International Journal of Otorhinolaryngology and Head and Neck Surgery
Priya A et al. Int J Otorhinolaryngol Head Neck Surg. 2026 Apr;12(2):234-240
http://www.ijorl.com
pISSN 2454-5929 | eISSN 2454-5937

DOI: https://dx.doi.org/10.18203/issn.2454-5929.ijohns20260792

Short Communication

Distraction osteogenesis of mandible: our experience at RIMS, Ranchi

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Received: 18 July 2025
Revised: 07 March 2026
Accepted: 10 March 2026

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ABSTRACT

Distraction osteogenesis has become an important modality in management of craniofacial deformities particularly in mandibular hypoplasia. This article describes extraoral distraction osteogenesis of mandible in management of mandibular deformities in 08 cases. Majority of patients presenting with mandibular deformities were secondary to TMJ ankylosis with a history of trauma. Body of mandible was primarily involved in 63% patients while in 37% patient's ramus of mandible was involved. Bilateral distraction device placement was done in 05 (62%) cases and unilateral distraction device placed in 03 (38%) cases. Sliding genioplasty was performed additionally in severe mandibular hypoplasia (37.5% cases) to achieve a good profile. 63% patients were satisfied with the improved facial features both frontal and profile with functional harmonious occlusion noted while 37% patients were not satisfied as there was not significant improvement in facial symmetry. Distraction osteogenesis is a valuable tool for mandibular reconstruction, though individualized planning and careful execution are critical to minimize complications and optimize results. Multidisciplinary approach plays a key role in patient management and satisfaction assessment.

Keywords: Distraction osteogenesis, Mandibular hypoplasia, TMJ ankylosis

INTRODUCTION

Distraction osteogenesis is a surgical process that gradually lengthens bone by creating a controlled fracture and applying a distraction device to separate the bone segments, allowing new bone to form in the gap.[1] Incremental traction gradually separates the new bone formed between adjoining bone segments.[2] This technique not only increases bone length but also promotes soft tissue expansion.[3] It was first applied to long bones before being adapted for the facial skeleton, including the mandible. Craniofacial distraction osteogenesis is a technique to elongate the bones of the mandible, midface and cranial vault.[4,5] The basic concept is induction of new bone formation along the vector of pull obviating the need for a bone graft.[1,5] The increase in mandibular bone stock will provide more reconstructive options for subsequent orthognathic surgical techniques.[6] It is successful in treating a variety of both syndromic and non-syndromic patients with craniofacial abnormalities, providing both cosmetic and functional result that is superior to other technique.[4,6]

The technique was first introduced by Codivilla at the beginning of twentieth century and during 1950s, Gavril Ilizarov, a Russian orthopedic surgeon, used it primarily for limb lengthening and correcting deformities in long bones.[2,7] Snyder et al first reported experimental distraction osteogenesis in the craniofacial skeleton on animal models in 1973.[8] In 1992 McCarthy et al were the first to apply distraction osteogenesis successfully to the human mandible. They used it for mandibular lengthening in pediatric patients with congenital mandibular hypoplasia such as Pierre Robin Sequence.[1] After McCarthy's work, distraction osteogenesis gained

popularity for treating mandibular hypoplasia, hemifacial microsomia, post-traumatic defects, congenital and syndromic conditions.[4] The technique evolved with internal and external distractor devices, 3D planning, and customized hardware to improve outcomes and aesthetics.[4,6]

Regardless of the anatomic site, the goal of Distraction Osteogenesis is to elongate the chosen bone in order to restore more normal anatomic function.[2,4] The common indications for distraction in mandible are mandibular hypoplasia due to congenital deformities like Pierre Robin sequence, Nager's syndrome, Treacher Collin's syndrome, craniofacial dysostosis and Hemifacial microsomia; sequelae of TMJ ankylosis and mandibular asymmetry, retrognathia/micrognathia causing obstructive sleep apnea syndrome.[4,9,10] The most common application of distraction osteogenesis in the craniofacial skeleton is the mandible.[4] It is also used for maxillary advancement (e. g., OSAS) and in upper face and cranial vault as well.[4,10]

Distraction osteogenesis is often preferred as it avoids large grafts, allows simultaneous soft tissue lengthening, can be used at a younger age before full skeletal maturity, reduced relapse risk compared to some traditional bone grafting, can improve airway space and high patient satisfaction rates, particularly aesthetic outcomes.[11]

Global distribution suggests that most procedures are concentrated in developed countries with access to craniofacial surgery teams and long-term airway management resources. Emerging adoption in developing countries, where access to technology and surgical expertise is increasing. This surgical technique is increasingly utilized in India to address various craniofacial deformities, particularly those affecting the mandible. While comprehensive national data on its prevalence is lacking, the increasing number of specialized centers and positive clinical outcomes suggest that distraction osteogenesis of mandible is becoming a standard practice in craniofacial reconstructive surgery across the country.

Aim and objectives

Aim and objectives were to evaluate and present the treatment approaches, clinical outcomes and complications in various cases of mandibular distraction osteogenesis managed at RIMS, Ranchi.

METHODS

A prospective longitudinal study was conducted on patients who underwent Distraction Osteogenesis of mandible in the Department of ENT and OMFS, RIMS, Ranchi for four-year duration between April 2021-March 2025. A written and informed consent was obtained from all the patients before the study.

Inclusion criteria

All patients who underwent distraction osteogenesis of mandible for various indications at RIMS, Ranchi between April 2021-March 2025 and patients who gave a written and informed consent were included in the study.

Exclusion criteria

Patients below 18 years of age, patients who did not give written and informed consent, patients who underwent distraction osteogenesis elsewhere and came to RIMS for follow up, patients who underwent distraction osteogenesis before the study period and patients who were not fit for surgery due to concurrent medical problems excluded from the study.

Sample size

Based on eligibility criteria, a total of 08 patients who underwent distraction osteogenesis were included. So, sample size was 08.

Sampling technique used was consecutive sampling.

Patient evaluation

Eight cases of diverse mandibular deformity were undertaken for surgical correction using extraoral mandibular distraction devices. At the initial evaluation, chief complaints, history of presenting illness along with past, family, personal and genetic history were noted. A thorough physical examination was conducted which included assessment of vital signs, signs of pallor, icterus, cyanosis, clubbing, lymphadenopathy and edema. 3-D CT face, orthopantomogram and cephalometric analyses were done to determine extent and plane of deficiency. Routine investigations such as complete blood count, bleeding time, clotting time, prothrombin time, international normalized ratio, liver function test, renal function test, serum electrolytes level, fasting blood sugar, postprandial blood sugar, serology, routine urine examination, chest x-ray, electrocardiogram and blood grouping were performed in patients in which distraction osteogenesis was to be done. Informed consent both verbal and written were obtained from all patients and/or attendants one day prior to surgery. All cases were subjected to cephalometric analyses to determine the extent and plane of deficiency. Cephalometrics for orthognathic surgery (COGS) analysis was done before deciding the vectors of distraction. Objective analyses gave the exact amount and vector of distraction to be achieved. All procedures were performed under general anaesthesia, under strict aseptic precautions. Patients underwent one/combination of surgeries described below.

Distraction osteogenesis

Extraoral Risdon's incision (4-5 cm in length) given 2 cm below the lower border of angle of mandible, extending

towards angle. Layers separated and access to inferior border of mandible made. Osteotomy (a surgical cut) made through the body/ramus of mandible and internal distraction device applied. After a latency period of about 5-7 days, distraction device gradually adjusted 0.5-1 mm per day to enable callus formation. This phase was continued until desired bone length achieved (Distraction phase). Once the distraction was complete, the device remained static to allow the new bone to mineralize and mature. This phase typically lasted 6-8 weeks or longer depending on patient age and healing response (Consolidation phase). After adequate bone consolidation, the distractor was surgically removed. Final healing and remodeling continued over several months.

Sliding genioplasty

A horizontal incision made inside the lower lip in the labial vestibule, usually below the mucogingival junction. Mentalis muscle carefully dissected and reflected to expose the anterior mandible. A horizontal curved osteotomy made through the mandibular symphysis, typically below the apices of the lower incisors and canine roots. The bony chin segment was mobilized. It was then repositioned forward for advancement. Temporary fixation and assessment of soft tissue tension and symmetry done. Repositioned segment fixed using titanium plates and screws. Stability was confirmed. Mentalis muscle reapproximated carefully to prevent chin ptosis. Mucosa closed in layers using reabsorbable sutures.

RESULTS

This prospective longitudinal study included 08 patients who underwent distraction osteogenesis of mandible in RIMS, Ranchi due to various indications. 63% (05) patients were female and 37% (03) were male. All the patients were between the age of 18 to 30 years with a mean age of 22.75 years. The median age was 22.0 years.

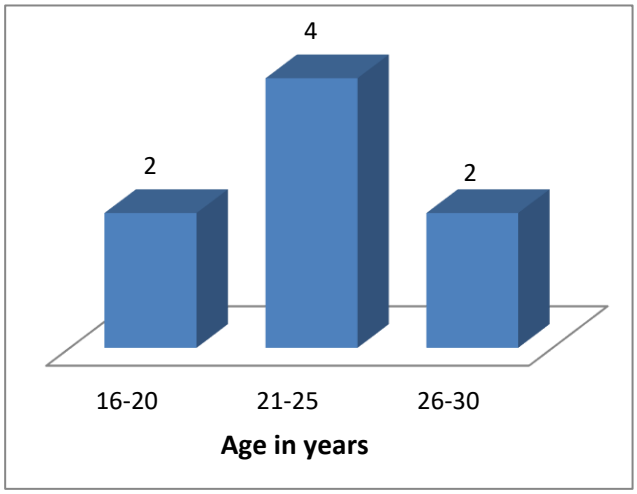


Figure 1: Age distribution of patients.

Presenting complaint

Four out of eight cases presented with mandibular hypoplasia [secondary to TMJ ankylosis which was due to trauma (03) and congenital (01)], two patients presented with retrognathia secondary to TMJ ankylosis, two patients had complaint of facial asymmetry out which one was congenital and other was due to trauma.

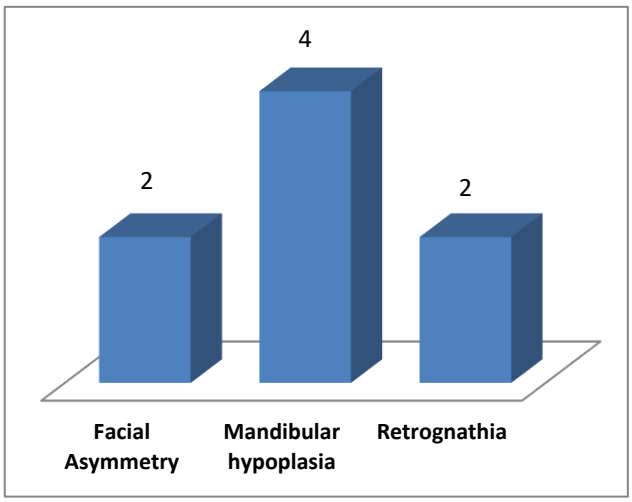


Figure 2: Distribution of patients based on presenting complaints.

Origin

Three fourth cases were acquired due to trauma while one fourth were congenital in origin.

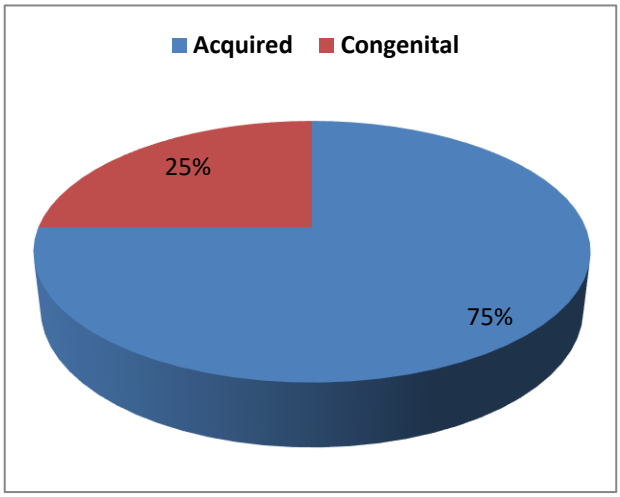


Figure 3: Distribution of patients based on the nature of origin of mandibular deformity.

Part of mandible affected

In 05 (63%) patients, body of mandible was primarily involved while in 03 (37%) patients ramus of mandible was involved.

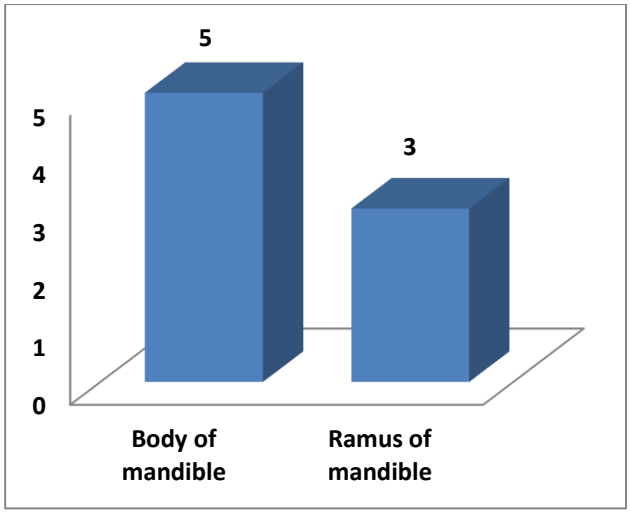


Figure 4: Distribution of patients based on part of mandible primarily involved.

Bilateral distraction device placement was done in 05 (62%) cases and unilateral distraction device placed in 03 (38%) cases.

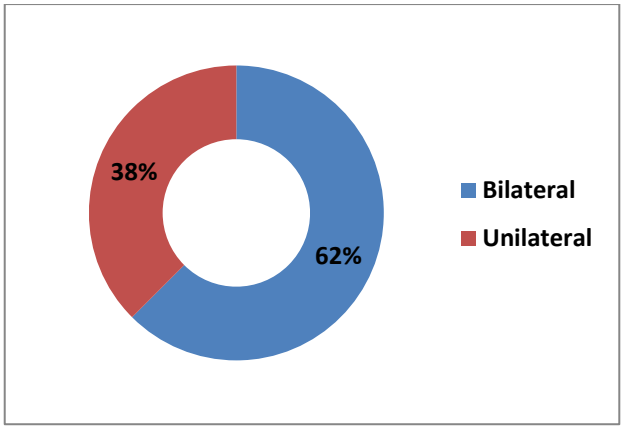


Figure 5: Distribution of patients based on unilateral/bilateral distraction device placement.

Latency phase i. e., postoperative day on which activation of distraction device began varied from 5 to 7 days. Average came out to be 5.63 days. Distraction phase varied from 08 days to 18 days. Mean duration was 12.8 days. Consolidation phase varied from 4 weeks to 6 weeks. Mean duration was 5.13 weeks.

Table 1: Duration of different phases following distraction device placement.

Latency period (No. of days)	N	Distraction phase (No. of days)	N	Consolidation phase (No. of weeks)	N
05	04	08	02	04	02
06	03	12	02	05	03
07	01	14	02	06	03
		16	01		
		18	01		

Distraction achieved

Total distraction ranged from 8.5 mm to 20.5 mm with a mean of 14.25 mm. Three patients had horizontal mandibular hypoplasia for which bilateral distraction osteogenesis was done with extraoral placement of internal distraction device in body of mandible. Two patients had a combined vertical and horizontal deficiency so, placement of vertical extraoral internal distractor in an oblique direction.

Additional surgery performed

Sliding genioplasty was performed additionally in severe mandibular hypoplasia (37.5% cases) to achieve a good profile. Facial symmetry was achieved in 06 (75%) cases and in 02 (25%) cases facial symmetry was not achieved even after 3 months postoperative follow up.

Complications noted

Residual malocclusion, asymmetrical distraction and inferior alveolar nerve injury, noted in one case each. However, potential but relatively a rare complication i. e the marginal mandibular branch of the facial nerve was injured in one case. This nerve runs superficially in the submandibular region and it might have gone injured during the removal of distraction device.

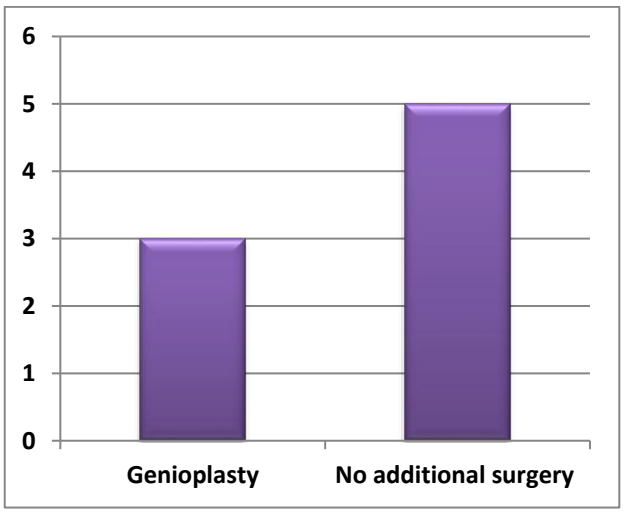


Figure 6: Distribution of patients based on additional surgery required.

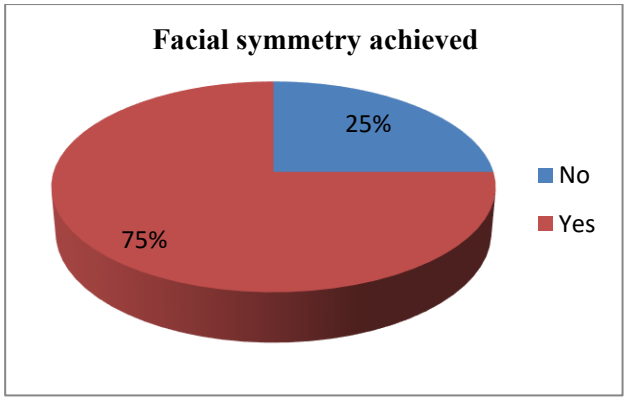


Figure 7: Distribution of patients based on facial symmetry achieved.

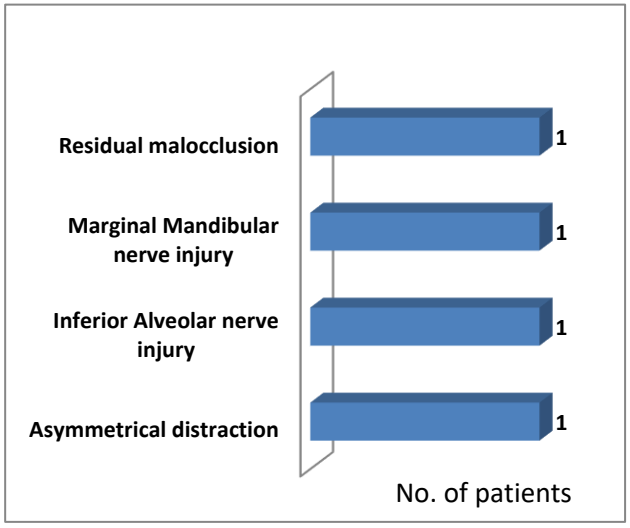


Figure 8: Different complications noted.

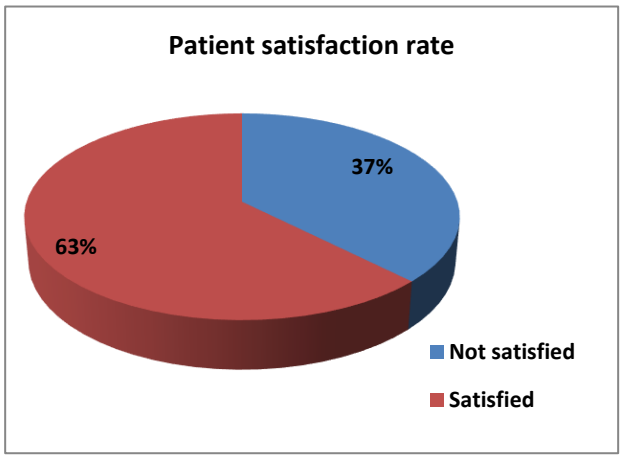


Figure 9: Distribution of patients based on patient satisfaction rate.

Patient satisfaction rate

63% (05) patients were satisfied with the improved facial features both frontal and profile with functional harmonious occlusion noted while 37% (03) patients were not satisfied as there was not significant improvement in facial symmetry.

Post surgical orthodontic correction was done in all the cases. Improved facial features both frontal and profile with functional harmonious occlusion noted in 63% patients.

DISCUSSION

The study included 08 patients who underwent distraction osteogenesis of mandible in department of ENT and OMFS at RIMS, Ranchi for various indications during the study period of four years. This study was conducted with the objective to evaluate and present the treatment approaches, clinical outcomes and complications in various cases of mandibular distraction osteogenesis managed at RIMS, Ranchi.

In our study, all the patients were between the age of 18 to 30 years with a mean age of 22.75 years. The median age was 22.0 years, as this age group is more prone to trauma and they have a higher ability for osteogenesis. In a study conducted on 09 patients by Menon et al age ranged between 14 and 21 years with a mean age of 17.5 years.[12] Female predominance noted with 63% of the cases occurring in females while 37% in males as females are more concerned to improve facial aesthetics.

50% cases presented with mandibular hypoplasia which were secondary to TMJ ankylosis, 25% cases presented with retrognathia secondary to TMJ ankylosis and 25% cases had complaint of facial asymmetry. In our study, 75% of cases were acquired in origin due to trauma while 25% cases were congenital in origin. Body of mandible was primarily involved in 63% patients while in 37% ramus of mandible was involved. Menon et al study showed ramus involvement in 67% cases and body involvement in 33% cases.[12] Bilateral distraction devices were placed in 62% cases and unilateral distraction device placed in 38% cases.

Latency phase varied from postoperative day 05 to 07. Average came out to be 5.63 days. Similar finding was noted in a study conducted by McCarthy et al.[13] Duration of the Phase of distraction varied from 08 days to 18 days and mean duration was 12.8 days. Duration of the consolidation phase ranged from 4 weeks to 6 weeks and mean duration was 5.13 weeks. McCarthy et al study showed consolidation phase of 8 or more weeks.[13]

Total distraction ranged from 8.5 mm to 20.5 mm with a mean of 14.25 mm. Three patients had horizontal mandibular hypoplasia for which bilateral distraction osteogenesis was done with placement of internal distraction device in body of mandible. Two patients had a combined vertical and horizontal deficiency so, placement of vertical extraoral distractor in an oblique direction. While in Menon et al study, total distraction ranged from 9.6 mm to 15 mm with a mean of 12.3 mm.[12]

Sliding genioplasty was performed additionally in severe mandibular hypoplasia (37.5% cases) to achieve a good profile. In Menon et al study, sliding genioplasty and premaxillary surgery were performed additionally in 50% of patients.[12]

Facial symmetry was achieved in 75% cases and in 25% cases facial symmetry was not achieved even after 3 months postoperative follow up. Residual malocclusion, asymmetrical distraction and inferior alveolar nerve injury, noted in one case each. However, potential but relatively a rare complication i. e., the marginal mandibular branch of the facial nerve was injured in one case. This nerve runs superficially in the submandibular region and it might have gone injured during the removal of distraction device.

A multidisciplinary team consisting of ENT surgeon, OMFS surgeon, nurse, physiotherapist and a patient representative was formed to assess patient satisfaction in all the cases. Methods like patients surveys and interviews were conducted to gather feedback on treatment outcomes, quality of care and overall experience. 63% patients were satisfied with the improved facial features both frontal and profile with functional harmonious occlusion noted while 37% patients were not satisfied as there was not significant improvement in facial symmetry due to residual malocclusion, asymmetrical distraction and complications like inferior alveolar nerve injury and marginal mandibular nerve injury were noted. While in Menon et al study, satisfactory facial features were achieved in all the cases with functional harmonious occlusion.[12] Post surgical orthodontic correction was done in all the cases.

Limitations

Distraction osteogenesis of mandible is performed in selected patients with specific conditions thus yielding a small sample size. Prolonged treatment duration is a major drawback as it involves a latency phase, distraction phase, consolidation phase that may extend for several weeks. High level patient compliance needed as daily activation of distraction device is essential, and poor cooperation can compromise results. Accurate vector planning is critical as improper vector control can lead to malocclusion, open bite, facial asymmetry or inferior border deformity. Once distraction begins, correcting an improper vector is difficult. Lack of standardized protocols due to differences in distraction devices, latency phases, rate of distraction and consolidation phases across studies create variability in outcomes and make it difficult to establish uniform guidelines. Distraction Osteogenesis is not ideal for minor advancements or complex multiplanar deformities, further limiting the sample size.

CONCLUSION

Distraction osteogenesis of the mandible is a valuable and biologically sound technique for the correction of mandibular deficiencies, facial asymmetry, and certain craniofacial deformities. It offers the advantage of simultaneous expansion of bone and surrounding soft tissues, making it particularly useful in large advancements and reconstructive cases where conventional osteotomies may be limited. Our study showed that meticulous planning, precise vector control, strict patient compliance, and a prolonged treatment period helped to achieve optimal results. Despite its limitations and potential complications, when properly indicated and carefully executed, mandibular distraction osteogenesis provides stable functional and aesthetic outcomes with predictable bone regeneration.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required

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Cite this article as: Priya A, Prakash O, Kumar S, Mark RR, Dubey UK, Kumar P. Distraction osteogenesis of mandible: our experience at RIMS, Ranchi. Int J Otorhinolaryngol Head Neck Surg 2026;12:234-40.