

The Sagittal Split Ramus Osteotomy as the Preferred Treatment for Mandibular Prognathism

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Since the introduction of the mandibular sagittal split ramus osteotomy (SSRO) by Trauner and Obwegeser¹ in 1957, it has become one of the most popular operations for correction of mandibular prognathism. This article discusses the indications and advantages of the SSRO and describes specific surgical modifications to improve outcome and reduce risks and complications.

Indications and Contraindications

The SSRO with rigid fixation (RF) can be best applied for correction of mandibular prognathism after the age of 12 years (after eruption of the mandibular second molars) in symmetric and mild to moderate asymmetric cases. Contraindications for the SSRO include 1) presence of unerupted mandibular second molars; 2) a severely narrow anteroposterior or mediolateral dimension of the ramus with no medullary bone between the buccal and lingual cortices; and 3) severe mandibular asymmetry.

Advantages and Disadvantages

The advantages of the SSRO with RF for correction of mandibular prognathism over the intraoral vertical ramus osteotomy (IVRO) or the inverted "L" osteotomy (ILO), for which maxillomandibular fixation (MMF) is usually required, include: 1) better bony interface between the segments; 2) easier application of RF; 3) enhanced healing because of the larger bony interface and the RF; 4) simultaneous removal of impacted or erupted third molars; 5) immediate post-

surgical jaw mobilization; 6) more accurate control of condylar position; 7) better speech during the healing phase; 8) better oral hygiene; 9) easier initial maintenance of postsurgery nutrition and quicker progression to a regular diet; 10) increased postoperative comfort level; 11) much better airway management, because patients can open the mouth to aid in breathing; 12) better nutrition for the cartilaginous structures of the temporomandibular joint (TMJ) due to jaw function (prolonged MMF can lead to deterioration of the fibrocartilage, adhesions, and subsequent osteoarthritic changes); 13) earlier initiation of postsurgical orthodontics (4 to 6 weeks); 14) shorter recovery time to regain a significant improvement in bite forces²; 15) repositioning of the mandible can be done first in double-jaw surgery; and 16) TMJ surgery (ie, disc repositioning, high condylectomy) and SSRO can be performed simultaneously.

Some disadvantages of the IVRO and ILO include: 1) there is little direct bone contact between the segments, which prolongs the healing process; 2) RF is difficult to apply; 3) there is less predictable control of condylar position; 4) there is significant rotation of the condyle, with the lateral pole being rotated up into a functionally loaded position and the medial aspect of the condyle being rotated downward out of its functional position, because the proximal segment must overlap the distal segment; 5) MMF is required to control the occlusion postsurgery; 6) the lateral pterygoid muscle is attached to the proximal segment, which may tend to displace the condyle downward and forward in the fossa, with a postsurgical tendency of the mandible to move into a Class II open bite occlusal relationship as the condyle settles back into the fossa³; and 7) long-term postsurgical elastics may be necessary to control the occlusion. The properly performed SSRO with RF minimizes torquing of the condyle medially or laterally out of the fossa and allows passive positioning of the condyle in the center of the fossa.

The disadvantages of the SSRO with RF, compared with the IVRO and ILO, include: 1) the surgical procedure takes longer; 2) the surgical technique must be very accurate; 3) an immediate shift of the

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occlusion postsurgery if the condyle is not properly seated in the fossa; 4) an increased risk of inferior alveolar nerve injury, particularly with the traditional surgical design; 5) technically greater difficulty in correcting moderate to severe asymmetries; and 6) greater blood loss, although rarely consequential. There are specific surgical modifications of the SSRO that significantly improve the positional control of the condyle and fit of the segments, and avoid unfavorable splits.^{4,5} These include the following: 1) modification of the buccal osteotomy to permit easy and predictable control of the proximal segment and facilitate condylar positioning, 2) using the inferior border saw to cut the lower borders, 3) careful bone removal on the proximal segment after the split to allow passive fit, and 4) correct seating of the condyles.

Risks and Complications

The basic major risks and complications of the SSRO⁶⁻¹⁰ for mandibular setback include: 1) inferior alveolar nerve injury; 2) lingual nerve injury; 3) displacement of the condyle anteroinferiorly, posteroinferiorly, medioinferiorly, or lateroinferiorly, resulting in an undesired postsurgical shift in the occlusion; 4) an unfavorable split; 5) infection; 6) unrecognized disproportionate mandibular growth (condylar hyperplasia);¹⁵ 7) airway compromise; and 8) TMJ pathology (ie, disc displacement).

Postsurgical Jaw Function

Ellis¹¹ has previously shown in Rhesus monkeys that wiring the jaws together for 6 weeks rather than using RF has a significant effect on the postsurgical range of motion. He attributed this to connective tissue changes around the joint. Kim and Oh² evaluated patients who had SSRO with RF, SSRO with wire fixation, and IVRO with or without wire fixation. (Those without RF had their jaws wired together for 6 to 8 weeks). The bite force was measured, and the results indicated that patients with the SSRO and RF recovered their bite force much faster than those who had other techniques involving MMF. It was concluded that the shorter the period of MMF, the more rapid the recovery of bite force. However, after 1 year, there was no significant difference between the groups relative to bite force, and the amount of bite force generated for all groups was twice the presurgical value.

Neurologic Considerations

Inferior alveolar nerve injury during the SSRO has been reported in the literature. Bell et al¹² preferred the IVRO to the SSRO because there was a lower

incidence of nerve injury. Paulus and Steinhauser¹³ found the incidence of mandibular nerve disturbance equal between the two procedures, but Wang and Waite¹⁰ reported an increased frequency with the SSRO. Jones et al¹⁴ performed SSRO with RF on 40 patients and evaluated the intraoperative occurrence of nerve injury. Using the modified SSRO surgical technique previously mentioned in this article^{4,5} and using somatosensory evoked potentials for nerve function evaluation, it was found that the major injury to the nerve happened with medial retraction, although recovery occurred in a relatively short period because of the minimal retraction forces used. Immediately postsurgery, some patients had a decreased nerve function, but by 1 year all cases had returned to normal based on subjective and SEP evaluations. This indicates that when proper technique and careful surgery are used to perform the SSRO, permanent nerve injury has a low incidence.

Unfavorable Splits and Third Molars

Precious et al¹⁶ evaluated 1,256 SSROs and reported 24 (1.9%) unfavorable splits. Only 5 of the 24 involved the presence of third molars. In the other 19 SSROs, third molars were removed a minimum of 6 months before surgery. In our study¹⁷ of 500 SSROs (250 having third molars removed at surgery and 250 without third molars), there were 11 (2.2%) unfavorable splits, with 8 (3.2%) occurring in the third molar group and 3 (1.2%) in the non-third molar group. All unfavorable splits were completed and stabilized with RF, with good outcomes. Unfavorable splits during the SSRO occur infrequently. However, knowing how to repair and stabilize the unfavorable split will still provide predictable results. If it is decided to remove the third molars before orthognathic surgery, it is recommended to remove them a minimum of 1 year before SSRO, because it will take that long for the bone in the third molar area to adequately heal.

Discussion

The SSRO is a very good procedure for correction of mandibular prognathism. The advantages of being able to correct the jaw alignment, have an excellent bony interface, apply RF for stability and to promote primary bone healing, have accurate control of the condylar position, and the benefits of no MMF, make the SSRO superior to the IVRO and ILO. Our study¹⁸ showed excellent stability in mandibular set-back with the SSRO in nongrowing patients. There was no statistically significant change of the absolute length of the mandible from immediate postsurgery to longest follow-up. Although some studies have indicated neuropathies associated with the inferior alveolar

nerve,^{10,12} other sources indicate no significant difference between the procedures,¹³ or reveal a minimal occurrence of nerve problems with the SSRO.¹⁴ The inferior border osteotomy modification can help to significantly minimize injury to the inferior alveolar nerve.^{5,14}

The relapse of prognathic cases with SSRO reported in the literature may be attributable to a few identifiable and avoidable factors, including: 1) unstable presurgical orthodontics, resulting in dental relapse; 2) the condyle being forced posteriorly in the fossa, compressing the bilaminar tissue and yielding immediate relapse; 3) positioning the proximal segment by pushing posteriorly on its anterior edge, thus displacing the condyle posterior and downward along the posterior wall of the fossa and resulting in an immediate postsurgical forward relapse with anterior open bite; 4) use of occlusal splints that open the bite and then create an upward and forward rotation of the mandible after splint removal; 5) impingement of the pterygomasseteric sling; 6) failure to remove bony interferences from the proximal segment that will not allow the segments to passively fit together; 7) macroglossia causing dentoalveolar protrusion; 8) vertical instability of the maxilla in double-jaw surgery causing upward and forward rotation of the mandible; and 9) untreated active condylar hyperplasia in which growth can continue into the mid 20s.¹⁵ The most common factors creating postsurgical instability in the occlusion and skeletal relapse are improper positioning of the condyle and condylar hyperplasia. The SSRO with RF is an excellent and predictable procedure for correcting mandibular prognathism as long as appropriate attention is directed to the pertinent details of the deformity and technical execution of the procedure. However, failure to attend to such details can result in unfavorable outcomes.

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