Original Article

Evaluation of stability and esthetic outcome following rigid fixation of a new sagittal genioplasty technique – A clinical study

ABSTRACT

Background: Routine and popular conventional genioplasty procedure is often curvilinear, requires lower border extension below, and behind the mental foramen, which after advancement has a tendency to produce step deformity, butt contact, hence nonunion, instability, and increased relapse tendencies. The present technique is aimed to study the new sagittal genioplasty technique and its efficacy to overcome the above-mentioned drawbacks of conventional genioplasty. This technique also aids in correcting mild-to-moderate breathing irregularities.

Materials and Methods: A total of 10 patients included in this study. The comparative analysis of the displacement of the chin in vertical and horizontal directions following surgery was evaluated by measuring the difference between preoperative, immediate postoperative, 3 and 6 months postoperative on lateral cephalometric radiographs.

Results: The study of new sagittal chin advancement results showed an advantage over conventional technique in terms of esthetics outcome (no jowl), easy to perform without damaging the mental nerve, superior healing with less relapse, and better surface area contact.

Conclusion: In this study, the new technique of sagittal genioplasty overcomes the disadvantages of conventional genioplasty. However, this technique is best suited for patients who require straight or moderately vertical augmentation advancement genioplasty and is not suitable for asymmetry corrections, i.e., centering genioplasty and double sliding genioplasty.

Keywords: COGS analysis, modified genioplasty, sagittal advancement genioplasty

INTRODUCTION

The current concept in diagnosis and treatment planning of dentofacial rehabilitation focus on the balance and harmony of various facial features.[1] The lower one-third of the face has a major impact on the perception of facial aesthetics. The chin is the most prominent osseous projection of the lower part of the face, and it portrays the lower facial esthetic lines and concludes the overall facial harmony.[2] Osseous deformities of the chin can lead to significant facial disfigurement and a noticeable compromise in facial aesthetics.

Genioplasty has become an important surgical technique to achieve or restore facial balance in the correction of dentofacial deformity allowing improvement in the profile, equilibrium in the labiomental musculature, and even the nasolabial region of the face.[3]

The most frequently performed osteotomy for correction of the small and retruded chin is the horizontal sliding genioplasty, first described by Hofer in 1942.[4] Converse in 1950, discussed the feasibility of bone grafts introduced

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through intraoral approaches. Sir Harold Gillies performed the first extra-oral "jumping" genioplasty in 1947 on a patient with Treacher-Collins-Franchetti Syndrome. Trauner and Obwegeser, in 1957, used the horizontal osteotomy through an intraoral incision.

Hinds and Kent in 1969 were the first to realize and discuss the importance of maintaining the soft tissue attachment along the inferior segment.

Modern technology using three-dimensional computer-aided designing, computer-aided milling or machining and manufactured using Stereolithographic techniques virtual planning for orthognathic surgery has critical advantages compared to conventional treatment planning.[5]

Conventional genioplasty involves oblique osteotomy of the symphysis to facilitate horizontal augmentation, thereby decreasing the vertical height and resulting in the deepening of the mentolabial fold (MLF). This notching may necessitate additional grafting in this area to avoid this problem. The sagittal split genioplasty technique (SS genioplasty) has been developed to avoid this specific aesthetic complication of the sliding genioplasty.[4]

The main purpose of this study to evaluate stability, esthetic outcome, and complication following rigid fixation of the sagittal split advanced genial segment.

MATERIALS AND METHODS

A total of 10 cases of retrogenia and/or retrognathic mandible, were included in the present study. All the patients were treated at the Department of Oral and Maxillofacial Surgery, Swami Vivekanand Subharti University, Meerut. Before the beginning of the study, the study design and method was approved by the ethical committee of the Swami Vivekanand Subharti University, Meerut, Ethical approval ref no. SDC/CER/2016.

Out of ten patients, two were males and eight were females with ages ranged from 18 to 28 years. Patient inclusion criteria were patient's willingness to participate in the study, patients with Angle's class I and II malocclusion with retrogenia, patients age from 18 years and above and medically able to undergo surgical intervention. Exclusion criteria were unrealistic expectations and medically compromised patients.

All patients were evaluated preoperatively both clinically and radiographically by COGS soft/hard tissue analysis. A detailed medical and dental history was recorded. The investigations carried out were routine blood investigations, radiographs were obtained. Informed consent from the patients was taken to participate in the study.

Data were recorded, clinical and radiographic examination preoperative [Figure 1a-d], immediate postoperative after 3 and 6 months postoperatively [Figure 2a-d]. Immediate postoperative and after 3 and 6months postoperatively.

Surgical technique

All the cases were operated under General Anesthesia with naso-endotracheal intubation following aseptic technique. Part preparation was done with 5% povidone-iodine. Infiltration with 2 mL of local anesthetic containing a vasoconstrictor (epinephrine in a concentration of 1:200,000) in the mandibular anterior vestibule was done. A translabial incision was given, this incision angled at 45° to the bone so that more submucosal tissue and periosteum remain at the superior aspect, which was easier for suturing. We exposed the chin bone down to the lower border on both sides a little beyond the foramina. Below the mental foramen, the periosteum was elevated around the inferior border to allow retraction for the osteotomy with very minimal stripping of soft tissue done in the midline. The osteotomy was begun below and slightly 5 mm anterior to the mental foramen on either side of the mandible.[6] The oscillating saw blade [Figure 3] was used and oriented almost vertically and in the sagittal plane. The horizontal cut was made perpendicular to the labial cortex, whereas the vertical osteotomy was much obliquely/sagittally behind and posterior to the mental nerve. This results in a sagittal split of two-thirds of the inferior chin segment. The advancement of the inferior chin segment does not result in a gap at the inferior border of the mandible behind the [Figure 4] advanced segment. The area behind the advanced chin segment still had the normal vertical mandibular height because of the sagittal splitting and no through and through the gap was created. The inferior chin segment is then secured in the anterior region by rigid fixation using a chin plate/miniplates and screws [Figure 5]. The suturing was done in layers.

Follow-up evaluation

Patients were discharged and were kept on semi-solid diet for the first 2 weeks and thereafter subsequently allowed to regain their normal diet. All the patients were followed up for 6 months. The postoperative lateral cephalogram was taken in all the cases to assess the changes in hard and soft tissue.

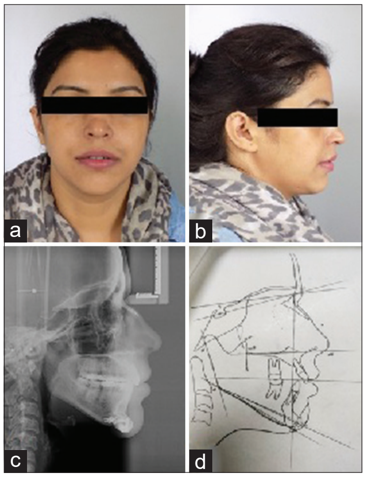


Figure 1: (a) Preoperative Front Profile. (b) Preoperative lateral profile. (c) Preoperative radiographs. (d) Preoperative tracing

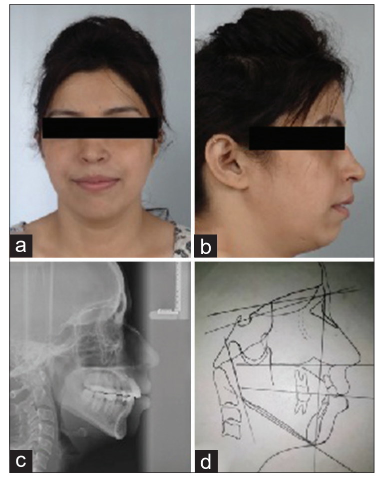


Figure 2: (a) Postoperative front picture. (b) Postoperative lateral profile. (c) Postoperative radiograph. (d) postoperative tracing

Figure 3: Oscillating saw

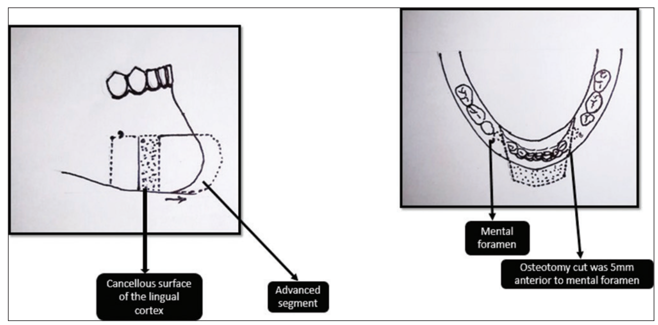


Figure 4: Diagram of oblique sagittal split sliding genioplasty

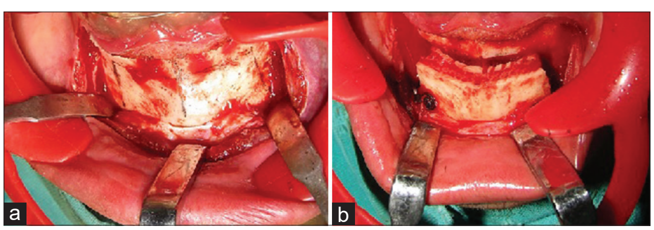


Figure 5: Intraoperative picture – (a) Osteotomy site was marked. (b) The osteotomy was begun below and slightly 5 mm anterior to the mental foramen on either side of the mandible

Figure 6: (a) Preoperative soft tissue analysis. (b) Postoperative soft tissue analysis

Preoperative and postoperative profile photographs were assessed for the esthetic outcome [Figure 6a-b].

RESULTS

In this prospective study, a new sagittal genioplasty technique was evaluated by assessment of its aesthetic results, degree of relapse, the intensity of pain and complications like sublingual haematoma/ecchymosis, neurosensory deficit– paresthesia of chin and/or lip and vitality of teeth.

The collected data were tabulated, and statistical analysis was performed by paired "t" test for comparison of means and Wilcoxon signed-rank test for variables, and software was SPSS 17 version.

This study included ten patients for surgical intervention, in which 8 (80%) were female and 2 (20%) were male with a mean age of ±22 years (range from 18 to 27 years).

Aesthetic outcomes were measured by the advancement of genial segment and relapse, the mean percentage of the net changes after 6 months postoperative period of Pg (Hard tissue pogonion) to PgS (Soft tissue pogonion) is 7.8:7.0 = 1:0.89 [Graph 1].

Pain assessment was made by visual analog scale (VAS) scale at specific interval of time. All 10 patients had pain in the immediate postoperative period with no pain at 3 months and 6 months (mean VAS score of "0"). Pain was controlled by nonsteroidal anti-inflammatory analgesics.

On the assessment of sublingual hematoma at specific intervals of time postoperatively, it was observed that two patients had sublingual hematoma in immediate postoperative period; however, it subsided after 3 months of the postoperative period.

All ten patients had paresthesia in the immediate postoperative period in both, lower lip as well as chin region (mental nerve sensation). None of these patients had complete neurosensory deficiency, mental nerve sensation resolved to normal by 3 months.

On the assessment of vitality of lower anterior teeth at specific interval of time, teeth of all 10 patients were vitals and none had sensitivity at any postoperative period.

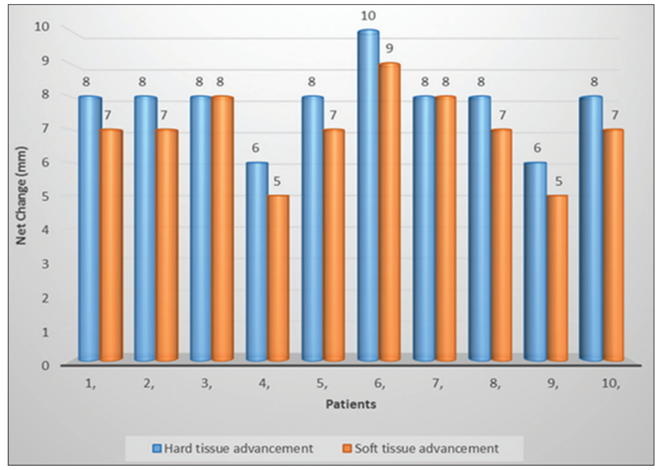
N-A-Pg (Angle of convexity-Hard tissue) - The mean value preoperative period was 9.30 ± 13.817, immediate postoperative value was 3.5 ± 13.159, at 3 months 3.5 ± 13.159, which was improved at the 6 months period of follow-up to 3.50 ± 13.159. A significant difference was found in statistical analysis with *P* value 0.023.

N-Pg (Position of mandibular chin in relation to Nasion) - The mean preoperative value was −4.90 ± 19.9 mm. Immediate postoperative value was −2.16 ± 15.290, at 3 months was −1.13 ± 15.46. It was improved to −1.18 ± 15.46 mm postoperatively at 6 months. No significant difference was found in statistical analysis.

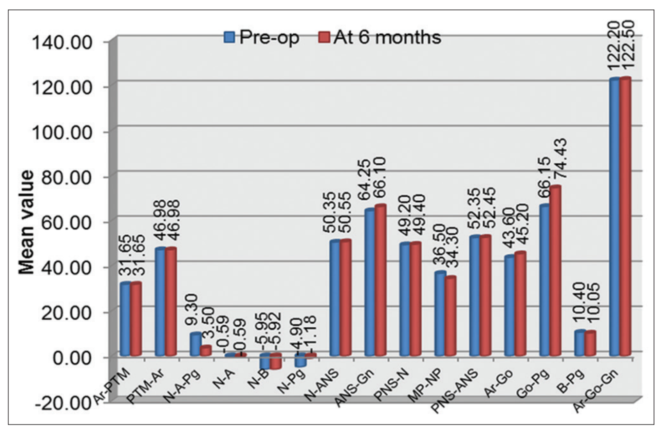
Go-Pg (Mandibular body length) - The mean preoperative value was 66.15 ± 6.51 mm. Immediate postoperative value was 74.03 ± 6.03, at 3 months was 74.03 ± 6.03. It was improved to 74.43 ± 5.86 mm after 6 months postoperative period. There was a highly significant difference present in statistical analysis with $P < 0.001$.

B-Pg (Prominence of chin in relation to mandibular apical base) – The mean preoperative value was 10.40 ± 4.52 mm, immediate postoperative was 9.55 ± 1.74, at 3 months 10.05 ± 2.00 and after 6 months it was found to be postoperatively by 10.05 ± 2.00 mm. No significant difference was found in statistical analysis between the two values [Graphs 2, 3 and Tables 1-3].

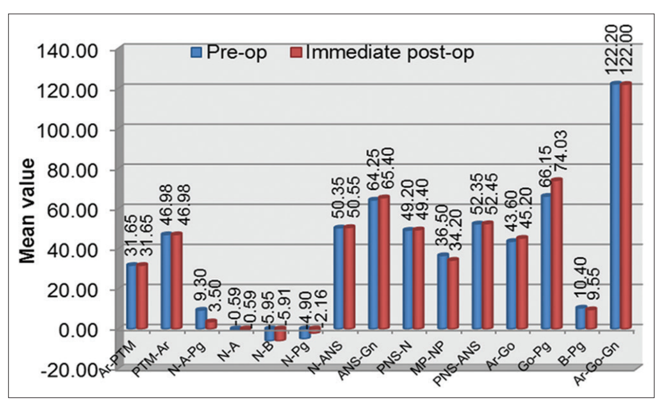
During the immediate postoperative period, there were changes in the soft tissues due to postoperative swelling,



Graph 1: Comparison of hard and soft tissue change



Graph 2: Comparison of COGS analysis between preoperative and 6 months postoperative period



Graph 3: Comparison of COGS analysis between preoperative and immediate postoperative period

and it was gradually declined after 3 months follow-up period.

Postoperative 6 months Soft-tissue analysis

Mentolabial fold

Clinically, there was a considerable change in the soft tissue versus hard tissue in the chin area and MLF as observed in the profile view. The facial profile was improved because of the advancement of the chin, the MLF depth decreased and became shallower. At 6 months, the MLF depicted a net deepening of 1.11 mm as a result of treatment. The soft-tissue thickness, Pg-PgS (Hard tissue pogonion and Soft tissue pogonion) demonstrated a small but significant difference of 0.90 mm.

Facial convexity

Soft-tissue analysis of facial convexity is evaluated at specific interval of time. A reduction of facial convexity depicted a decrease of 7.3° in the angle of G-Sn-PgS (G-Glabella, Sn–Subnasale, PgS–Soft tissue Pogonion) preoperative to 6 months postoperative.

Lower facial submental angle

The lower submental angle (Li-GnS-C, Li–Labial inferior, GnS– soft tissue Gnathion, C–cervical point) was evaluated and show a net decrease of 6 degree. The mean soft-tissue changes were significant at the end of the observation period [Graph 4 and Tables 4, 5].

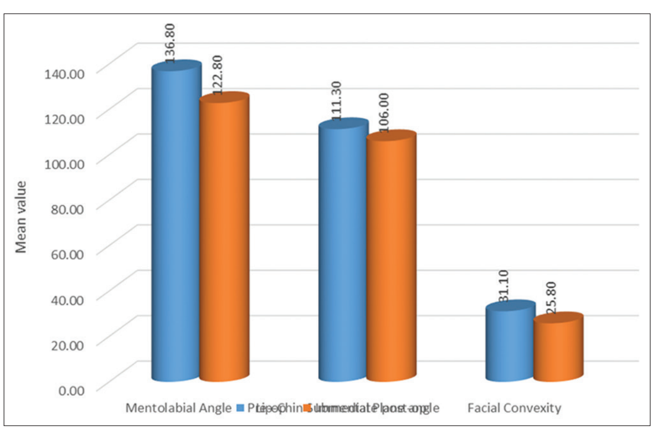
During the immediate postoperative period, there were changes in the soft tissue due to postoperative swelling and it was gradually subsided by 3 months follow-up period.

DISCUSSION

We, humans tend to acquire an appearance that is pleasing for self as well as for the society. Facial appearance plays a significant role in a person's psychological well-being and social acceptance, perhaps because the face is the most important part of the body, which determines social interaction. It is the harmony and symmetry of each segment, which contributes toward the total beauty of the face.[7] Among the various orthognathic surgical procedures, genioplasty is one of the most widely performed surgical procedures used for correcting chin deformities. In some patients esthetic results can be improved by surgery alone for example, accepting a Class II malocclusion after surgical advancement of the chin for a patient with mandibular anteroposterior deficiency.

Different types of genioplasties have been mentioned earlier for treating various types of dentofacial disorders such as the horizontal advancement, horizontal set back, the 'Tenon' technique, vertical reduction, vertical augmentation, and rotational genioplasty. The horizontal sliding osteotomy is widely used for genioplasty throughout the world because it has several advantages.

Fariña *et al*. in 2012 discussed "M-shaped"[8] genioplasty, this new technique makes it possible to increase the vertical and sagittal deficiencies of the chin, avoiding the need for grafting or the use of interposition materials. Advancement of the genioplasty segment using the sliding horizontal osteotomy also has its drawback. It will result in notching at the inferior border of the mandible behind the chin segment. This can result in an external esthetic deformity that is visible and will accentuate the soft-tissue jowls. By sagittal splitting the anterior lateral border of the mandible the inferior gap



Graph 4: Comparison of soft tissue analysis between preoperative and immediate postoperative period

Table 1: Comparison of cephalometric analysis for orthognathic surgery analysis between preoperative and 6 months postoperative period

Variable	Mean±SD		*P*
	Preoperative	At 6 months	
Ar-PTM	31.65±3.544	31.65±3.544	-
PTM-Ar	46.98±6.038	46.98±6.038	-
N-A-Pg	9.30±13.817	3.50±13.159	0.023*
N-A	−0.59±3.298	−0.59±3.298	-
N-B	−5.95±13.608	−5.92±13.598	0.873
N-Pg	−4.90±19.998	−1.18±15.469	0.063
N-ANS	50.35±4.559	50.55±4.634	0.343
ANS-Gn	64.25±7.443	66.10±7.156	0.133
PNS-N	49.20±4.894	49.40±5.232	0.343
MP-NP	36.50±11.058	34.30±11.586	0.366
PNS-ANS	52.35±7.550	52.45±7.683	0.343
Ar-Go	43.60±3.950	45.20±7.829	0.280
Go-Pg	66.15±6.515	74.43±5.864	<0.001**
B-Pg	10.40±4.520	10.05±2.009	0.823
Ar-Go-Gn	122.20±8.917	122.50±8.236	0.868

*$P<0.05$; significant; **$P<0.001$; highly significant. SD: Standard deviation

Table 2: Comparison of cephalometric analysis for orthognathic surgery analysis at specific interval of time

Variable	Mean±SD			
	Preoperative	Immediate postoperative	At 3 months	At 6 months
Ar-Ptm	31.65±3.544	31.65±3.544	31.65±3.544	31.65±3.544
Ptm-Ar	46.98±6.038	46.98±6.038	46.98±6.038	46.98±6.038
N-A-Pg	9.30±13.817	3.50±13.159	3.50±13.159	3.50±13.159
N-A	−0.59±3.298	−0.59±3.298	−0.59±3.298	−0.59±3.298
N-B	−5.95±13.608	−5.91±13.603	−5.92±13.598	−5.92±13.598
N-Pg	−4.90±19.998	−2.16±15.290	−1.13±15.461	−1.18±15.469
N-ANS	50.35±4.559	50.55±4.634	50.55±4.634	50.55±4.634
ANS-Gn	64.25±7.443	65.40±7.905	66.10±7.156	66.10±7.156
PNS-N	49.20±4.894	49.40±5.232	49.40±5.232	49.40±5.232
MP-NP	36.50±11.058	34.20±11.478	34.30±11.586	34.30±11.586
PNS-ANS	52.35±7.550	52.45±7.683	52.45±7.683	52.45±7.683
Ar-Go	43.60±3.950	45.20±7.829	45.20±7.829	45.20±7.829
Go-Pg	66.15±6.515	74.03±6.030	74.03±6.030	74.43±5.864
B-Pg	10.40±4.520	9.55±1.743	10.05±2.009	10.05±2.009
Ar-Go-Gn	122.20±8.917	122.00±8.551	122.50±8.236	122.50±8.236

SD: Standard deviation

Table 3: Comparison of cephalometric analysis for orthognathic surgery analysis between preoperative and immediate postoperative period

Variable	Mean±SD		*P*
	Preoperative	Immediate postoperative	
Ar-PTM	31.65±3.544	31.65±3.544	-
PTM-Ar	46.98±6.038	46.98±6.038	-
N-A-Pg	9.30±13.817	3.50±13.159	0.023*
N-A	−0.59±3.298	−0.59±3.298	-
N-B	−5.95±13.608	−5.91±13.603	0.835
N-Pg	−4.90±19.998	−2.16±15.290	0.108
N-ANS	50.35±4.559	50.55±4.634	0.343
ANS-Gn	64.25±7.443	65.40±7.905	0.131
PNS-N	49.20±4.894	49.40±5.232	0.343
MP-NP	36.50±11.058	34.20±11.478	0.343
PNS-ANS	52.35±7.550	52.45±7.683	0.343
Ar-Go	43.60±3.950	45.20±7.829	0.280
Go-Pg	66.15±6.515	74.03±6.030	<0.001**
B-Pg	10.40±4.520	9.55±1.743	0.615
Ar-Go-Gn	122.20±8.917	122.00±8.551	0.897

*$P<0.05$; significant; **$P<0.001$; highly significant. SD: Standard deviation

is eliminated. The area behind the advanced chin segment still has the normal vertical mandibular height because of the sagittal splitting and no through and through gap.

The incidence of neurosensory deficiency, however remains very high and does not decrease significantly. Soft- and hard-tissue influence of genioplasty has also been studied by various surgeons. The soft-tissue attachment to the genial segment has been considered important for bone resorption after advancement genioplasty. In fact, the average resorption rate of 14.3% after advancement genioplasty using the genial segment as a free graft that was reported by Ellis *et al*. in 1984, from their study indicated that during advancement genioplasty, soft tissue pedicles to the genial segments should be maintained to minimize the amount of bone resorption in the postoperative period.[9]

Chaushu *et al*. 2001 concluded compared vertical and horizontal profile changes of the lower lip and chin after genioplasty with or without precise reattachment of the mentalis muscle. Precise reattachment of the mentalis muscle during an intraoral surgical approach produces a superior result.[10]

Genioplasty can also be used to alleviate obstructive sleep apnoea (OSA), either in isolation or in combination with other procedures. Heggie *et al*. in 2015 described genioplasty as a mode of treatment for OSA. He designed a genioplasty, to enable a rotational repositioning that allows for advancement of the genioglossus attachments but also avoids an excessive projection of pogonion, which would otherwise result in an unfavorable profile.[11]

In the present study, all the patients operated with genioplasty were treated with rigid fixation and showed a mean relapse of 10.2%, i.e., 0.89 mm, which is minimum when compared to Van Sickels *et al.* and Mc Donnnel *et al*., who observed 0.92 mm and 2.8 mm of relapse.[12,13]

The observed incidence of net changes in the mandibular soft-tissue landmarks was found to correlate with the movement of their corresponding bony structures. The mean percentage of the net changes of Pg to PgS is 7.80:7.0 = 1:0.89. The soft-tissue profile change seen as the effect of the advancement of the genial segment has been studied differently by various authors.[14,15] The ratio of horizontal changes for osseous to soft-tissues ranges from 1:0.8 to 1:1 in

Table 4: Comparison of soft tissue analysis at specific interval of time

Variable	Mean±SD		
	Preoperative	Immediate preoperative	At 6 months
Mentolabial angle	136.80±15.469	122.80±10.207	116.50±11.683
Lip-chin submental plane angle	111.30±2.869	106.00±4.320	105.50±3.472
Facial convexity	31.10±6.454	25.80±7.871	23.80±5.554

SD: Standard deviation

Table 5: Comparison of soft-tissue analysis between preoperative and immediate postoperative period

Variable	Mean±SD		*P*
	Preoperative	Immediate preoperative	
Mentolabial angle	136.80±15.469	122.80±10.207	0.047*
Lip-chin submental plane angle	111.30±2.869	106.00±4.320	<0.001**
Facial convexity	31.10±6.454	25.80±7.871	0.009*

*$P<0.05$; significant; **$P<0.001$; highly significant. SD: Standard deviation

the literature. In our study, the mean ratio of horizontal change is 1:0.89, which correlates with the literature.

All our patients underwent minimal soft tissue stripping with the broad attachment of labial soft tissue layered closure was done with reattachment of mentalis muscle. There was no incidence of postoperative wound dehiscence/infection in any patient. Mild transient mental nerve paresthesia was noticed, which may be due to retraction and recovered in 5–10 days of immediate postoperative follow-up.

The sublingual hematoma was noticed in two patients, which subsided within a week. Postoperative healing was uneventful and satisfactory.

The angle of facial convexity was evaluated. Our result showed a decrease of 7.3° in the facial convexity angle, which is in contrast with Scheideman *et al*.[16] who showed 2.7° decrease.

With the larger advancements, there is an increase in stretching of soft tissue pedicle, which produces thinning of soft tissue overlying pogonion. Polido *et al*. and Bell *et al*.[17,18] observed a mean decrease of 1.3 mm, whereas Shaughnessy *et al*. observed a mean decrease of 0.89 mm in the postoperative soft-tissue thickness. In the present study, it is decreased by 0.90 mm.

The chin throat angle, which is demonstrated as a lower facial submental angle, decreased by 17° correlating with Gallagher *et al*.[19] showing a decrease of 22.7°.

Drawbacks are:
1. Negotiating oblique osteotomy anterior to mental foramen is blinded
2. Cannot perform this without an oscillating saw
3. Uneven oblique osteotomy bilaterally may cause chin asymmetry while advancing.

No specific contraindication particular to this technique.

CONCLUSION

The sagittal split genioplasty is a new variation of the sliding osteotomy genioplasty technique for the correction of the small and retrusive chin. The advantages of this technique are mainly aesthetic. Osseous genioplasty is an extremely stable procedure associated with a relatively low risk of complications. However, the present technique of genioplasty cannot be applied to correct chin asymmetries. Vertical reduction genioplasties and advancement is limited as it depends on surface area contact rather than butt joint. The technique is best performed using saw blades compared to burs due to limitations in depth of a bone cutting/osteotomy.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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