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CASE REPORT

MANDIBULAR BODY OSTEOTOMY FOR SKELETAL CLASS III MALOCCLUSION: A CASE-BASED REVIEW

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ABSTRACT

Mandibular step body osteotomy has been out of favour since more stable ramus osteotomies were refined and used for jaw deformities. Mandibular body osteotomy still has certain indications for which it is preferable over ramus osteotomies. Mandibular body osteotomy is best suited to correct prognathism caused by mandibular body excess with a retained tooth or in presence of extraction space, with good posterior occlusion, when ramus osteotomies and setback will lead to loss of the last tooth and non-obtuse gonial angle. Other indications are apertognathia, mandibular asymmetry and small advancements of the anterior mandible.

Here we present a case 24 year male with a skeletal class III malocclusion managed with an intraoral mandibular step osteotomy and setback of 8 mm. One-year followup has shown minimum neurosensory and odontogenic complications associated with mandibular step osteotomy and very high satisfaction among the patient. We also present a brief review of the indications, modifications and refinement of the technique and summarize current published clinical usage.

This is a very stable osteotomy with favourable fracture pattern and does not involve stripping or change in position of muscles of mastication thereby ensures long term stability and minimal risk of relapse. This surgery also has minimal effect on airway narrowing compared to the ramus osteotomy setback. For some specific indications not suited to a sagittal split ramus osteotomy, mandibular body step osteotomy still has relevance and usage.

INTRODUCTION

The Mandibular body step osteotomy has been used to treat mandibular prognathism, retrognathism, asymmetry, and apertognathia. The first report of the step osteotomy comes from Pichler in Vienna in 1918.[1] He described the use of this osteotomy on a patient with mandibular prognathism and a Class III malocclusion with a 15 mm negative overjet. Before that time, Hullihan in 1849, Angle in 1897, Blair in 1906, and Harsha in 1912 had been performing ostectomies of the mandibular body for the treatment of mandibular prognathism.[2] New and Erich in 1941, performed vertical body ostectomies from both intra and extraoral approaches by using a supraperiosteal dissection to minimally disturb the periosteal circulation. Through this combined approach, they were able to remove sections of the mandibular body without "excessively" traumatizing the inferior alveolar nerve. In 1944, Dingman[3] altered the approach of New and Erich by performing combined intraoral and extraoral two stage vertical ostectomies of the mandibular body. Converse and Shapiro described a purely intraoral approach for the step osteotomy in 1952.[4]

Mandibular body osteotomy has been replaced by ramus osteotomies for mandibular orthognathic surgery procedures because of its inherent disadvantage of inferior alveolar nerve injury and small bone contact surface for osteosynthesis.[5] Despite losing out in favour of more stable ramus osteotomies, body osteotomy still can be utilized for specific indications like mandibular corpus excess with a stable posterior occlusal relationship and anterior openbite closure. Here we present a case of 24 year male with skeletal class III malocclusion and anterior crossbite corrected with a stepladder mandibular body osteotomy and setback.

CASE REPORT

The patient was a 24-year male with prognathic mandible and anterior crossbite (Figs. 1A,1B). On clinical examination he had a skeletal Class III jaw relationship with a large mandibular body. The mandibular second premolars were missing congenitally and the second primary molars were retained (Fig. 1C). There was an acceptable occlusion in the molar region with no lateral crossbite. OPG and lateral cephalogram were used for evaluation and Orthodontic features and cephalometric values are as in table (Table 1). Calculations revealed that he had a normal ramus measurement but a hyperplastic corpus of mandible. A surgical orthodontic plan of mandibular setback by

body osteotomy was planned based on the fact that there was an excess of mandibular corpus and the retained deciduous molars bilaterally could provide enough space for the setback.

Table 1: Cephalometric analysis at presentation, before and after surgery

Parameter	Initial presentation	Just before surgery	Immediate after surgery
SNA (degree)	87	86	86
SNB(degree)	92	94	86
ANB(degree)	-5	-8	0
Downs mandibular plane angle(degree)	30	29	39
Steiner MP angle (degree)	26	24	25
Tweeds MP angle (degree)	32	25	39
Facial angle (degree)	92	91	80
Angle of convexity(degree)	-14	-20	-5
Interincisal angle (degree)	127	158	131
Upper incisor to NA (mm, degree)	8mm, 44	6mm,24	6mm, 34
Lower incisor to NB (mm, degree)	3mm, 23	4mm, 28	3mm, 13
Occlusal plane angle (degree)	21	14	5
S-line (mm)	-0.5mm, 1mm	-1mm, 2mm	1mm, 1.5mm
E-line (mm)	-4mm, -1mm	-7mm, -3mm	-3mm, -1mm

Figure 1: Pre-surgery clinical presentation. (A) Frontal view. (B) Lateral view. (C) Preoperative Occlusion. Post surgery clinical presentation (D) Frontal view. (E) Lateral view. (F) postoperative occlusion. (G) Preoperative lateral cephalogram after presurgical orthodontics (H) Immediate Postoperative lateral cephalogram (I) Postsurgical orthodontics

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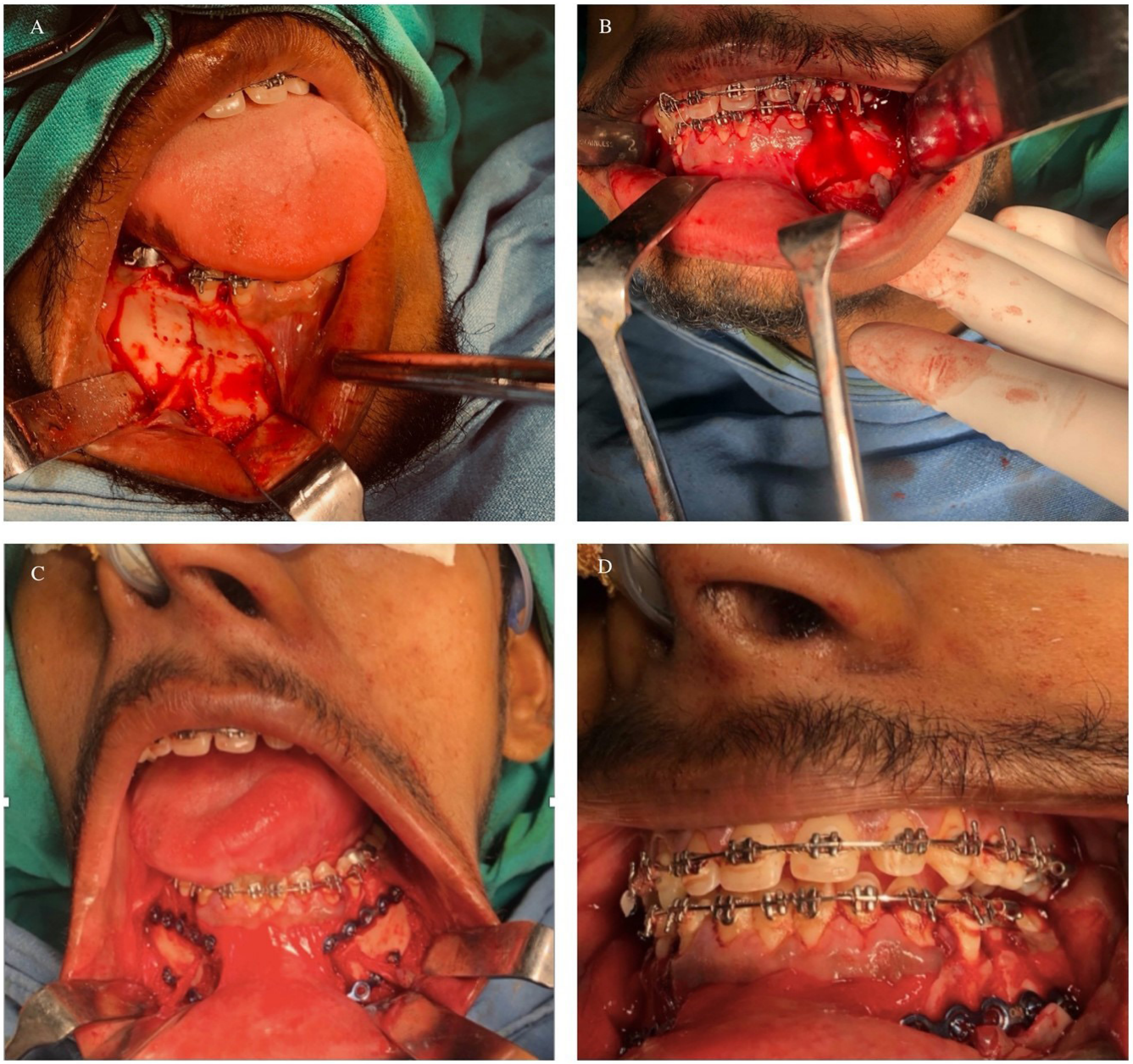

Figure 2: Operative technique. (A) Stepladder osteotomy outlined with microdrill. (B) Bilateral osteotomy completed and mandible setback in occlusal splint. (C) Bilateral 2 point fixation above and below the mental nerve. (D) Final evaluation of occlusion on table

Presurgical orthodontic treatment to improve the labial tipping of maxillary incisors was performed using a fixed appliance therapy for 6 months. Bilateral retained mandibular second primary molars were preserved to maintain the space between the first premolar and first molar, and mandibular body osteotomies were performed in this space.

The surgery was performed under general anesthesia. The amount of setback movement planned was 8 mm on both the left side and right side. A full-thickness intraoral mucoperiosteal crevicular flap was reflected to expose the mental foramen and the inferior border of the mandible (Figure. 2A). A cuff of tissue was left attached at the alveolar border for predictable periodontal healing around the osteotomy site. Traditional Dingman's rectangular osteotomy was ruled out because of the presence of mental foramina within the osteotomy bilaterally.[3] After mapping and compensating for the normal course of mental neurovascular bundle which protrudes anterior to the formen before looping back, a posterior sliding stepladder osteotomy (Figure. 2B) based on Converse and Shapiro's[4] and Sandor's[2] work was designed which allowed us to keep the osteotomy lines anterior and superior to the mental foramen. Bone cuts were performed using a fissure bur and the bone was removed with an osteotome. The main trunk of the inferior alveolar neurovascular bundle was left attached to the proximal segment of the mandibular body. After the comple-

tion of bilateral osteotomy, we had three independently mobile segments. The anterior segment was moved posteriorly and bilateral posterior segments were brought into maximum intercuspation with the prefabricated occlusal splint and an orthodontic elastic chain was applied to the brackets. Fixation was achieved bilaterally with two titanium 2 mm, 6 hole plates and 2x6mm screws applied above and below the mental nerve (Fig. 2C, 2D). There was no airway related difficulty during the immediate post-operative period. The patient was discharged on the third postoperative day and The IMF was released after two weeks of follow up. Post-operative lateral cephalogram shows immediate improvement in skeletal, dental and soft tissue profile (Fig. 1G, 1H). The occlusion is stable after one year of follow-up and patient is currently satisfied with the outcome (Fig 1D, 1E). There were no deficits in terms of tooth sensibility, periodontal status, neurosensory deficit in terms of light-touch threshold, 2-point discrimination and pain threshold, as well as temporomandibular joint function with no major complaints. Postsurgical orthodontic treatment was initiated to finish minor discrepancies and to establish an Angle Class I molar occlusion (Fig 1I).

DISCUSSION

Blair first described this procedure in 1907 but Pichler in 1916 described the first step like osteotomy of the mandible.[6] These early procedures were completely extraoral and didn't take into account the inferior alveolar neurovascular bundle. Dingman Reported the successful use of the rectangular body osteotomy as an improved method with combined intraoral and extraoral two-stage approach.[3] Many modifications to preserve the inferior alveolar neurovascular bundle were reported and modification like Converse and Shapiro's step ladder osteotomy, inverted L osteotomy of Trauner and Obwegeser and functionally stable osteosynthesis of Cesteleyn and Boateng were reported to increase the bony contact area.[4,7-9] Converse and Shapiro refined the technique with one stage intraoral procedure with stepladder pattern of osteotomy that completely left the inferior alveolar nerve undisturbed. They also described a reverse stepladder osteotomy of the body of mandible for advancement.[4] Freihofer reported modified sagittal osteotomy of the mandibular body for two cases of Treacher Collins syndrome with good results.[10]

With the popularity of mandibular Ramal osteotomies, mandibular body osteotomy has been performed less often in recent years. The disadvantages of body osteotomy is that it carries a higher risk of inferior alveolar nerve injury as the mental neurovascular bundle is present in the path of osteotomy.[2,11] There is a higher risk of damage to the roots and unpredictable periodontal healing of adjacent teeth as the osteotomy is in the dentate area which might require post-operative endodontic and periodontal management of the adjacent teeth. There is also a lack of adequate bony contact area for fixation and osteogenesis.[5,11,12]

The problem of inferior alveolar nerve injury can be minimized by creating a bony window to house the inferior alveolar neurovascular bundle, surgical repositioning of the neurovascular bundle posteriorly and creating enough room for ostectomy in presurgical orthodontic treatment, which also reduces the incidence of root damage and encroachment of periodontal space of adjacent teeth.[4,12] We performed the osteotomy 2 mm anterior and superior to the mental foramen to compensate for the anterior loop of distal mental neurovascular bundle as it exits the foramen, and observed no neurosensory disturbance after a week of surgery.

The bony contact area for stability can be maximized with various modifications as described by Cesteleyn and Boateng and Sandor.[2,7] The posterior sliding stepladder osteotomy provides both the increase in contact area and stability by addition of a horizontal contact area. We did not observe any periodontal problems with the adjacent teeth.

In a long term study on complications associated with mandibular step osteotomy, Sandor and Stoelinga reported a very low rate of permanent neurosensory changes, periodontal problems and damage to teeth adjacent to the osteotomies.[2] They also reported a high satisfaction and acceptance rate among patients. Since this technique doesn't violate the muscles of mastication and pterygomasseteric sling, there is a very low risk of immediate surgical complications and long term relapse caused by a change in musculature. The favourable fracture pattern with this osteotomy is physiologic to both the elevator and depressor muscles of jaws and minimum stabilization is required after surgery.[2,11]

Cheung et al in their contemporary long term followup and evaluation of mandibular step osteotomy patients for complications found out that only 0.98% of teeth required endodontic treatment post-surgery, average periodontal probing was only 5mm which can be classified as mild periodontal disease, there was no significant difference in maximal mouth opening between normal patients and patients treated with MSO but the lateral excursion was significantly reduced in MSO patients.[13] This can be attributed to the change in the spatial position of the condylar head during adjustment of posterior segments to improve the crossbite and arch form. They also reported that the majority of the surgical patients in this study were satisfied with the treatment and would accept the same surgical treatment if given a second chance to consider the therapy.[13] However, some patients expressed that they noticed a change in the frontal appearance from a tapered face to a square face following surgery. Though, the patient in our case didn't complain of square chin deformity after the setback, we did notice the change on clinical examination and examination of the photographs. We have planned for reduction genioplasty at the patient's discretion. This phenomenon should be considered in advance and a reduction genioplasty at the same stage or as a secondary procedure can be advised to the patient.[14]

A stydy by Guven et al[15] compared the effect of mandibular body osteotomy and sagittal split ramus osteotomy on pharyngeal airway space and position of hyoid bone used

for the mandibular setback, the reduction in airways space and downward displacement of hyoid bone was lesser in body osteotomy group compared to ramus osteotomy group. Mandibular setback with sagittal split osteotomy was seen to be associated with immediate and long term narrowing of airway in all three dimensions and predisposed to obstructive sleep apnea syndrome.[16,17,18,19] The body osteotomy has an advantage over ramus osteotomy related to immediate post-operative respiratory care and long term development of obstructive sleep apnoea.[20]

A recent case report describes a modified step osteotomy as a modified tongue-in- groove like osteotomy technique in a patient with Hanhart syndrome, where advancement greater than 15 mm was required, preserving the nerve and achieving solid bony intact surfaces.[21] Golaszewski et al reported a successful correction of long face syndrome with a mandibular body osteotomy.[22] Choi et al reported a mandibular step osteotomy combined with 2-stage orthognathic surgery, To reduce a large amount of mandibular setback and to prevent pharyngeal airway space narrowing when correcting a severe anteroposterior skeletal discrepancy.[14] Bjorklund et al recently reported a small series of patients with severe mandibular overgrowth secondary to lymphatic malformations. Following debulking of the malformations and tongue reductions, the authors describe the results of their treatment with bilateral mandibular body resections and setback with satisfactory outcomes.[23] Huh et al recently reported a case of a patient who had a mandibular step osteotomy using a CAD/CAM-derived wafer for mandibular setback with reduction of the arch.[24]

CONCLUSION

Step ladder mandibular body osteotomy can be successfully utilized for correction of specific indications without interfering with inferior alveolar nerve functions. This technique has the advantage of early neurosensory recovery and ability to preserve the posterior occlusion without manipulation of muscles of mastication. The outcomes are predictable and satisfactory, and the technique still has relevance in contemporary surgical orthodontic management.

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