bone healing and condylar position owing to the reduced bone contact and the poor handling of the short proximal segment. In the present study we present a prospective clinical evaluation of the high oblique sagittal split osteotomy (HSSO) regarding proximal segment positioning by mobile cone-beam computerized tomography (CBCT). We established the HSSO as a new standard procedure in our clinic (Figure 1). Furthermore, we modified the osteotomy technique to avoid the use of condylar-positioning devices. We attempted to keep the technique simple and feasible even for inexperienced surgeons, and therefore we had a close look at possible adverse events. One of our main concerns was the condyle position and with it the stability of the results and possible temporomandibular disorders. We decided to use a mobile CBCT for intraoperative positioning control to allow revisions immediately. The reliability of CBCT for evaluation of condylar changes was recently described.[9,10]

## MATERIALS AND METHODS

We carried out a prospective clinical and radiologic analysis of the selected patients. Permission from the Ethics Commission of the Medical Faculty of the University Hospital, Heidelberg, was obtained (S-131/2009). In the study, we included within 6 months 22 consecutive patients suffering from skeletal class II (n = 8) and class III (n = 14) malocclusion. No temporomandibular disorders were recorded before surgery. All patients underwent HSSO for repositioning the mandible in either monomaxillary (n = 9) or bimaxillary (n = 13) surgery. All patients were examined

## Statement of Clinical Relevance

This study is of high clinical value: first, in demonstrating the reliability of intraoperative mobile cone-beam computerized tomography for proximal segment positioning control; and second, in the evaluation of the high oblique sagittal split osteotomy as an alternative technique (instead of the classic bilateral sagittal split osteotomy) regarding condyle positions.

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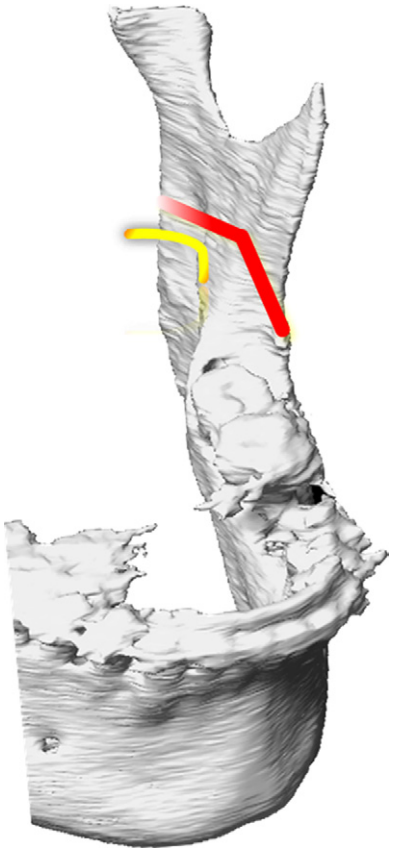

Fig. 1. Schematic presentation of the high oblique sagittal split osteotomy. *Yellow* indicates the inferior alveolar nerve entering the ascending ramus of the mandible, and *red* the planned osteotomy line.

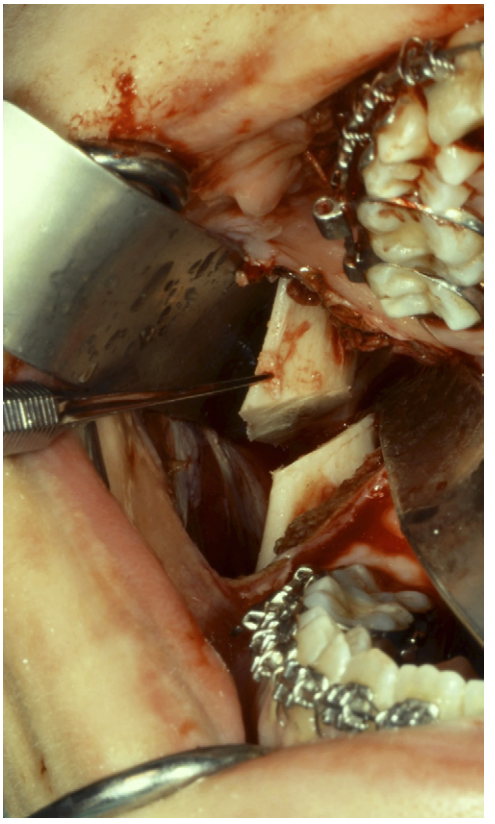

Fig. 2. After completion of the osteotomy the condyle is center-positioned into the mandibular fossa by a forceps.

by CBCT (Sirona Dental Systems, Germany) before and during surgery by mobile CBCT (Siemens Healthcare, Germany) just before wound closure. The preoperative CBCT of all patients was acquired in upright position wearing the centric split. No further postoperative imaging was acquired.

After incision and preparation of the ascending ramus, the entry of the inferior alveolar nerve into the bone was identified. Hooks for soft tissue protection were inserted, and the osteotomy was performed by jigsaw. The cut starts on the lingual (inner) side ~3 mm above the nerve's entry and runs downward to the vestibular edge of the mandible. It ends above the mandible angle. Completion of the osteotomy was then performed by a chisel. This procedure was repeated on the contralateral side. After intermaxillary fixation (IMF) into the final splint, the centric position of the condyle into the mandibular fossa was achieved by a forceps (Figure 2). No positioning devices were used. Osteosynthesis was performed with 1 fence-shaped miniplate (Medartis, Switzerland) on each side and an angled screwdriver by an intraoral approach (Figure 3).

After opening the IMF, the occlusion was checked with and without the final splint. At this stage the mobile CBCT was prepared (Figure 4). After IMF into the final splint again we performed the CBCT scan intraoperatively. The mobile CBCT used was the Arcadis Orbic 3D (Siemens Healthcare, Germany). The software included allowed only the measurements of the intercondylar distances (Figure 5). The measurements were performed in the axial plane on the medial edge of the condyle on its maximum extents. According to the recent literature we allowed a maximum tolerance of 1 mm compared with the preoperative value.[10] When the intercondylar distance exceeded 1 mm, the indication for revision was given.

The evaluation of the changes of the condylar axis and position by HSSO was performed on the mobile CBCT images after surgery. The changes in the condylar axis (axial, coronal, and sagittal) were measured on the multiplanar reconstructed pre- and intraoperative images. The reference planes were the Frankfort horizontal plane and the midsagittal plane. The sagittal condylar axis angle was measured between the condylar long axis at the posterior border of the proximal segment and the Frankfort horizontal plane in the sagittal plane. The coronal condylar axis