Journal of Advanced Medical and Dental Sciences Research

@Society of Scientific Research and Studies *NLM ID: 101716117*

Journal home page: www.jamdsr.com doi: 10.21276/jamdsr Indian Citation Index (ICI) Index Copernicus value = 100

(e) ISSN Online: 2321-9599; (p) ISSN Print: 2348-6805

Case Report

Space Closure with Frictionless Mechanics in a Class I Bimaxillary Protrusion: A Case-Based Insight

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ABSTRACT:

Background: Management of skeletal Class I malocclusion with proclined incisors and hypodivergent vertical pattern remains clinically challenging. This case report delineates diagnostic strategies, extraction decision-making, comprehensive cephalometric analysis, and orthodontic mechanics employed in such a case. **Case Presentation:** An 18-year-old female presented with forwardly placed upper incisors and esthetic concerns. Thorough extraoral, intraoral, cephalometric and model analyses revealed skeletal Class I relationships, proclined upper and lower incisors, hypodivergent growth pattern, lower anterior crowding, scissor bite, and proclined lips. **Treatment:** Extraction of the first premolars in both arches followed by MBT fixed mechanotherapy with sequential archwire progression. Loop Mechanics was followed for space closure. Anchorage was controlled and space closure achieved. Retention with upper and lower bonded retainers was instituted. **Results:** Following approximately 18 months of active treatment, the patient attained Class I canine and molar relationships, ideal overjet and overbite, improved facial esthetics and lip posture. **Conclusion:** Frictionless mechanics can effectively help in space closure and proclinationreduction in hypodivergent skeletal Class I cases when guided by detailed diagnostic analysis and controlled treatment mechanics.

Keywords: Orthodontics; Class I Malocclusion; Hypodivergent; Proclined Incisors; Premolar Extraction;frictionless Mechanics; Case Report.

Received: 16 July, 2025 Accepted: 26 August, 2025 Published: 30 August, 2025

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This article may be cited as: Prasanna L, Maddula D, Madham S, K Nagarjuna P, J Vishishta, D Kalyani V. Space Closure with Frictionless Mechanics in a Class I Bimaxillary Protrusion: A Case-Based Insight. J Adv Med Dent Scie Res 2025; 13(8):82-87.

INTRODUCTION

Skeletal Class I malocclusion with dentoalveolar proclination and hypodivergent vertical pattern is a complex variant where esthetic and functional demands coexist [1]. Proclined incisors contribute to esthetic imbalance and functional instability; addressing them often necessitates reducing proclination and resolving crowding [2]. Treatment involved extraction of the first premolars, followed by anterior retraction with maximal anchorage. Space closure can be achieved using either friction (sliding) mechanics or frictionless (loop) mechanics [19]. Frictionless mechanics makes use of various loop designs, including vertical, reverse, boot, teardrop, T, omega, delta, and mushroom loops [19]. The Teardrop loop, one of the most commonly used designs, is simple, versatile, and easy to fabricate. It provides controlled anterior retraction and efficient space closure with minimal friction. In this case report, the application of frictionless mechanics with a teardrop loop for the management of bimaxillary protrusion is described.

CASE PRESENTATION

Patient Demographics: An 18-year-old female, in good systemic health, presented on 25 January 2020, with the chief complaint of “forwardly placed upper front teeth.” Family history was relevant: her mother exhibited similar malocclusion pattern. The patient demonstrated fair oral hygiene, brushing once daily without adjunctive aids.

Extraoral Examination:
Frontal: mesocephalic head, euryprosopic face, vertical facial thirds roughly proportional (upper–54 mm, middle–56 mm, lower–53 mm), zero mm incisal display at rest, 4 mm incisor display on smile, consonant smile, midline coincident.
Profile: convex profile, acute nasolabial angle, low clinical FMA, normal lips, chin, and facial divergence.

Functional Examination: Normal nasal respiration, no TMJ dysfunction, backward mandibular closure deviation, freeway space 3.5 mm, maximum mouth opening 42 mm, excursions R = 9 mm, L = 11 mm, normal swallow and speech.

Intraoral Examination:
Soft tissue: fair hygiene; normal frenal attachments.
Hard tissue: lower midline shifted 1 mm to the right; scissor bite on 27–37; maxillary and mandibular U-shaped asymmetric arches with rotations (11,12,13,23 maxillary; 35,45 mandibular), attrition on 22, buccally placed 27, palatal inclination on 15; mandibular arch crowding, distolingual rotations (35,45), lingual inclination of 37,47; curve of Spee right and left = –2 mm; overjet = 4 mm, overbite = 1 mm; bilateral Class I canine and molar relationships.

General History: Athletic build, normal gait and posture. Psychosocially motivated by esthetic improvement.

Diagnostic Record & Analysis:
Model Analysis:
Carey's: Upper L1–5 sum = 74 mm, arch perimeter = 66 mm → 8-mm crowding.
Arch Perimeter (U1–5): 84.5 mm vs. 77 mm → 7.5-mm excess.
Pont's: Calculated premolar width and molar width suggested expansion need.
Ashley Howe's: TTM = 107.5 mm, PMBAW = 43.5 mm → 40.5% width ratio, borderline case for expansion.
Bolton's: Anterior ratio 77.4% (mandibular excess 0.1 mm), overall ratio 90.2% (maxillary excess 1.3 mm).

Cephalometric Analysis:
Tweed: Normodivergent, proclined lower incisors, poor esthetic balance.
Downs: Skeletal Class I, normodivergent growth, proclined incisors.
Steiner: SNA 83.5° (prognathic maxilla), SNB 80° (orthognathic mandible), ANB 3.5° (Class I), hypodivergent mandible (Go-Gn to SN 29°), incisors forward and proclined, occlusal plane clockwise.
Holdaway Soft Tissue: Retrognathic mandible, protrusive lips, thin upper lip, increased upper sulcus depth.
McNamara: Prognathic maxilla and mandible, normodivergent, decreased facial heights, forward incisors, decreased lower pharyngeal airway.
Schwarz: Decreased anterior cranial base, decreased facial heights, hypodivergent, skeletal Class II? (but composite diagnosis revealed Class I).
Wits appraisal: 0 mm, Beta angle: 31°, both indicating skeletal Class I.
Composite: Orthognathic profile, skeletal Class I, hypodivergent pattern, protrusive teeth.

Space Analysis:
Upper: Required 12 mm space (proclination 8 mm, crowding 3 mm), available 0 mm.
Lower: Required 18.7 mm (crowding 4 mm, curve of Spee 2.5 mm, proclination 11.2 mm), available 0 mm.

Diagnosis:
18-year-old female with Angle's Class I malocclusion on skeletal Class I base, hypodivergent growth, proclined incisors, lower anterior crowding, rotations, lower midline shift, protrusive lips, acute nasolabial angle.

Treatment Objectives
Skeletal: Maintain hypodivergent pattern; does not require surgical correction.
Dental: Correct proclination; align arches, resolve crowding, normalize overjet/overbite.
Soft Tissue: Achieve harmonious facial profile; reduce lip protrusion; improve nasolabial angle.

Treatment Plan
1. Extraction of first premolars in both arches to gain space for alignment and retraction.
2. Fixed appliance (MBT brackets).
3. Sequential archwire progression: 0.014″ NiTi → 0.016″ NiTi → 0.016×0.022″ NiTi → 0.016×0.022″ SS → 0.017×0.025″ NiTi → 0.017×0.025″ SS → 0.019×0.025″ NiTi → 0.019×0.025″ SS.
4. Group A anchorage mechanics with Tear drop loop made of 17*25 S.S wire and anterior biteplane for scissor bite correction.
5. Controlled retraction of anterior segments with frictionless mechanics.
6. Estimated treatment duration: 18 months.
7. Prognosis: Fair.
8. Retention: Upper and lower bonded retainers.

Treatment Progress & Outcome
Treatment began with extraction and bond-up of MBT brackets in early 2020. Sequential wires facilitated leveling and alignment. Retraction phase included closure of extraction spaces with Tear Drop Loops, improvement in overbite/overjet, correction of midline. Anchorage was effectively maintained with mechanics.To prevent more anterior proclination, the archwires were cinched distal to the molar. Using 0.017x0.025" S.S wire, the tear drop loops were used

for exhibiting en masse retraction; 15° of alpha while 25° of beta bends were given in a loop.The loop was activated by 2 mm every 1½ months with tight cinching back distal to molar. Retraction and complete extraction space closure were achieved within 12months.

Soft tissue profile improved, with reduction in lip protrusion and a more acute nasolabial angle.At approximately 18 months, treatment completed. Final occlusion: Class I molar and canine, ideal overjet/overbite, improved arch symmetry. Facial esthetics enhanced with improved lip posture and nasolabial balance. Retention planned with upper and lower lingual bonded retainers. Figure 1-5

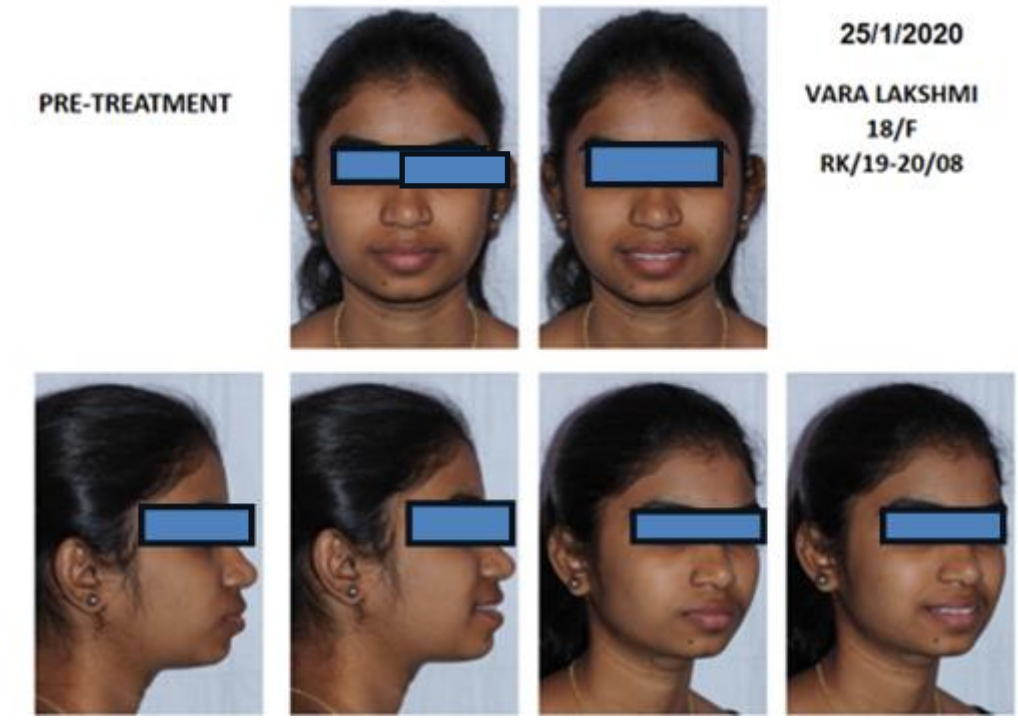

Figure 1: Pre-Treatment Extra Oral Photographs

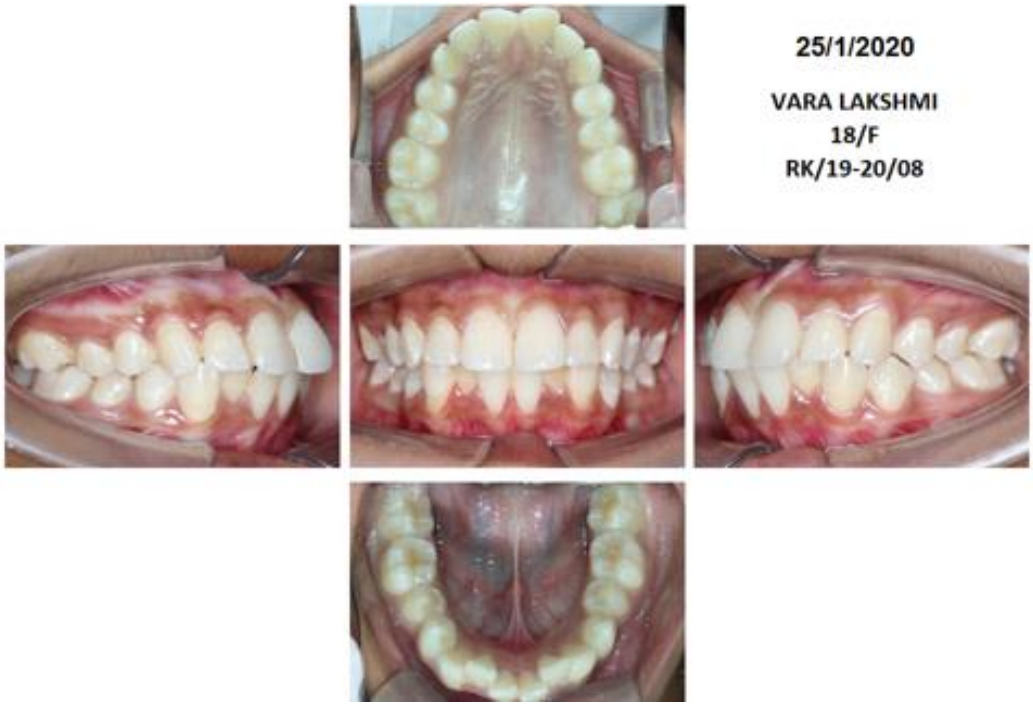

Figure 2: Pre-Treatment Intra oral Radiographs.

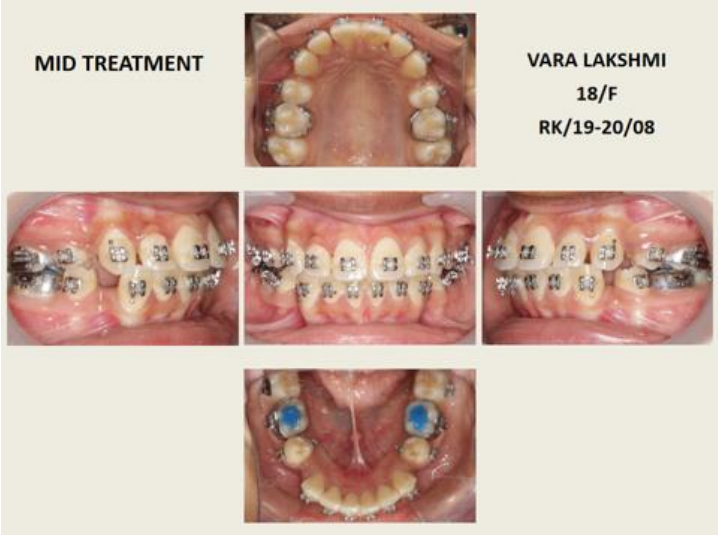

Figure 3: Intra Oral mid-treatment photographs

Figure 4: Intra oral examination loops placement.

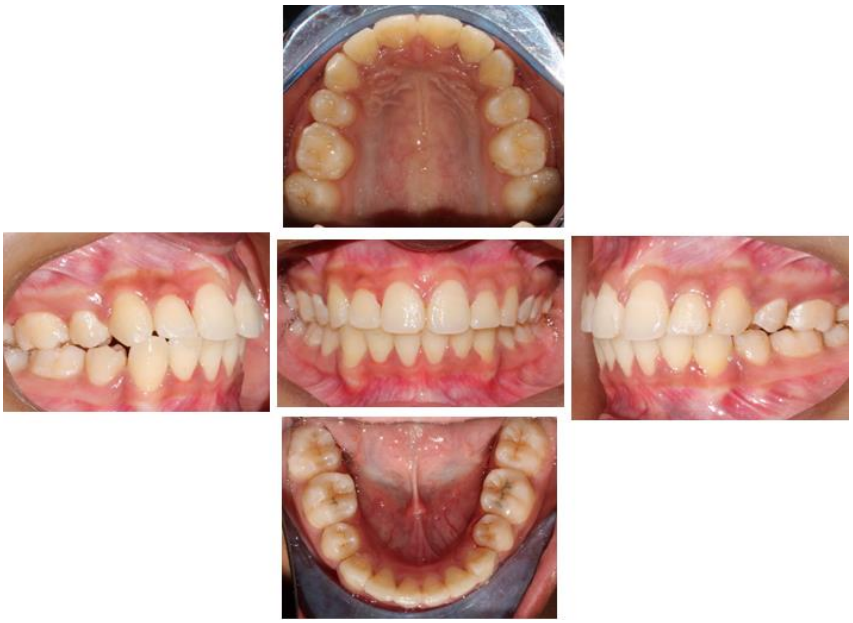

Figure 5: Intra Oral photographs post debonding.

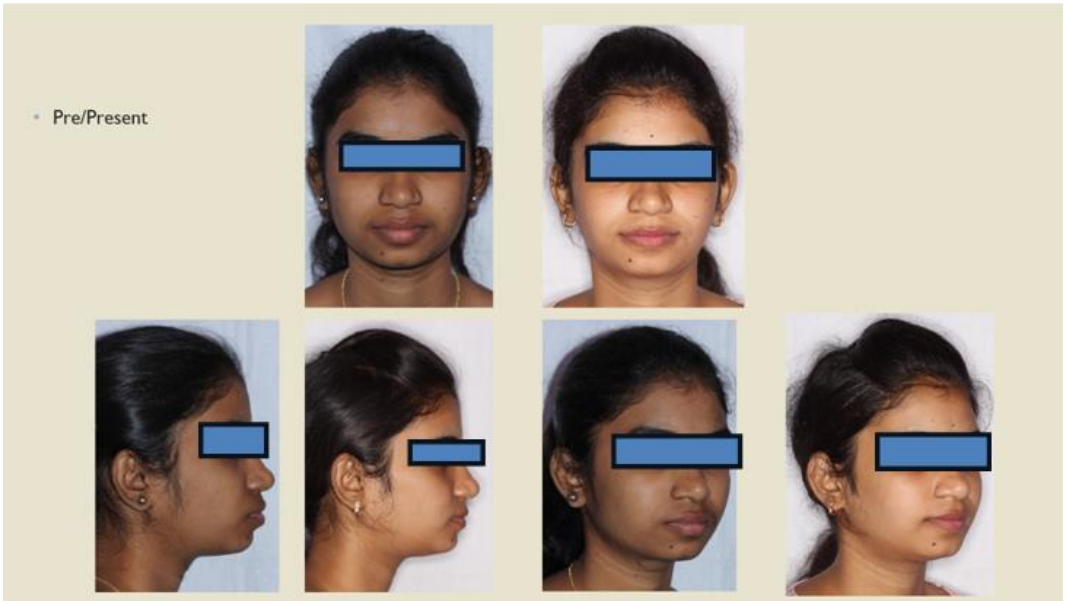

Fig 6: Pre Treatment and Post treatment Comparison of Extra Oral Photographs.

DISCUSSION

This case exemplifies how frictionless mechanics can effectively manage proclined incisors and crowding in hypodivergent Class I patients. In hypodivergent cases it is difficultto achieve controlled space closure with minimal vertical changes along with maintaining the anchorage[3]. Controlling a force system applied on a tooth is one of the major challenges in biomechanical orthodontic field. It happens because obtaining optimum magnitude of force in combination with the application of an appropriate M/F ratio is not an easy task to be achieved[20]. Compared to sliding mechanics, loop mechanics permits the use of a large span of archwire which will lead to less friction and binding.The major advantage is the lack of friction between bracket and archwire during space closure. While activating the loop in each appointment, there is controlled biomechanics applied. Each time when we activate the loop we tend to generate more force and decrease the moment to force ratio. Slowly when the force decays, moment to force ratio increases and reaches to a point where bodily movement of the tooth occurs. In loop mechanics, anchorage control and controlled retraction of anterior teeth is well balanced with the alpha and beta bends[13,14]. In this case, we have chosen Tear drop loop for retraction. Tear drop loop was given by R.G Alexander. It is easy to fabricate and doesn't involve complicated wire bending which saves clinician's time.

Here, Bimaxillary dental proclination was treated successfully by extracting four first premolars followed by retracting anteriors with Tear drop loopresulting in improved lip posture.

We were able to achieve good amount of anterior retraction and space closure maintaining Class I molar relationship and finished the case in 18 months.

Limitations include absence of three-dimensional airway imaging, though literature suggests no adverse airway changes [15]. Retention via bonded lingual retainers mitigates relapse risk, essential in extraction cases. Long-term follow-up will be necessary to monitor stability.

CONCLUSION

This case underscores the advantage of Frictionless mechanics in space closure along with meticulous diagnostic analysis and individualized treatment planning in addressing dentoalveolar proclination and crowding within a hypodivergent skeletal Class I framework. Extraction of first premolars, combined with sequential mechanotherapy with loop mechanics, achieved desirable esthetic and functional outcomes. Thus, with a Tear drop loop, desirable biomechanical responses were achieved successfully in a patient with bimaxillary proclination.Detailed cephalometric and model analysis guided the treatment effectively. Such camouflage interventions can be successful in similar orthodontic scenarios.

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