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Skeletal stability following mandibular advancement with and without advancement genioplasty

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Abstract. The correction of most cases of skeletal class II mandibular deficiency requires surgical advancement of the mandible for treatment of the malocclusion. Often genioplasty is included in the procedure to improve the soft tissue profile. Long-term skeletal stability is an important goal for the surgeon and orthodontist following bilateral sagittal split osteotomy (BSSO) and is influenced by the muscles attached to the mandible. Following the surgical advancement of the mandible, the suprahyoid muscle complex is stretched and even more so when the procedure is combined with surgical advancement of the chin. This retrospective comparative study determined the long-term skeletal stability of patients who had undergone surgical advancement of the mandible by means of BSSO with an advancement genioplasty, compared to those who had undergone mandibular advancement surgery (BSSO) without an advancement genioplasty. This study concluded that the postoperative hard tissue relapse following BSSO advancement, with or without genioplasty, was clinically insignificant.

Keywords: bilateral sagittal split osteotomy (BSSO); genioplasty; skeletal stability; mandibular advancement.

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Anteroposterior mandibular dentoskeletal discrepancies that cannot be treated with orthodontic techniques alone, should be corrected by surgical repositioning of the mandible. The technique of splitting the mandibular ramus in the sagittal plane was first described by Trauner and Obwegeser in 1955.[1] The technique was modified by Dal Pont[2] in 1961 and further refined by Hunsuck[3] in 1968 and later by Epker[4] in 1977. These developments have enabled surgeons to predictably establish optimal occlusal function and improve facial harmony and balance by surgical repositioning of the mandible.

Postoperative skeletal stability is key to any surgical correction. Several factors may influence the long-term stability of the mandible following surgical advancement, as outlined below.[5–9]

Correct seating of the condyles: Peripheral condylar sag is caused by remodelling of the condyle post-surgically,[9] with an alteration in the relationship of the condyle within its fossa resulting in a malocclusion.

The magnitude of advancement: It has been reported that advancements of 7 mm and more are more prone to horizontal relapse.[6,9]

The soft tissue and muscle stretch: Surgical advancement of the mandible causes stretching of the soft tissue drape, periosteal tissue, and the suprahyoid muscles. When the procedure is combined with surgical advancement of the chin, these components are stretched even further.[8–11]

The mandibular plane angle: In a study of mandibular advancement alone, Joss and Vassalli[6] found that patients with a low mandibular plane angle have an increased tendency to vertical relapse; patients with a high mandibular plane angle have an increased tendency to horizontal relapse.[9]

The use of wire versus rigid fixation: Several studies have shown that the postoperative skeletal stability following a bilateral sagittal split osteotomy (BSSO) is improved if rigid internal fixation (RIF), rather than wire fixation, is utilized.[9,12–28] In a literature search, only one study of skeletal stability following BSSO with RIF combined with advancement genioplasty was found.[29]

Distal segment rotation: Counter-clockwise rotation of the distal segment of the mandible in BSSO has been reported to result in greater relapse than if clockwise rotations are performed.[9] However, more recent reports indicate that if the 'short split' modification as described by Epker[4] is combined with stripping of the medial pterygoid muscle and stylomandibular ligament, which allows for the rotation of the distal fragment within the soft tissue envelope, relapse is minimal if rigid fixation is used.[30]

Neuromuscular adaptation: Mandibular function involves entrenched neuromuscular pathways. Altering mandibular position requires new pathway patterns to be developed. Habitual patterns may resist these positional changes, resulting in surgical relapse.[5]

Remaining growth: If BSSO is performed in growing individuals, it may result in incongruous growth of the mandible and maxilla, causing the development of a new malocclusion.[9]

The skill of the surgeon: Inexperienced surgeons suffer greater relapses in their operated cases.[9]

Long-term skeletal stability is an important goal following orthognathic surgery. Relapse after surgery can be determined radiologically by comparing the immediate post-surgical skeletal positions to the positions a minimum of 6 months post-surgery. Recent investigations have shown that the greatest amount of relapse occurs in the first 6 months following surgery.[8,31]

Advancement genioplasty is a valuable and reliable technique for the aesthetic enhancement of the lower facial skeleton by improving the soft tissue profile. Lip competence may also be improved in certain cases. Reyneke[32] suggested that when considering a genioplasty procedure, two important aspects should be kept in mind: (1) genioplasty is not a substitute for mandibular surgery, and (2) chin shape or contour is more important than chin position (anteroposterior position of the pogonion). If a retrusive mandible is corrected by performing a genioplasty rather than mandibular advancement surgery, a poor aesthetic result will follow. When the chin itself is retrusive with an obtuse labiomental fold, the lip–chin–throat angle is obtuse, and the chin–neck length is deficient, genioplasty in addition to a BSSO is the treatment of choice.[32]

The suprahyoid musculature has been implicated as a factor responsible for relapse after mandibular advancement surgery. A study by Ellis and Carlson[33] on Rhesus monkeys supported the hypothesis that stretching the suprahyoid musculature as a result of mandibular advancement surgery was a major contributor to skeletal relapse. Previous studies have indicated that the muscle and connective tissues comprising the suprahyoid muscles must adapt to the increased length brought about by mandibular advancement for skeletal stability to be achieved.[10] The value of suprahyoid myotomies and cervical collars has not been proved.[34]

The suprahyoid musculature consists of the following muscles: digastric, geniohyoid, mylohyoid, genioglossus, hyoglossus, and stylohyoid. Of these muscle complexes, the geniohyoid, mylohyoid, and digastric muscles are involved in a BSSO procedure (Figs. 1 and 2).

One study has assessed the impact of genioplasty on skeletal stability following BSSO combined with RIF.[29] Reyneke suggested that the influence of suprahyoid muscle stretch on long-term stability needs further research.[32]

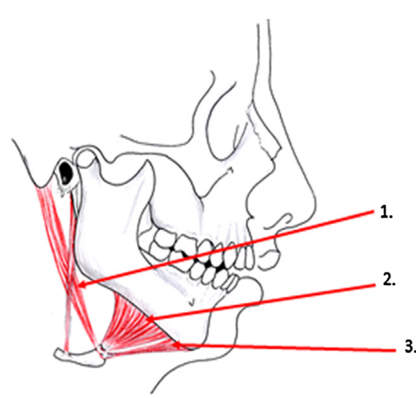

Fig. 1. Suprahyoid muscles involved in a BSSO: 1. digastric muscle; 2. mylohyoid muscle; 3. geniohyoid muscle.

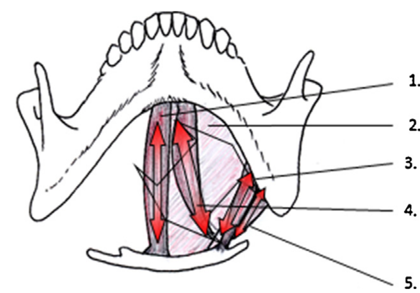

Fig. 2. Suprahyoid muscles involved in BSSO from an inferior view: 1. geniohyoid muscle; 2. mylohyoid muscle; 3. stylohyoid muscle; 4. anterior belly of the digastric muscle; 5. posterior belly of the digastric muscle.

The aim of this study was to determine whether the additional stretch of the suprahyoid musculature brought about by a concomitant advancement genioplasty with BSSO advancement combined with RIF, would influence the skeletal stability of the procedure.

Materials and methods

The cephalometric records of 58 patients with an anteroposterior mandibular deficiency who had undergone surgical correction of a class II malocclusion were analysed. Patients with known temporomandibular joint problems were excluded from the study. Twenty-nine patients received a BSSO and advancement genioplasty (group 1) and 29 patients only had a BSSO performed (group 2). Each group comprised males and females at an age when growth had been completed. Growth completion was determined and confirmed by hand–wrist X-rays for subjects aged less than 21 years. Group 1 consisted of 10 males and 19 females, and group 2 consisted of 9 males and 20 females. The average age at time of surgery was 23.0 years (range 14–46 years) in group 1 and 24.0 years (range 15–46 years) in group 2. The mean follow-up time for group 1 was 11.7 months (range 6–28 months) and for group 2 was 9.1 months (range 6–20 months).

All surgeries were performed by the same surgeon. RIF was accomplished utilizing three bicortical screws positioned in a triangular or straight-line fashion on each side. Postoperatively, light occlusal guiding elastics were positioned in the canine region (3.5 ounce, ¼ inch) and a soft diet was recommended for a period of 4 weeks. For patients in group 1, a sliding genioplasty was utilized to advance the chin and two tricortical screws were employed to fixate the bone segments.