CASE REPORT

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Bypassing mandibular osseous defect using the high oblique sagittal split osteotomy: a case report and review of literature

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The presence of a mandibular osseous defect significantly complicates revision orthognathic surgery by increasing the risk of unfavorable fractures and inferior alveolar nerve (IAN) injury. In such instances, the high oblique sagittal split osteotomy (HOSSO) serves as a strategic alternative to the conventional bilateral sagittal split osteotomy. We report a case involving a 31-year-old Chinese female presenting with skeletal relapse twelve years after the primary bimaxillary surgery. Preoperative imaging identified a 1.5×1.5 cm circular osseous defect in the right mandibular body, communicating with the IAN canal. To bypass the defect site, a unilateral HOSSO was performed on the right mandible, while a standard sagittal split ramus osteotomy was utilized on the left. Postoperative clinical and radiographic evaluations at six months demonstrated satisfactory facial profile improvement and stable occlusion, with absence of neurosensory deficits or unfavorable fractures. This case underscores the importance of thorough preoperative radiographic assessment and suggests that HOSSO is a safe, effective technique for bypassing localized mandibular body pathology, particularly during revision procedures.

Key words: Orthognathic surgery, Reoperation, Mandibular diseases, Sagittal split ramus osteotomy, Trigeminal nerve injuries

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I. Introduction

The bilateral sagittal split osteotomy (BSSO) remains the cornerstone of modern orthognathic surgery for its predictability and versatility. However, revision orthognathic surgery often presents additional challenges, including tissue scarring, altered vascularity, and the presence of residual osteosynthesis hardware from the primary procedure.

One rare but clinically significant complication is the presence of abnormal mandibular anatomy. A localized osseous defect—whether resulting from an unfavorable fracture or hardware-related complications during the primary surgery—significantly increases the risk of unfavorable fractures[1] and injury to the inferior alveolar nerve (IAN), both of which can be deleterious to the patient's quality of life.

In such cases, the high oblique sagittal split osteotomy (HOSSO) may serve as a viable alternative to BSSO. First described by Seeberger et al.[2] in 2013, HOSSO employs a single oblique osteotomy line positioned above the mandibular foramen, effectively bypassing the mandibular body and reducing the risk of nerve manipulation. While HOSSO has been discussed primarily in the context of IAN preservation, its application as a bypass maneuver in the presence of localized mandibular pathology has not been widely documented.

This case report describes a unique case of revision bimaxillary surgery in a patient with a localized, crater-like osseous defect in the right mandibular body. We demonstrate the successful application of HOSSO to circumvent the defect, achieving skeletal stability and nerve preservation where traditional sagittal split techniques carried a high risk of failure.

II. Case Report

A 31-year-old Chinese female presented with a chief complaint of lip incompetence, gummy smile, and protruded up-

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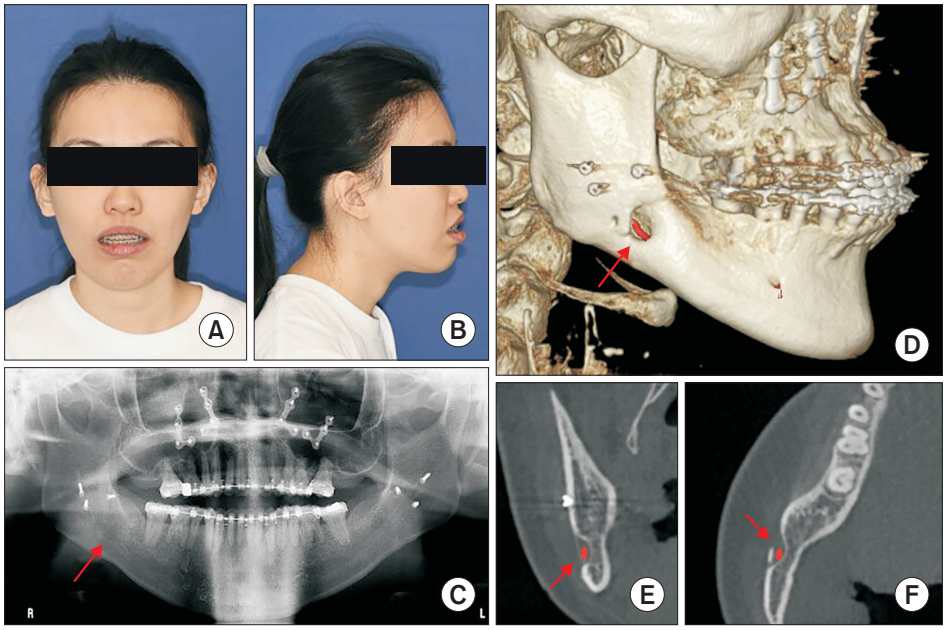


Fig. 1. Preoperative clinical and radiographic assessment of a patient with a prior history of Le Fort I osteotomy and bilateral sagittal split osteotomy (12 years prior). A, B. Frontal and profile views demonstrating lip incompetence and bimaxillary protrusion. C. Orthopantomogram revealing a 1.5×1.5 cm osseous defect in the right mandibular body (red arrow). D-F. Three-dimensional cone-beam computed tomography reconstruction of the right mandible, illustrating the crater-like morphology of the defect on the mandibular body (red arrows). The course of the inferior alveolar nerve is highlighted in red, demonstrating possible communication with the defect.
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per and lower incisors.(Fig. 1) Twelve years prior, she had undergone bimaxillary orthognathic surgery combined with orthodontic treatment to correct a class III malocclusion, vertical maxillary excess and mandibular asymmetry; no perioperative complications were reported at that time. The patient first noted clinical relapse in 2022 and visited our clinic for examination. Subsequent clinical and radiographic evaluation confirmed a diagnosis of incisal class I malocclusion on skeletal class I base, characterized by bimaxillary protrusion, vertical maxillary excess and cant, and mandibular asymmetry. Revision bimaxillary surgery and concurrent orthodontics were therefore indicated.

Preoperative orthopantomogram and cone-beam computed tomography (CBCT) revealed a 1.5×1.5 cm circular, crater-like osseous defect in the right mandibular body, situated inferior to three Leibinger bicortical lag screws placed during the primary surgery. The defect appeared to communicate with the IAN canal, though there were no signs of malunion or fibrous union. Despite these radiographic findings, the patient reported no neurosensory alterations in the lower lip, no history of subsequent mandibular trauma, and the intraoral examination was unremarkable.

A conventional sagittal split ramus osteotomy (SSRO) was deemed unsafe for the right mandible for two reasons. First, the osseous defect created a structural discontinuity in the right mandibular body, with CBCT demonstrating near-complete absence of the buccal cortex and critically deficient lingual cortical bone at the defect site. This reduction in cortical integrity indicated that the osteotomy would likely propagate towards this zone of least resistance, increasing risk of unfavorable fracture with potential comminution or loss of the inferior border. Second, CBCT findings revealed that the course of the IAN ran in close proximity to the proposed sagittal split osteotomy line (Fig. 1), raising concern for nerve transection or traction injury during segment mobilization should a conventional SSRO be attempted. HOSSO was therefore planned for the right mandible to bypass the osseous defect entirely, while a conventional SSRO was planned for the contralateral side.

Le Fort I osteotomy, left SSRO and Hofer's osteotomy were performed using standard techniques. For the right mandible, an intraoral incision was made along the anterior ramus, and a mucoperiosteal flap was elevated to expose the medial and lateral aspects of the ascending ramus, the lingula and the coronoid process. A medial channel retractor was positioned to protect the IAN. The three bicortical screws were removed via a transbuccal approach.

The HOSSO was performed using a sagittal saw oriented at a 45º angle to the vertical axis of the ramus. The medial corticotomy was placed 3 mm superior to the mandibular foramen to ensure IAN preservation. Following segment mobilization, the mandible was repositioned using a prefabricated splint to achieve 1.8 mm pogonion advancement. After temporary intermaxillary fixation (IMF), the proximal segment was manually guided to ensure anatomical condylar seating within the glenoid fossa. Internal fixation was achieved using a transbuccal trocar to place two 1.0 mm miniplates with four monocortical screws each at the anterior and middle thirds of

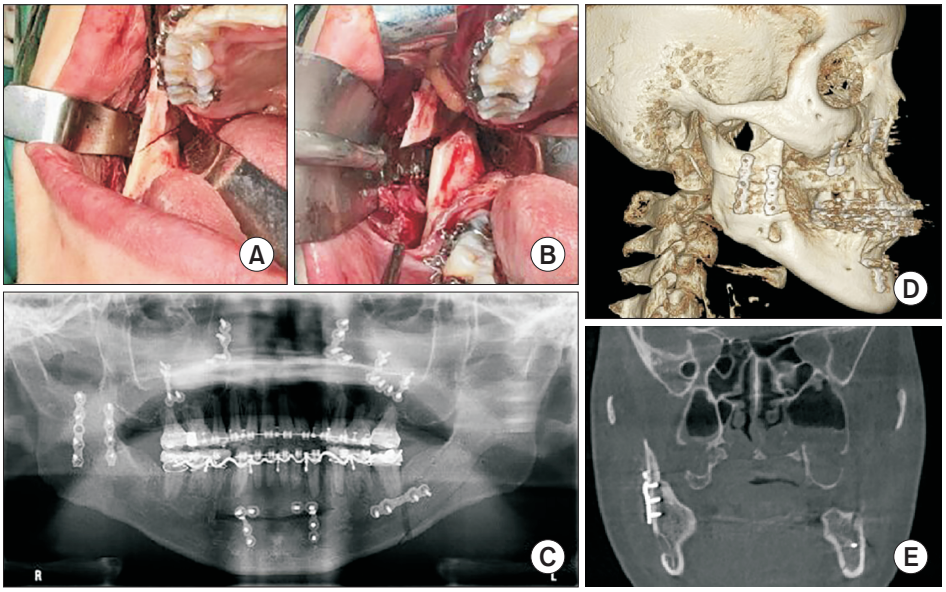


Fig. 2. Intraoperative and postoperative assessment. A, B. Intraoperative view demonstrating the high oblique osteotomy oriented at 45° to the vertical axis of the ramus, with the medial corticotomy positioned superior to the mandibular foramen. C. Orthopantomogram obtained on postoperative day one confirming satisfactory implant positioning and absence of unfavorable fractures. D. Three-dimensional cone-beam computed tomography (CBCT) reconstruction at postoperative day four. E. Coronal CBCT view showing the position of the miniplates relative to the osseous defect.
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the lateral ramus.(Fig. 2) The patient was kept in IMF with elastic bands for seven days postoperatively as per institution protocol.

On postoperative day 1, neurosensory assessment revealed full sensation in the right lower lip, in contrast to a visual analogue scale score of 9 out of 10 for the left. A CBCT scan obtained on postoperative day 4 confirmed the absence of unfavorable fractures or propagation of the pre-existing right mandibular defect, with bilateral condylar positions verified within the glenoid fossae. At the two-week follow-up, a minor epidermal dehiscence was noted at the right transbuccal puncture site, which was managed conservatively with 3% tetracycline ointment and dressing, resulting in complete healing within two weeks. At the six-month review, the patient exhibited satisfactory facial profile, stable occlusion, and full bilateral neurosensory function. Follow-up CBCT confirmed successful osseous union of all osteotomy segments.

III. Discussion

Revision orthognathic surgery in this case was complicated by a 1.5×1.5 cm crater-like osseous defect in the right mandibular body, necessitating a departure from the standard BSSO. The primary surgical risks included an unfavorable fracture through the thin residual cortex at the defect site and potential IAN injury, given the apparent communication between the defect and the IAN canal on the preoperative CBCT scan.

The formation of a localized osseous defect in the mandibular body following BSSO is exceedingly rare. In the literature, such defects mostly occur at the inferior border of the mandible, often following large mandibular advancements or unintentional incorporation of the full thickness of the lower border into the proximal segment[3]. The resulting bony gap may permit soft tissue ingrowth into the space before osseous healing can occur. A similar mechanism likely occurred in this case; given the inherently thin cortices of the mandibular body[1], an unrecognized unfavorable fracture during the primary surgery might have resulted in the loss of a buccal plate fragment. Subsequent soft tissue ingrowth, rather than hematoma organization, likely led to the observed crater-like morphology of the defect. This localized presentation is distinct from avascular necrosis, which typically manifests as segmental sequestration[4].

When managing a localized mandibular osseous defect in the setting of revision orthognathic surgery, alternative approaches to the conventional SSRO warrant consideration. Intraoral vertical ramus osteotomy (IVRO) avoids the mandibular body entirely; however, it precludes rigid internal fixation, necessitating a prolonged IMF duration of 4 to 6 weeks[5] with consequent impact on nutrition and quality of life. IVRO also carries an inherent risk of condylar sag[5] secondary to proximal segment displacement and excessive stripping of the pterygomasseteric sling. The technique is further limited by its technical demands, requiring right-angled instruments and offering restricted surgical access. HOSSO was therefore determined to be the most appropriate technique, as it repositioned the osteotomy entirely superior to both the defect and the mandibular foramen, mitigating risk

of unfavorable fracture and nerve injury while still permitting rigid internal fixation and predictable mandibular repositioning. Additionally, the simplified osteotomy design of the HOSSO reduced operative time[6] compared to conventional BSSO while facilitating comparable mandibular movements, further supporting its selection in this case.

Another critical advantage of the HOSSO in this scenario was IAN preservation. The HOSSO design affords improved visualization and protection of the IAN in cases where the mandibular anatomy may be distorted. Despite the defect's communication to the IAN canal, performing the HOSSO allowed us to maintain nerve integrity, which is consistent with the absence of neurosensory deficit at the six-month review. Early recovery of neurosensory function following orthognathic surgery is recognized as an important contributor to the patient's quality of life[6].

One of the main concerns with HOSSO is the reduced bony contact area (BCA) associated with the smaller proximal segment, which may theoretically impair osseous healing. However, orienting the osteotomy at a 45º angle to the vertical ramus, as proposed by Kaduk et al.[7], optimizes the BCA and minimizes gap formation between segments. Successful osseous union at six months in this case correlates with the findings of Möhlhenrich et al.[8], who demonstrated that HOSSO provides clinically sufficient BCA for movements up to 8 mm.

The small proximal segment may also complicate intraoperative condylar positioning. While some surgeons advocate the use of a pre-bent condylar positioning plate[7], freehand positioning with a Kocher clamp in this case provided adequate condylar seating in the glenoid fossa without the need for additional devices[9]. Therefore, concerns regarding proximal segment control need not discourage surgeons from utilizing the HOSSO.

Regarding osteosynthesis, although three-dimensional finite element analysis favors double-plate fixation at the anterior and posterior thirds of the ramus for optimal biomechanical stability[10], fixation at the anterior and middle thirds was selected in this case due to limited intraoperative visibility, restricted surgical space, and technical difficulty of plate adaptation at the posterior ramus. Regardless, successful osseous union at six-months indicates that this configuration provided sufficient rigidity throughout the healing phase. Future cases may benefit from patient-specific surgical guides[11], pre-bent plates, or intraoperative endoscopy[7] to facilitate posterior ramus access and plate positioning.

To our knowledge, this is the first reported case of HOSSO being used specifically to bypass a localized osseous defect in the mandibular body. This case demonstrates that HOSSO can be a versatile tool for revision surgery when the traditional SSRO pathway is compromised by mandibular pathology or abnormal anatomy. Further studies are needed to evaluate the long-term skeletal stability of HOSSO and its applicability across a wider range of mandibular movements, including rotational corrections.

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Authors' Contributions

S.J.M. participated in data collection and writing the manuscript. G.J.C.W.T. participated in data collection and performed the surgery. L.S. performed the surgery and coordinated the study. All authors read and approved the final manuscript.

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Consent for Publishing Photographs

Written informed consent was obtained from the patient for publication of this article and accompanying images.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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