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Technical Note
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Use of a 'low and short' medial cut limits sagittal ramus osteotomy interferences

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Abstract. The traditional 'high and short' medial cut of the sagittal ramus osteotomy (Hunsuck modification) is a frequent cause of lingual plate interferences in patients undergoing mandibular yaw or cant corrections. We describe how the modified 'low and short' medial cut of the sagittal ramus osteotomy reduces lingual plate interferences with improved passive alignment of the osteotomy segments.

Key words: sagittal split ramus osteotomy; orthognathic surgery; mandibular osteotomy; osteotomy; orthognathic surgical procedures.

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Since Obwegeser initially introduced the sagittal ramus osteotomy (SRO) over 60 years ago, several useful modifications have been described[1]. Most notable are alterations in osteotomy design to enhance the favorability of splitting and for osteotomy healing, as described first by Dalpont and later by Hunsuck[2,3]. The Dalpont modification extends a vertical osteotomy anteriorly into the molar region, allowing for a longer buccal plate extension[2]. This improves bony overlap and healing when the mandible is advanced extensively. The Hunsuck modification terminates the medial (horizontal) osteotomy just posterior to the lingula[3]. This design encourages the posterior osteotomy to propagate into the retrolingual fossa rather than to the posterior border. Specifics of the Hunsuck modification include placement of the medial ramus osteotomy cut 'high', just a few millimeters above the lingula, superior and lateral to the entrance point of the inferior alveolar nerve (IAN) into the mandibular foramen. A potential disadvantage of the Hunsuck technique is propagation of the medial osteotomy superiorly toward the condyle or fragmentation of the ramus. An unfavorable propagation negatively impacts the operative course, necessitating either complex rigid fixation if feasible or termination of the procedure altogether.

To reduce the frequency of unfavorable osteotomy propagation toward the condyle, a third SRO refinement was suggested by Posnick (Figs 1 and 2)[4–6]. This is a modification to the medial horizontal osteotomy that keeps the cut both low (close to the mandibular occlusal plane and below the lingula) and short (terminating the cut anterior to the lingula). This design change allows for splitting of the SRO with the posterior osteotomy component propagating anterior to and below the lingula. This modification virtually eliminates the possibility of propagation toward the condyle and in so doing, avoids a 'bad split'[6]. Susarla et al. confirmed the efficacy of the 'low and short' medial horizontal cut of the SRO at decreasing the risk of an unfavorable split[7]. In a second study, Susarla and colleagues confirmed that when using the low and short medial cut, the IAN was retained within the proximal segment approximately 50% of the time[8]. However, no difference in functional sensory recovery was found when the IAN was either freely entering the distal segment or when it was partially retained within the proximal segment and not further surgically manipulated to free it from the proximal segment.

An important aspect of an orthognathic procedure is the proper maintenance of

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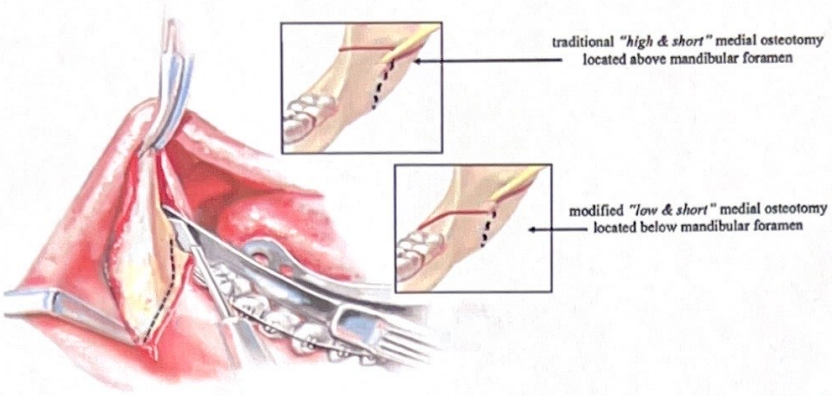

Fig. 1. Artistic illustrations demonstrating differences in the location of the modified 'low and short' versus the traditional 'high and short' medial cut of the sagittal ramus osteotomy of the mandible.

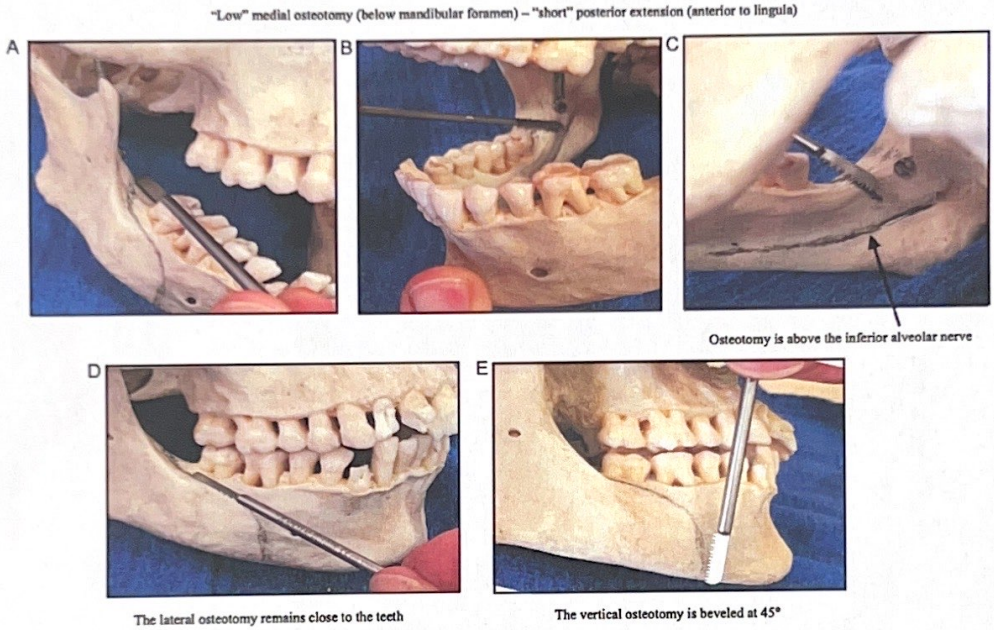

Fig. 2. Dry skull illustration of the modified 'low and short' medial cut and other aspects of the sagittal ramus osteotomy of the mandible. (A) The medial cut is made at the level of the mandibular molar occlusal plane and below the lingula. (B) Demonstration of the lingual plate osteotomy site location. (C) The sagittal saw (2 cm straight saw blade), demonstrating clearance from the inferior alveolar nerve even if the blade is 'turned down'. (D) The sagittal ramus osteotomy continues anteriorly just lateral to the molars. (E) The location of the vertical cut is determined by the extent of the planned mandibular advancement.

each mandibular condyle within its glenoid fossa at the end of the operation[4]. Unfortunately, when utilizing a traditional SRO as a method to surgically reposition the mandible (i.e., Hunsuck modification), the proximal and distal segments often do not align themselves passively to one another. This is due to interferences with the posterior portion of the distal segment. This is especially true in cases of mandibular asymmetry (e.g., unilateral condylar resorption or hemi-mandibular elongation) when the roll and yaw orientation of the jaw(s) must also be corrected. For example, when the medial cut is 'high and short' (i.e., Hunsuck modification) and the distal mandible must be repositioned to one side (i.e., lateral shift), the most posterior aspect of one distal segment is rotated medially and the other is rotated laterally. This causes an anterior located

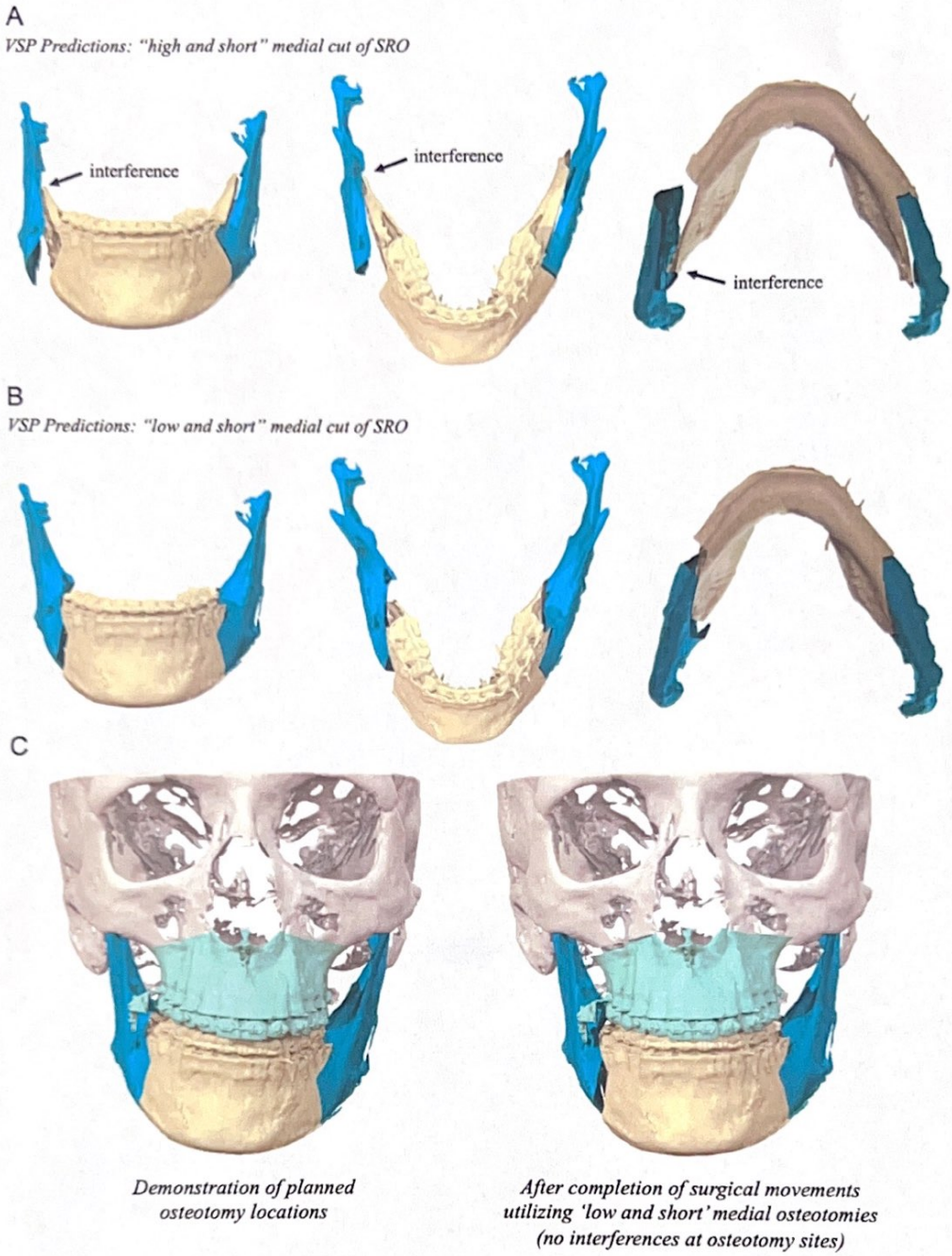

Fig. 3. Longstanding asymmetric mandibular excess resulting in hemi-mandibular elongation. Bimaxillary surgery is to include Le Fort I and sagittal ramus osteotomies to advance the jaws and correct the facial asymmetry. (A) VSP prediction of osteotomy site interferences using a traditional 'high and short' medial cut as part of the SRO. On the right side of the mandible, the posterior aspect of the distal segment is rotated laterally causing interference (marked with the arrow). This prevents broad contact across the osteotomy site and results in an anterior osteotomy site gap with flaring out of the proximal segment buccal shelf extension. Significant osteotomy site recontouring will be required. (B) VSP prediction of osteotomy site approximation using a 'low and short' medial cut as part of the SRO in the same patient. The proximal and distal segments of the mandible evenly approximate across the osteotomy site without condylar displacement out of the glenoid fossa. There is no need for surgical recontouring to improve osteotomy site contact. (C) CBCT scan imaging of the patient's craniofacial skeleton indicating the planned locations of osteotomies utilizing the 'low and short' medial cuts.

gap between the segments on one side and may cause a posterior located gap between the segments on the other side (Fig. 3). On the side with an anterior gap (posterior distal segment interference), Ellis recommends managing the problem by completing an additional osteotomy through the distal segment just behind the terminal molar[9]. The additional osteotomy is to remove interferences from the lingual plate extension of the distal segment. Ellis claimed that with the lingual plate fractured medially, there was elimination of the premature contacts and the segments passively approximated.

We have found the low and short medial osteotomy modification to be an efficient and effective method to limit the tendency for the segments to interfere with one another (Fig. 3)[4–6]. With this technique, the need for Ellis's additional osteotomy is eliminated. The SRO modification described herein maximizes the passive bony contact across the osteotomy site after surgically repositioning the distal segment in most cases. In so doing, the proximal segment is also passively positioned without displacement of the condyle out of the fossa.

Surgical technique

After completing the vestibular mucosal incision and adequate sub-periosteal dissection, the cortical cuts of the SRO are accomplished. The osteotomy lines are marked with a sterile pencil, and a reciprocating saw (i.e., short, straight blade) is utilized to complete the cortical osteotomies (Fig. 2).

The first osteotomy is made horizontally through the medial cortex of the ramus. This is judged to be just superior to the occlusal plane of the mandibular molars (it is located below the lingula) and well inferior to the region of the anterior aspect of the ramus, where the medial and lateral cortices join and no longer maintain a medullary cavity (Fig. 2A–C). The medial osteotomy does not extend more than 2 cm posterior. This is referred to as a 'low and short' medial cut and is part of the overall SRO.

The osteotomy then continues anteriorly and just lateral (buccal) to the molars. The saw blade penetrates the cortex to enter the medullary cavity in all locations (Fig. 2D). If the third molar is impacted, the saw blade will bounce off the crown of the tooth just after penetrating the superior paper-thin cortex; this is typically just lateral to the second molar. The blade will penetrate back into the medullary cavity as the osteotomy progresses anterior past the impacted tooth.

The reciprocating saw is then repositioned to complete the vertical cortical osteotomy. The osteotomy location will depend on the planned buccal extension of the proximal segment (i.e., Dalpont modification). The vertical osteotomy begins at the inferior border of the mandible, where the IAN is close to the cortex and therefore prone to laceration (Fig. 2E). The osteotomy then continues superiorly to join the cortical osteotomy, which was previously completed lateral to the molars.

Discussion

The first author has used the low and short medial cut as a modification of the traditional SRO since the late 1980s[4]. The impetus to make this change was in search of a way to reduce the occurrence of a bad split. While its value in eliminating the risk of an unfavorable split was immediately apparent, a frequent finding of the IAN within the proximal segment just after its entrance through the mandibular foramen was troubling. It was soon realized that release of the IAN from the proximal segment just after its entry through the mandibular foramen was an unnecessary technical step. Even with extensive advancements of the mandible, tension on the IAN was rarely seen. We have reported good results with no unfavorable splits in a consecutive series of SROs ($n = 524$) when using the low and short medial cut[6]. The low occurrence of unfavorable splitting and the favorable functional sensory recovery of the IAN without the need for full release from the proximal segment when using the low and short medial cut has been independently corroborated by Susarla et al. at the University of Washington[7,8,10].

A secondary advantage of the low and short medial cut of the SRO is the limited need to remove bony interferences once the distal segment is placed in its new location. Designing the distal segment of an SRO without an extensive lingual plate was immediately realized by the first author to be an advantage in this regard. By the 1990s, Ellis also recognized the same problem of osteotomy site interferences when using the Hunsuck technique. Ellis approached the problem from a different perspective[9]. His solution requires an additional osteotomy to modify the lingual plate position after traditional splitting. The Ellis osteotomy puts both the IAN and the lingual nerve at some risk of injury. With concern for successful SRO healing, he also cautioned surgeons to limit its use to just one side of the mandible[9].

A theoretical disadvantage of the low and short medial cut of an SRO is having inadequate lingual plate in the distal segment for sufficient bony contact to achieve osteotomy site healing. It was postulated that by altering the buccal shelf extension of the SRO according to patient specifications (i.e., large advancements warrant a more extensive buccal shelf extension of the proximal segment) this risk could be mitigated. Posnick et al. reviewed a large series of SROs undergoing the medial cut modification, confirming adequate bony contact to achieve rigid fixation using bicortical screws[6]. The study data also documented timely osteotomy site healing with achievement of the expected occlusion and the successful return to a full chewing diet and vigorous physical activities by 9 weeks after surgery in all subjects[6].

The current literature suggests that the low and short medial cut modification of the SRO reduces the risk of an unfavorable split without decreasing functional sensory recovery of the IAN. The technique may also be used to improve the passive approximation of the SRO segments as part of the orthognathic reconstruction without undue risk of unfavorable osteotomy site healing.

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Competing interests

None.

Ethical approval

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Patient consent

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