International Journal of Otorhinolaryngology and Head and Neck Surgery
Thapa A et al. Int J Otorhinolaryngol Head Neck Surg. 2025 Aug;11(4):426-430
http://www.ijorl.com
pISSN 2454-5929 | eISSN 2454-5937
DOI: https://dx.doi.org/10.18203/issn.2454-5929.ijohns20252254

Case Report

Long-term stability and condylar status evaluation following distraction osteogenesis for severe mandibular retrognathia with mild obstructive sleep apnoea: a 10-year experience

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Received: 08 July 2025
Revised: 16 July 2025
Accepted: 21 July 2025

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ABSTRACT

This case report highlights role of distraction osteogenesis (DO) in the treatment of severe mandibular retrognathia with mild obstructive sleep apnoea (OSA), highlighting its ability to address complex maxillofacial deformities while ensuring long-term stability and temporomandibular joint (TMJ) health. Severe mandibular retrognathia with mild OSA, causes functional and aesthetic concerns. DO chosen over conventional orthognathic surgery due to its ability to gradually lengthen the mandible and create new bone formation, thereby correcting mandibular size and improving function and aesthetics. Significant improvement in facial aesthetics, correction of skeletal base relations, optimization of dental occlusion, and reduction in OSA symptoms confirmed through post-treatment assessments including cephalometric analysis and polysomnography (PSG). Ten-year follow-up demonstrated excellent stability of treatment outcomes with sustained improvement in facial aesthetics and absence of OSA symptoms. Cone beam computed tomography (CBCT) imaging confirmed the long-term health and functionality of the TMJ complex.

Keywords: Distraction osteogenesis, Obstructive sleep apnoea

INTRODUCTION

Distraction osteogenesis is a promising treatment modality for correcting severe mandibular retrognathia, a condition characterized by a posterior positioning of the mandible relative to the maxilla, often leading to functional and aesthetic concerns. Moreover, when mandibular retrognathia is accompanied by obstructive sleep apnoea (OSA), the treatment becomes even more critical due to its potential impact on respiratory function during sleep.[1] Distraction osteogenesis is becoming common surgical method for resolving maxillofacial skeletal discrepancies, providing a good substitute for conventional orthognathic surgery.[2] By gradually lengthening the mandible through controlled distraction forces, this technique allows for the creation of new bone formation at the osteotomy site, thereby correcting mandibular size and improving both function and aesthetics.[3] Distraction osteogenesis has been shown to produce good results for mandibular retrognathia in several trials; however, long-term follow-up is lacking, especially with regard to the stability of results and the condition of the temporomandibular joint (TMJ). It is essential to comprehend the long-term stability of mandibular advancement attained using distraction osteogenesis in order to evaluate the resilience and efficacy of this therapeutic strategy.[4]

TMJ health and function post-distraction, particularly in patients with underlying OSA, comprehensive evaluation of condylar status is imperative. Cone-beam computed tomography (CBCT) imaging provides a detailed

assessment of the TMJ anatomy, allowing for the identification of any morphological changes or pathological conditions.[5] Therefore, the aim of this case report is to present the long-term stability of distraction osteogenesis in the correction of severe mandibular retrognathia with mild OSA, with a specific focus on evaluating the condylar status using CBCT imaging. A ten-year follow-up of a patient who had distraction osteogenesis is given, demonstrating not only the long-term maintenance of healthy TMJ condyles but also improvements in mandibular size and respiratory function.

CASE REPORT

Diagnosis and etiology

A 15 year and 8 months old male patient reported with chief complaint of forwardly placed upper front teeth with nil contributory past medical and dental history. Face of the patient was bilaterally symmetric and proportional in horizontal fifth and reduce in vertical lower 3rd. However, patient had a severe convex profile with reduced nasolabial angle, potentially competent lips, retruded lower lip and chin position and altered smile esthetics (Figure 1a). Intraorally patient had asymmetric and ovoid maxillary and mandibular arches with approximately 2mm crowding in mandibular arch with class II molar and canine relation bilaterally, increased overjet to 12 mm and a deep impinging overbite (Figure 1a).

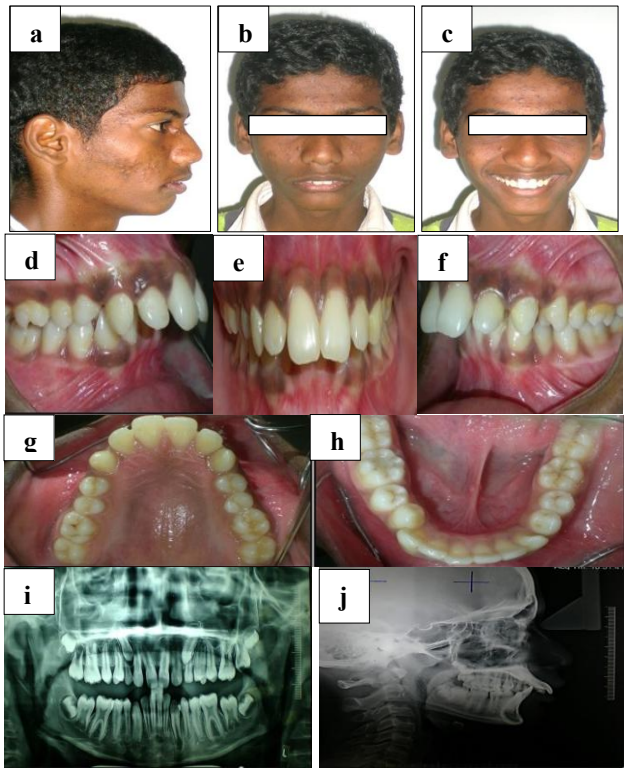

Figure 1 (a-j): Pre-treatment documentation including extraoral and intraoral clinical photographs, panoramic radiograph (orthopantomogram), and lateral cephalogram.

On further evaluation of orthopantomogram and cephalometric evaluation, patient had class II skeletal bases with severely retrognathic mandible mainly contributed by reduced size of mandible with proclined upper anteriors and reduced airway dimensions associated with hypodivergent growth pattern (Figure 1b and Table 1).

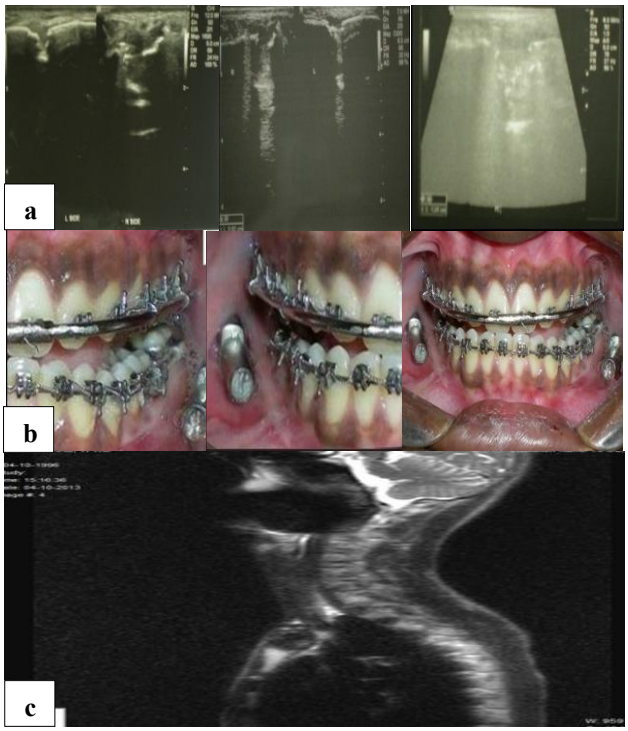

Figure 2 (a-c): Sequential ultrasonographic images illustrating progressive callus formation at the distraction site. Intraoral photographs demonstrate placement of right and left mandibular distractors. Magnetic resonance imaging (MRI) shows pharyngeal airway dimensions pre- and post-distraction.

Table 1: Pretreatment cephalometric evaluation.

S. no.	Parameter	Patient value
1	SNA	82^0
2	SNB	76^0
3	ANB	6^0
4	Wits	9 mM
5	UI-NA	36 (10)
6	LI-NB	25 (6)
7	GoGn –SN	24^0
8	FMA	20^0
9	IMPA	102^0
10	Co-A	85 mm
11	Co-Gn	98 mm
12	LAFH	60 mm
13	SN: Go-Pog	1:0.9
14	ANS- PNS :GoPog	1:1.1

On further clinical evaluation and subjective evaluation by Epworth sleepiness scale of 15 indicate treatment require for OSA as he was having symptoms of OSA with peculiar symptoms such as day time sleepiness during school and other activities, snoring every time he sleeps which is audible to everyone in the roomas revealed by both parents. Magnetic resonance imaging (MRI) of airway (Figure 2c) and polysomnography (PSG) (Table 2) was taken for more confirmatory to establish compromise pharyngeal airway. MRI evaluation revealed narrowing of retroglossal pharyngeal wall. Further PSG evaluation revealed increased apnoea-hypopnea index (AHI) to 14.1 which was obstructive in nature. On corroborating clinical, radiographical, MRI and PSG examination the final diagnosis was severe mandibular retrognathia contributed by reduced size of mandible with mild OSA.

Table 2: Pre-treatment PSG charting.

Variables	Apneas	Hypopneas	A + H	Central	Obstructive	Mixed
Events	34	53	87	1	86	0
Index	5.5	8.6	14.1	0.2	14.0	0.0
Index with arousal	2.0	1.5	3.5	0.0	3.4	0.0
Mean duration(s)	31	15.8	21.8	12.4	21.9	-
Longest duration(s)	87.4	49.4	87.4	12.4	87.4	-

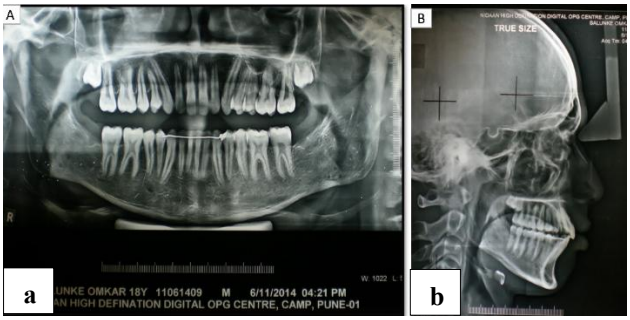

Figure 3 (a and b): Post-treatment radiographic assessment comprising panoramic radiograph (orthopantomogram) and lateral cephalogram.

Treatment alternatives

Alternative treatment alternative could have been planned in the form of functional jaw orthopedic with compromise correction in less skeleton and more dentoalveolar changes as patient reported when he was in stage CS6.

Treatment objectives

Treatment objectives were correction of mild OSA, improvement of facial and smile esthetics, correction of skeletal bases relations mainly improvement in mandibular size, correction of inclination of upper anteriors, correction of molar and canine relations, decrowding lower anteriors and optimizing overjet and overbite.

Treatment progress

Both arches were bonded utilizing 0.18 Roth PEA in accordance with the selected treatment plan of orthosurgical correction with distraction osteogenesis for advancement of mandible in the presurgical phase. Alignment was carried out till the rigid wire of dimension 0.017×0.025 SS. Vector planning was carried out before surgery for mandibular distractor placement and orientation where distractor was kept parallel to maxillary occlusal plane as minimum increase in lower anterior facial height was desired as per surgical treatment objective. Osteotomy cuts were given and rigid extra mucosal internal mandibular distractor was placed in mandible bilaterally (Figure 2b).

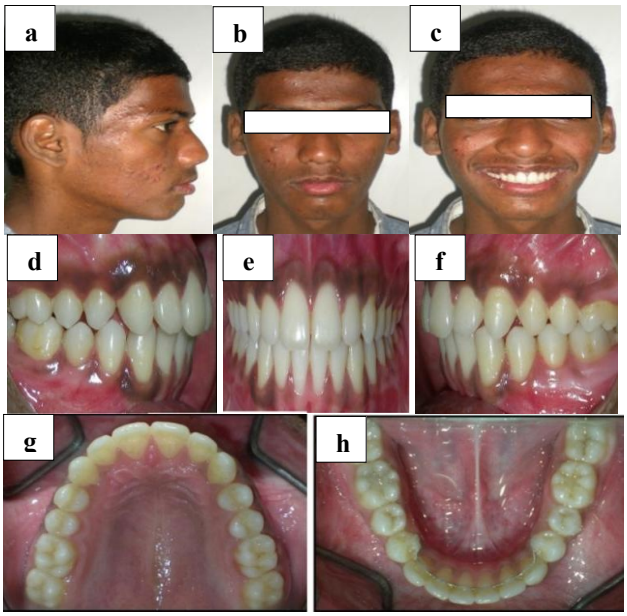

Figure 4 (a-h): Post-treatment extraoral and intraoral clinical photographs demonstrating facial and dental outcomes following distraction osteogenesis.

After a latency period of 5 days, 10 mm distraction was carried out for 2 weeks with a rate of 1 mm per day and a rhythm of 0.5 mm twice a day which led to an over corrected mandibular position post distraction. This was followed with consolidation period of 12 weeks during which transient posterior open bite was closed with callus moulding technique of Bodo Hoffmeister using light elastics.[6] Progressive evaluation of callus maturation was carried out using ultrasonography (USG) (Figure 2a) prior to removal of intraoral distractor. Further in the post-

surgical phase settling of the occlusion, finishing and detailing was carried out.

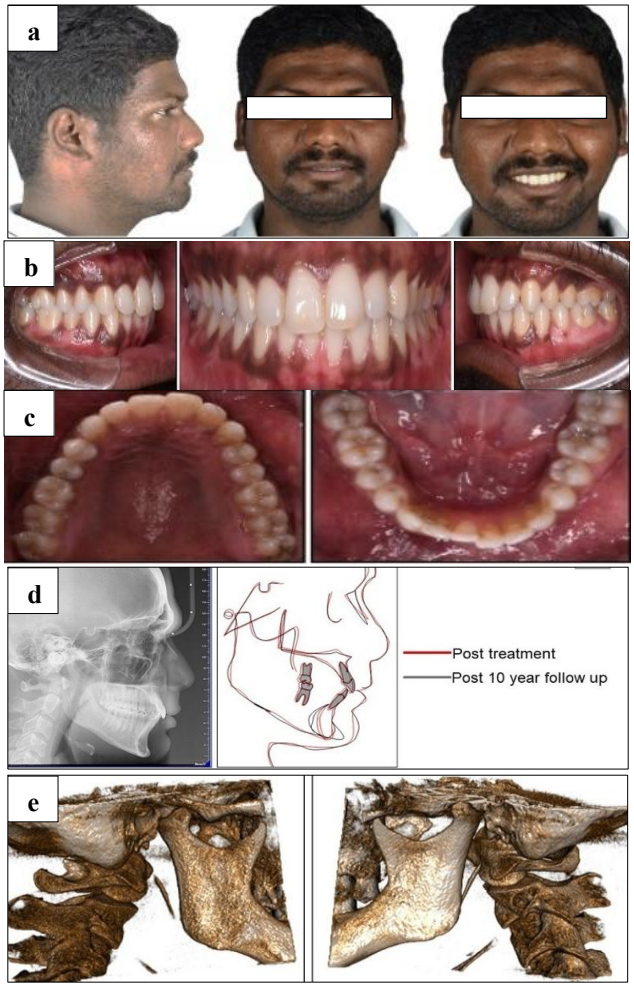

Figure 5 (a-e): Long-term follow-up at 10 years post-treatment showing extraoral and intraoral clinical photographs, lateral cephalometric superimposition highlighting skeletal stability, and cone-beam computed tomography (CBCT)-derived coronal sections of the right and left temporomandibular joint (TMJ) condyles.

Treatment results

Upon reviewing the extraoral and intraoral images (Figure 4) taken after the therapy, it is evident that every treatment goal that was specified during the pre-treatment phase was accomplished. There is marked improvement of facial and smile esthetics.

When comparing the orthopantomogram and post-treatment and presurgical cephalograms, the correction of skeletal bases relations can be appreciated (Figure 3 and Table 3. Correction of inclination of upper anteriors was carried out which led to optimization of overjet and overbite. Correction of molar and canine relations were also carried out bilaterally. On comparing pre-treatment and post treatment PSG report (Table 4), improvement in AHI of patient can be noticed which led to improvement in OSA symptoms of patient in turn enhances the quality of life of the patient.

Follow up after 10 years

Patient was recalled after 10 years and all the extraoral and intraoral records were repeated to evaluate the stability of results (Figure 5a). On comparing 10 years follow up and post treatment cephalogram (Figure 5d) the maintenance and excellent stability of post treatment results can be appreciated (Table 5). Facial and smile esthetics of the patient was well maintained. Patient was devoid of any OSA symptoms. To evaluate the possibility of any degenerative changes in temporomandibular joint and condyles post treatment 10 year follow up cone beam computed tomography (CBCT) was recorded. On three-dimensional evaluation using CBCT scanning it can be appreciated that there were no degenerative changes in the temporomandibular joint and mandibular condyles even after 10 years post treatment (Figure 5e). It can be appreciated that the quality of life of the patient was well maintained with no regression in facial esthetics and OSA symptoms.

DISCUSSION

Present case report highlights the successful long-term outcome of distraction osteogenesis in the correction of severe mandibular retrognathia accompanied by mild OSA. The treatment objectives aimed at addressing both functional and aesthetic concerns associated with the patient's condition, including improvement in facial esthetics, correction of skeletal base relations, optimization of dental occlusion, and alleviation of OSA symptoms. Distraction osteogenesis has emerged as a valuable surgical technique for correcting mandibular retrognathia by gradually lengthening the mandible, thereby addressing both skeletal and soft tissue deficiencies. The gradual advancement of the mandible allows for the generation of new bone, resulting in stable outcomes. This technique offers advantages over traditional orthognathic surgery, including reduced morbidity, avoidance of extensive osteotomies, and enhanced adaptability to individual anatomical variations.[7] The treatment progress outlined in this case report adhered to established protocols for distraction osteogenesis. Preoperative orthodontic preparation facilitated alignment of the dental arches, ensuring stable postoperative occlusion. Vector planning and precise placement of the internal mandibular distractors optimized the direction and magnitude of mandibular advancement, leading to satisfactory postoperative outcomes.[8] Evaluation of treatment outcomes included assessment of facial esthetics, dental occlusion, and respiratory function. Postoperative cephalometric analysis confirmed significant improvement in skeletal base relations, correction of upper anterior inclination, and optimization of overjet and overbite. Furthermore, polysomnography

demonstrated a notable reduction in the AHI, indicating successful management of OSA symptoms.[9]

The 10-year follow-up assessment revealed excellent stability of treatment results, with sustained improvement in facial esthetics and absence of OSA symptoms. CBCT imaging confirmed the absence of degenerative changes in the TMJ and mandibular condyles, highlighting the long-term health and functionality of the TMJ complex following distraction osteogenesis.[10,11] The findings of case report highlight the effectiveness and durability of distraction osteogenesis as a treatment modality for severe mandibular retrognathia with associated OSA. Long-term follow-up is essential for assessing the stability and integrity of treatment outcomes, particularly in complex cases involving craniofacial deformities and respiratory disturbances.

CONCLUSION

This case report highlights the effectiveness of distraction osteogenesis as a long-term treatment modality for severe mandibular retrognathia with mild obstructive sleep apnea. The comprehensive evaluation, well executed distraction procedure, and long-term follow-up revealed not only esthetic and functional improvements but also the maintenance of healthy TMJ condyles over time. Long termfollows up highlights the importance of distraction osteogenesis in addressing complex maxillofacial deformities such as severe mandibular retrognathia while ensuing long-term stability and TMJ health.

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

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Cite this article as: Thapa A, Kumar AN, Jayan B, Ray S, Chopra SS. Long-term stability and condylar status evaluation following distraction osteogenesis for severe mandibular retrognathia with mild obstructive sleep apnoea: a 10-year experience. Int J Otorhinolaryngol Head Neck Surg 2025;11:426-30.