Original Article

Evaluation of Long-term Stability of Bilateral Sagittal Split Osteotomy in Individuals with Different Growth Patterns

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Objective: Bilateral sagittal split osteotomy (BSSO) is a routinely used surgical step for the correction of a class III with mandibular prognathism. Many factors influence the stability of the surgical correction achieved. This study was designed to access the role of growth pattern in the surgical stability after a BSSO correction. Materials and Methods: A total of 18 individuals (6 vertical growers, 6 horizontal growers, and 6 normal growing individuals) were considered for the study. Five parameters, horizontal plane (HP)–pogonion (POG) angle, HP-occlusal plane angle, POG height, POG depth, and Point B depth, were measured and compared postsurgically and in the follow-up phase. Result: Vertical growing individuals showed greater tendency for relapse and clockwise rotation of mandible postsurgically. No major difference was observed in the normal and horizontal growing individuals. When planning BSSO on vertical growing patient, utmost care should be taken to prevent posttreatment relapse to ensure better surgical stability.

Keywords: Bilateral sagittal split osteotomy, growth pattern, relapse, stability

INTRODUCTION

Skeletal class III malocclusion has been an important topic of discussion for decades in specializations of both oral surgery and orthodontics. Despite a relatively low prevalence of this malocclusion in population, it has been reported that approximately one-third of orthognathic surgery patients presents with this type of malocclusion. The prevalence of class III malocclusion in India was reported to be 3.4%. The etiology of class III malocclusions is multifactorial and complex. It includes genetic, environmental, and gene–environment interactions.

Studies have reported that at least 30%–40% of skeletal malocclusions have significant component of maxillary deficiency, with 45.63% of cases of maxillary hypoplasia being associated with a normal or mildly prognathic mandible. Conversely, mandibular prognathism as a primary cause of class III malocclusion was found in only 19% of the class III cases studied.

Intraoral sagittal split osteotomy of the mandibular ramus was first introduced by Trauner and Obwegeser in 1957, and it is one of the most commonly used techniques to correct mandibular prognathism. Isolated mandibular setback is often considered as a less stable procedure. Stability of orthognathic procedure depends on various factors but relaxed soft tissue and neuromuscular adaptation are major ones. When the mandible is set back, a major cause of instability appears to be the tendency at surgery to push the ramus posteriorly when the chin is moved back. Brachyfacial individuals are found to be less stable after setback procedures in Japanese individuals due to the deeper bite and strong musculature, which provides a strong natural anchorage. But we need to address the...
factors including distribution of growth and rotation of mandible as well.

In our study, we evaluated the stability of isolated BSSO setback procedures immediately after surgery and long-term follow-up on Indian population.

**MATERIALS AND METHODS**

Three groups were formed before the selection of the patients for the study, which included Group 1 patients with normal growth pattern, Group 2 patients with horizontal growth pattern, and Group 3 patients with vertical growth pattern. This classification was based on the Steiner's mandibular plane angle measurements. A random search of our database was done, and six patients were allocated to each of the groups, combining a total of 18 patients, including 12 males and 6 females. All the patients had class III skeletal pattern, with mandibular prognathism and was indicated for bilateral sagittal split osteotomy (BSSO) procedure. Informed consent was obtained from all the patients before the procedure. Patient requiring bi-jaw surgery and genioplasty procedures were excluded from the study. The patients were available for long-term follow-up in the Department of Orthodontics, Sree Anjeneya Institute of Dental Sciences, Calicut, Kerala, India. All the surgeries were performed with the first surgery approach to avoid the bias. Mean age of patients were 20 years and 11 months. A team of orthodontist and oral surgeons planned and carried out the procedures. Lateral cephalograms and study models were made at T0 (pretreatment), T1 (postsurgical), and T2 (5–6-year follow-up period). The average follow-up period was 5 years and 7 months.

All the patients were initially strapped with 022” MBT brackets (3M Corporate Headquarters, 3M Center St. Paul, MN 55144-1000), and first and second molars were banded with straight wire tubes. Third molars were extracted in all the patients at least 6 months before the surgical procedure. A completely passive stainless steel wire was engaged in the brackets, and presurgical orthodontic procedure was limited to the elimination of premature contacts during setback. A mock surgical procedure was performed in the plaster model, and a splint was fabricated to ensure a three-point contact, one anterior and two posteriors at the end of the procedure. A team of experienced surgeons performed the procedures in the patient, titanium rigid fixation was used to secure the bony segments and occlusal splints were kept in place for 7 days post-surgery. The retention protocol was kept uniform in all the patients with chin cup for 3 months post-surgery, the force levels for chin cup were kept at 350–400 g and were continuously monitored during the course of wear.

For this study, additional parameters including linear and angular measurements were formulated to evaluate the post and follow-up stability of the BSSO procedure performed. Five parameters were listed. Horizontal plane (HP) was taken as a cranial reference landmark for all measurements, HP was constructed by taking 7° from the S-N plane. HP was chosen as it can correct the arbitrary nature of reference planes (SN and FH) used in other analysis.

The parameters chosen were as follows:

1. HP-POG angle (in degree), the angle between the HP and the pogonion
2. HP-occlusal plane (in degrees), the angle formed between the HP and the functional occlusal plane
3. POG height (in mm), the linear measurement between the nasion and the pogonion
4. POG depth (in mm), the linear measurement between the HP perpendicular and pogonion
5. Point B depth (in mm), the linear measurement between the HP perpendicular and point B

**RESULTS**

Postsurgical and follow-up cephalograms were assessed in all the three groups of patients. All the five parameters were assessed, and the statistical significance was calculated [Table 1].

1. HP-POG angle: Normal growth pattern individual showed a mean increase in the angle (0.5°), whereas the vertical growers showed the most increase (-3°) when compared to the horizontal growers (-2.66°)
2. HP-occlusal plane: Vertical growing individual showed a mild decrease in the occlusal plane angle (0.5°), whereas the normal growers showed a mild increase (2.16°). The mean occlusal plane angle in horizontal growers did not show any change postsurgery and follow-up.
3. POG height: All the three groups showed increases in POG height with the maximum in horizontal growers (1.83 mm) followed by vertical (1.16 mm) and normal growth individuals (0.83 mm).
4. POG depth: A significant decrease in the mean value of POG depth was noted in the vertically growing individuals (-6.16 mm), in horizontal growers the mean value was -3.58 mm, and the least decrease was noted in normal growers (-2.0 mm).
Figure 1: Horizontal-pogion angle

Figure 2: Horizontal plane-occlusal plane angle

Figure 3: Pogonion height
5. Point B depth: Point B depth also followed a similar trend with maximum decrease seen in vertical growers (-4.66 mm), whereas normal growing individuals showed a greater decrease in the value (-2.33 mm) when compared to the horizontal growers (-1.41 mm) [Graph 1].

Statistical methods: All statistical procedures were performed using Statistical Package for Social Sciences (SPSS) software, version 20.0 (IBM, New York, United States). All quantitative variables were expressed in mean and standard deviation. Qualitative variables were expressed in percentages. Shapiro–Wilk test was used for testing the normality assumption of the data. Kruskall–Wallis test was used for association. Probability value ($P < 0.05$) was considered statistically significant [Table 1].

On statistical analysis, none of the five parameters showed a statistically significant value, but cephalometrically, the values showed a general trend for greater relapse in vertically growing individuals, whereas not much of a difference was observed between the horizontal and normal growing individuals.

Discussion

Surgical stability after BSSO depends on a number of variables both operative, orthodontic and postoperative retention. In this study, care was taken to subject all the patients through the same process of surgical and postsurgical phase to correctly access the true correlation between surgical stability and the growth pattern. The presurgical orthodontic, the surgical, and the retentive phase were all performed by the same team of specialists to avoid errors. Five parameters were specifically designed for this study so as to clearly assess the relapse tendency in the mandible both in anteroposterior plane and rotation.

The values showed a greater relapse in the vertical growers, whereas in the horizontal and normal growers, a mild relapse was noted, but it was difficult to predict the one with the greater relapse tendency. Pogonion depth was decreased greater in normal growing individuals when compared to that in the horizontal growers, but point B depth showed the reverse tendency.

The small group of individuals was a hindrance for accessing the statistical significance in the study, but every effort was made to choose patient requiring the same surgical procedure, single jaw with no genioplasty and first surgery approach. Follow-up of all the patients during the period was carefully monitored, and postsurgical chin
cup wear schedule was properly monitored through time tables given to all individuals for the duration of wear.

Irrespective of the growth tendency, all the cases in this study showed a relapse in the mandible postoperatively. In the hierarchy of stability of orthodontic surgical treatment, single jaw mandibular setback surgeries are considered problematic with less stable prognosis. According to our study, the prognosis becomes still worse if it is a horizontal grower. Natural late mandibular growth tendency can be considered as a causative factor for the relapse seen in the cases. The mean age of patients in our study was 20 years and 11 months. At this age, the growth of the mandible ceases so it cannot be considered as the sole factor for relapse.

The greater relapse tendency in a vertical grower may be due to the difference in the weaker natural anchorage of the muscles seen. According to the Ricketts Bioprogressive Therapy, the high angle and the dolichocephalic facial types have larger vertical component of muscle pull around the chin. So relapse and clockwise rotation of the mandible after BSSO will be greater in such patients as seen in our study. In the horizontal grower, the clockwise rotation of the mandible is prevented by the stronger musculature, which provides a natural anchorage thereby minimizing the relapse tendency. In a similar study conducted comparing the relapse tendency of BSSO with the facial types, it was concluded that the dolichocephalic patients had more relapse tendency when compared to the brachy facial group, our study also reached a similar conclusion.

Another major factor that influenced the stability of the surgical correction is the postsurgical occlusion. In our study, utmost importance was given to establish good postsurgical occlusion with orthodontics. Acceptable cusp interdigitation was achieved in all the patients, minimizing premature contacts and altered mandibular closure.

Single-jaw surgery for class III correction is always prone to relapse, and it is further aggravated in a vertical growing patient as per our study. So utmost care is warranted in such patient right from treatment planning to postsurgical retention to ensure a good surgical stability. Planning for a bi-jaw procedure, good postsurgical occlusion, long-term retention, and follow-up can ensure surgical stability.

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Conflicts of interest
There are no conflicts of interest.

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