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Bilateral sagittal split osteotomy buccal cut classification. Indications: pros and cons

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Abstract

Bilateral sagittal split osteotomy (BSSO) and its numerous modifications remain the cornerstone of mandibular orthognathic surgery. Despite extensive literature describing individual techniques, we know of no comprehensive comparison of their properties, indications, and clinical outcomes. This review proposes a novel classification of the BSSO technique based on the position of the buccal cut relative to the mandibular notch and angle: pre-notch, post-notch, and post-gonial. Their technical characteristics and clinical implications are described and compared, providing a straightforward guide to the optimal approach in each scenario. A narrative review of key publications on BSSO techniques was conducted and combined with the authors' clinical experience. Using this foundation, an original classification was formulated, organising established osteotomy designs according to the position of the buccal cut relative to the mandibular notch. Pre-notch approaches provide broad bony contact and stable outcomes for standard procedures with a thick soft tissue; post-notch techniques reduce inferior border notching and help protect the inferior alveolar nerve, and are therefore indicated for large mandibular movements and thin soft tissues; post-gonial strategies facilitate ramus lengthening and the correction of complex vertical asymmetry. The proposed classification offers a simple, clinically oriented framework that aligns existing BSSO modifications with surgical objectives, and supports more precise and individualised treatment planning.

Keywords: Bilateral sagittal split osteotomy; Orthognathic surgery; Mandibular notch; Osteotomy classification; Inferior alveolar nerve

Introduction

Bilateral sagittal split osteotomy (BSSO) remains the cornerstone of mandibular orthognathic surgery for the correction of dentofacial deformities. Over the decades, numerous modifications, ranging from the classic Trauner-Obwegeser design to contemporary minimally invasive and supraforaminal approaches, have been developed to optimise functional stability, aesthetic outcomes, and neurosensory safety.[1,2]

Despite sharing the same goal of achieving stable mandibular repositioning, these techniques differ in their ability to address specific clinical challenges such as inferior border notching, vertical ramus discrepancies, and risk of injury to the inferior alveolar nerve (IAN). As no single design is ideal for every clinical scenario, the surgeon must select the osteotomy that best aligns with the patient's anatomical characteristics and the treatment objectives.

Although the literature extensively describes individual techniques, we know of no classification or comprehensive comparison of their properties, indications, and clinical outcomes. Therefore, the present review proposes a patient-tailored BSSO framework, comparing established and emerging sagittal split techniques, including their

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indications, advantages, and limitations, to guide surgeons in choosing the most appropriate approach for each individual case.

Description of surgical techniques

The authors have formulated an original classification that organises established osteotomy designs according to the position of the buccal cut relative to the mandibular notch and angle: pre-notch, post-notch, and post-gonial**.** The technical characteristics of each one and the clinical implications are described and compared (Table 1), providing a straightforward guide for selection of the optimal approach in each scenario.

Pre-notch osteotomy (A)

Technique

The classic BSSO[3–5] consists of a horizontal medial cut in the lingual cortex, starting just above the lingula, combined with a buccal vertical cut along the external oblique ridge. Modifications by Dal Pont (anterior extension of the buccal cut), Hunsuck (shorter, more direct lingual cut), and Epker (refined posterior and inferior extensions) all aim to improve split reliability, increase bony contact, and simplify fixation while maintaining the original concept. To reduce the risk of injury to the IAN, the authors recommend slight backwards tilting of the vertical buccal osteotomy of the BSSO (Fig. 1).

Indications

- Large mandibular advancements require a vertical buccal osteotomy positioned as medially as possible to maximise bony contact, as the described pre-notch osteotomy (the authors recommend its use only in patients with thick soft tissues).[6]

Advantages

- Large and reliable bony contact surfaces that promote solid healing and stable fixation.[7]
- Versatility: allows all 3-dimensional mandibular movements.[8]
- Well documented, with decades of clinical experience and predictable outcomes.

Disadvantages

- Higher risk of unfavourable fractures (“bad splits”) requiring intraoperative management. The main drawback is that the IAN runs close to the base of the mandibular body at this level, thus risking damage to the lower part of the osteotomy.[9,10]
- Significant risk of inferior border notching, especially in large advancements, therefore bone grafting is usually mandatory.[11,12]

Post-notch osteotomy (B)

Technique

The angled lateral osteotomy[13] uses the classic medial horizontal cut but replaces the vertical buccal cut with an oblique one that angles posteriorly (approximately 45°) towards the masseteric tuberosity. The inferior border cut follows this angled path and is therefore positioned posterior to the mandibular notch, which is typically hidden beneath the masseter muscle, rendering it less visible. Moreover, the IAN runs far from the lower part of the osteotomy (Fig. 2).

Indications

- All 3-dimensional mandibular movements can be easily performed.[6]
- Large mandibular advancements in which the minimising of inferior border defects or “notching” is critical for aesthetics, particularly in patients with thin soft tissues.[11,14]
- Allows large counterclockwise rotations, preventing protrusion of the buccal plate of the proximal segment in the inferior mandibular border.[13]
- Patients at higher risk of IAN injury, where a more posterior fracture is desired.[15]

Advantages

- Encourages a true Hunsuck-type posterior lingual split, reducing inferior border notching and visible contour defects.[4,12,13]
- Trend towards fewer bad splits and less nerve manipulation compared with conventional BSSO.[13,15,16]
- Masseter muscle coverage helps camouflage notching.[17,18]

Disadvantages

- Slightly more technically demanding, requiring precise posterior angulation of the buccal cut.[13]
- In large mandibular advancements and/or counterclockwise rotations, there is a risk of minimising bony contact, which may lead to instability. Careful assessment during 3D planning is therefore mandatory.[8,11,19]

Post-gonial osteotomy (C)

Technique

Building on the foundational principles established by Obwegeser, these techniques extend a basal cut to the posterior border of the mandibular ramus while preserving the basal portion of the mandibular angle within the distal segment.[20–24] The vertical osteotomy is placed between the first and second molars to provide broad cortical contact and facilitate ramus lengthening during mandibular advancement. The internal cortex of the mandibular ramus should

Table 1
Patient-tailored bilateral sagittal split osteotomy (BSSO) classification and key surgical features.

	Bone contact surface	Notching	Angle modification	Vertical ramus change	IAN safety	Need for bone grafting	Indication
Pre-notch (Type A)	+++	++	-	-	+	+ Notching camouflage	Big advancements + thick soft tissues
Post-notch (Type B)	++	+	-	+	++	+ Stability	Standard technique + thin soft tissues
Post-gonial (Type C)	+	-	+++	+++	+++	+ Stability	Vertical changes in ramus length

IAN: inferior alveolar nerve.

be preserved within the distal segment, as described by Dal Pont, to ensure continuity of the mandibular ramus. Otherwise, a perceptible triangular gap may appear in the posterior border of the ramus (Fig. 3).

Indications

- Correction of vertical ramus asymmetry resulting from congenital hemifacial microsomia, trauma, condylar hyperplasia, or similar conditions.[24]
- Cases in which a conventional BSSO would not adequately address a discrepancy in ramus height and where additional augmentation procedures would otherwise be required.[14]

Advantages

- Increases ramus length by preserving the basal mandibular angle in the distal segment.[14,23,24]
- Enhances facial symmetry and aesthetics without the need for patient-specific implants or secondary augmentation procedures.[23–25]
- Provides adequate bony contact for stable healing and allows moderate mandibular advancement when vertical elongation is required.[21]
- Maintains protection of the IAN through a standard intraoral approach.[14,21,24]

Disadvantages

- Technically more demanding than a conventional BSSO, requiring precise posterior extension to avoid a bony gap.[21]
- Limited clinical data beyond initial reports; long-term outcomes are still being established.[14]
- Higher risk of relapse due to stretching of the pterygomasseteric sling.[26,27]

Discussion

Patient-tailored osteotomies have progressively shifted the focus from standarised designs towards customised approaches that are adapted to each patient´s anatomy and treatment goals. Among mandibular procedures, the conventional or pre-notch BSSO remains the technique of choice due to its versatility, stable bony contact, and ability to allow 3-dimensional repositioning of the distal fragment while preserving condylar seating. Alternative techniques, such as the vertical ramus osteotomy (VRO), may be indicated for mandibular setback.[28] Nevertheless, compared with other techniques, the conventional pre-notch BSSO is often preferred, as evidence further supports the fact that it can simultaneously address sagittal, vertical, and transverse discrepancies, and provide stable postoperative outcomes.[29,30]

However, when large mandibular movements are required, an increased and unaesthetic basal notch may result, particularly in patients with thin soft tissues. In such cases, post-notch BSSO is indicated, as coverage by the masseter muscle helps camouflage any irregularities in the inferior border. An additional consideration for maintaining a smooth mandibular contour after large advancements is the use of an iliac crest bone graft at the inferior border defect, as described by Raffaini et al.[11] This technique, applied during standard BSSO when advancements exceed 10 mm, involves placing a monocortical block of iliac crest into the gap between the proximal and distal segments without altering the osteotomy design. Although not a new osteotomy itself, this adjunct significantly reduces the incidence and size of inferior border notching, and provides improved aesthetic outcomes with minimal additional operating time or morbidity.

Finally, post-gonial designs would be indicated to correct vertical ramus asymmetries caused by congenital hemifacial microsomia, trauma, condylar hyperplasia, or similar conditions. The authors emphasise the fact that the internal cortex of the mandibular ramus should be preserved within the distal segment, as described by Dal Pont, to ensure continuity of the mandibular ramus and avoid a perceptible triangular gap in the posterior border.

Although all post-gonial designs preserve the basal mandibular border and allow moderate advancement, compared with pre-notch techniques, their reduced bony contact makes them less suitable for very large horizontal advancements. Moreover, this approach presents greater technical challenges, particularly an increased risk of unfavourable fracture (“bad split”), which precludes its use as a first-

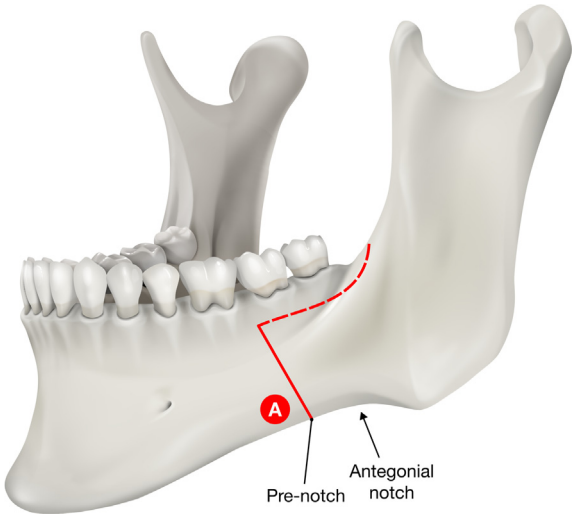

Fig. 1. Design of pre-notch buccal osteotomy.

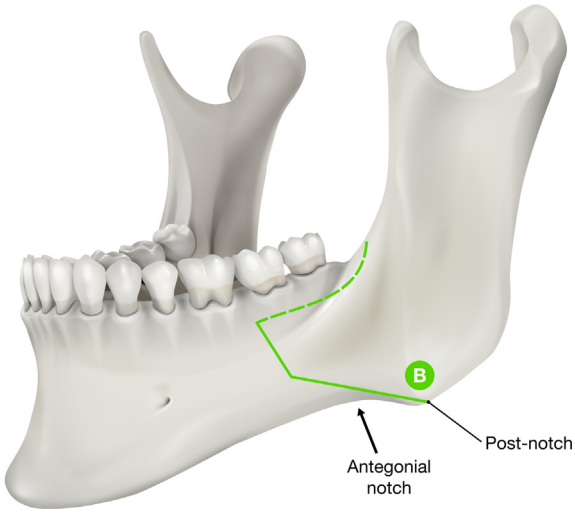

Fig. 2. Design of post-notch buccal osteotomy.

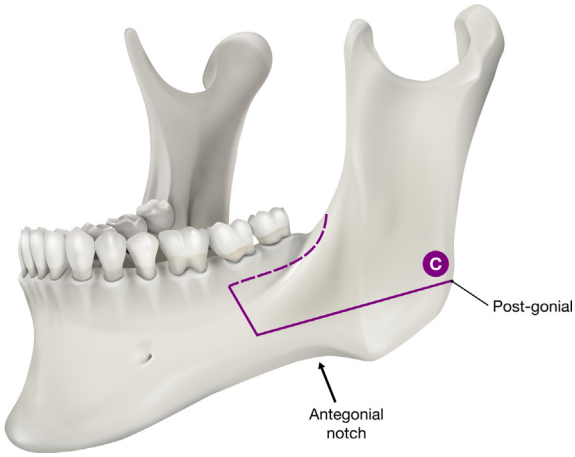

Fig. 3. Design of post-gonial buccal osteotomy.

choice technique for conventional procedures. The use of piezoelectric instruments is therefore recommended to improve precision and minimise complications.[31,32]

In contrast, IAN injury remains an area of concern, with reported risks of approximately 13% at one year and up to 36% when intraoperative nerve exposure occurs.[33] Several strategies have been proposed to minimise this complication, including preoperative cone-beam computed tomographic (CBCT) assessment of canal position, use of piezoelectric saw devices, direct visualisation to avoid blind splitting, manual twist techniques, and controlled splitting with forceps or elevators rather than chisels.[31–37] Regarding the osteotomy design itself, it is well established that the course of the IAN changes gradually from lingual to buccal between the mandibular second molar and second premolar, exiting through the mental foramen on the buccal surface of the mandible.[36] Therefore, the closer the vertical osteotomy is placed to the mandibular ramus, the lower the risk of nerve injury.

Evaluation of condylar position after sagittal osteotomy has shown that the extent and direction of mandibular movement exert a greater influence on temporomandibular joint (TMJ) position than the osteotomy technique itself.[38]

Finally, regardless of the osteotomy design selected, the application of minimally invasive surgical principles (small vestibular incisions, piezoelectric devices, and limited muscular dissection) can reduce surgical trauma, trismus, and postoperative dysfunction, preserve bone overlap and fixation stability, and align with current Enhanced Recovery After Surgery (ERAS) protocols, to support faster recovery and lower perioperative morbidity. Surgeons can integrate these design-specific insights with 3-dimensional planning to tailor BSSO to individual anatomy, balancing stability, aesthetics, and neurosensory safety.[39,40]

Conclusions

The proposed pre-notch/post-notch/post-gonial classification offers a simple, clinically oriented framework that aligns existing BSSO modifications with specific clinical scenarios and surgical objectives, supporting more precise and individualised treatment planning.

Conflict of interest

We have no conflicts of interest.

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Ethics statement/confirmation of patients permission

Not required

Author contributions

All authors contributed to the conception, drafting, and critical revision of the manuscript, and approved the final version.

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