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CASE REPORT

Biomechanical and Clinical Considerations in correcting Skeletal Class II Malocclusion with Forsus™

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ABSTRACT

Aim: The present case report describes the importance of understanding of biomechanical and clinical considerations in application of Forsus appliance in correction of class II skeletal malocclusion.

Background: Angle's class II malocclusion is one of the most prevailing that may be either skeletal or dental presenting with different clinical manifestations. There are number of appliances to treat such a malocclusion in a growing child. Fixed functional appliances are indicated for class II corrections in patients who report late with minimal residual growth left.

Case description: A case of class II skeletal and dental malocclusion treated with preadjusted edgewise appliance supplemented with Forsus Fatigue Resistant Device (FRD) (3M Unitek Corp, California, USA) is reported.

Conclusion: Forsus device is an effective alternative in treating moderate skeletal class II malocclusion. The Forsus FRD (3M Unitek Corp, California, USA) can be used instead of class II elastics in mild cases and in place of Herbst appliance in severe cases.

Alteration of force vector by modifying the archwire as shown in this case report while applying Forsus and incorporation of 10 degree labial root torque in lower archwire will minimize the effects on dentition.

Engaging modules or tubing on to the pushrod and leaving 1 to 2 mm clearance between distal end of the upper tube and L-pin as shown in this case report will significantly improve the patient compliance.

Clinical significance: Much emphasis should be given to biomechanical considerations which were discussed in this article while treating patients with Forsus to prevent the unwanted effects.

Clinical considerations and certain modifications advised in this case report should be utilized while treating class II skeletal malocclusions with Forsus appliance to eliminate the patient cooperation factor and make treatment time estimates much more accurate.

Keywords: Angle's class II malocclusion, Fixed functional appliance, Biomechanical considerations, Forsus fatigue resistant device.

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BACKGROUND

Among all malocclusions, class II malocclusion constitutes approximately 15%. The class II malocclusion is used to describe the condition in which the mandibular first molars occlude distal to the normal relationship with the maxillary first molars. Class II can be further divided into—dental and skeletal. In dental class II malocclusions, it is possible to have a normal skeletal jaw relationship associated with dental class II molar relationship. Skeletal discrepancies associated with class II molar relationship have been termed as class II skeletal malocclusions.[1]

Devices commonly used for the correction of class II malocclusion can be classified as extraoral (headgear), intra-arch or interarch. The intra-arch devices are either removable (cetlin or sagittal appliances) or fixed (pendulum, distal jet, Jones jig). Fixed intra-arch appliances often depend on a Nance button for anchorage. Interarch devices which use the maxillary arch for anchorage, can be removable (bionator, twin block) or fixed. They can pull (class II Elastics, SAIF springs) or push (Forsus, Herbst, Jasper Jumper).[2] Interarch appliances tend to produce some slowing of maxillary growth, some acceleration of mandibular growth (which may not be clinically significant) and flaring of the mandibular incisors.[2]

Functional appliances have been shown to produce beneficial effects in growing patients with class II malocclusions, but the mechanism and effectiveness of these

appliances remains controversial.[3,4] Some authors contend that functional appliances have a mandibular skeletal effect,[5] while others do not believe.[6] DeVincenzo JP study showed an initial stimulation of condylar growth, but a long-term total amount of growth that was no higher than in untreated control groups.[7] In any event, the ability of removable functional appliances to produce dental rotations and bodily movements is limited.[8] Conventional functional appliances can be used when the patient reports during active growth spurt period. But, if the patient reports after the pubertal growth spurt or during the late stages of puberty then, fixed functional appliances would be the better choice.

CASE REPORT

A 13-year-old female patient reported for orthodontic treatment with a chief complaint of forwardly placed front upper teeth (Figs 1A to H, 2A and B). The general health of the patient was good with no significant medical history.

Extraoral Examination

Examination revealed a symmetric and dolichocephalic facial type. In profile, the patient exhibited a convex profile due to deficient lower jaw, prominent upper lip, deep mentolabial sulcus and average nasolabial angle.

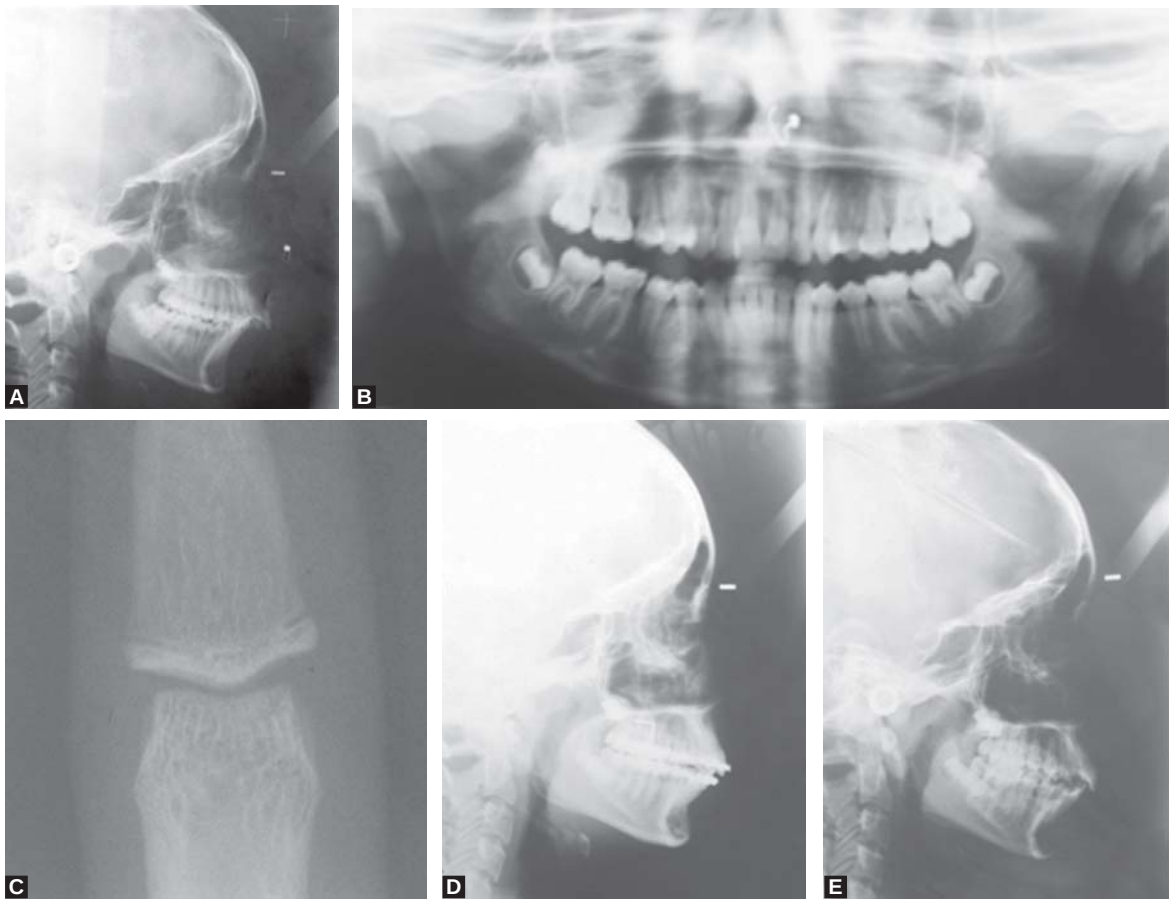
Intraoral Examination

Orthodontically, the patient presented an Angle's class II division 1 malocclusion with a deep overbite and an overjet of 9 mm. Upper and lower arches had mild crowding in anterior region. Both arches were ovoid in shape.

Cephalometric Analysis

Cephalometric analysis revealed (Table 1) a class II apical base discrepancy with SNA angle of 80 degree, an SNB angle of 74 degree, an ANB angle of 6 degree with a hypodivergent growth pattern (Pal–Man = 20°), skeletal

Figs 1A to H: Pretreatment photographs



Figs 2A to E: (A) Pretreatment lateral cephalogram; (B) Pretreatment OPG; (C) MP3 radiograph; (D) Post-forsus lateral cephalogram; (E) Post-treatment lateral cephalogram

Table 1: Pretreatment and post-treatment cephalometric values

Cephalometric measurement	*Pretreatment*	*Post-treatment*
Skeletal parameters		
SNA	80	79
SNB	74	77
ANB	6	3
Pal-Man	20	25
Y-axis	60	63
Co-A	93	92
Co-B	105	108
Dental parameters		
$\underline{\mid}$1-NA	9	6
$\underline{\mid}$1-NA (angular)	33	20
T 1-MP	108	112
T 1-NB	5	7
T 1-NB (angular)	34	38
Soft tissue parameters		
Cm-Sn-Ls	95	100

SNA: Sellaturcica-Nasion-Point A; SNB: Sellaturcica-Nasion-Point B; ANB: Point A-Nasion-Point B; Pal-Man: Palatal mandibular plane angle; Co-A: Condylion-Point A; Co-B: Condylion-Point B; $\underline{\mid}$1-NA: Upper incisor to Nasion-point A (linear); $\underline{\mid}$1-NA (angular): Upper incisor to Nasion-point A (angular); T1-MP: Lower incisor to mandibular plane (angular); T1-NB: Lower incisor to Nasion-point B (linear); T1-NB (angular): Lower incisor to Nasion-point B (angular); Cm-Sn-Ls: Columella-subnasale-labii superioris

deep bite and short mandibular base length. The maxillary incisors were proclined and were 9 mm anterior to the N-A line with an upper incisor to NA angle of 33 degree. The mandibular incisors were 5 mm anterior to the N-B line with an IMPA of 108 degree.

Assessment of Growth Potential

MP3 radiograph (Fig. 2C) shows patient was in H-stage which says patient is after peak growth spurt and is before the end of growth spurt.

Diagnosis

The patient was diagnosed with Angle's class II division 1 malocclusion on skeletal class II bases with short mandibular base length, hypodivergent growth pattern, skeletal deep bite, proclined upper teeth and convex profile.

Treatment Objectives

To achieve mandibular advancement, to reduce facial convexity, to achieve class I canine and molar relation, to improve smile esthetics and to reduce overjet and overbite.

Treatment Plan

Analyzing the clinical and cephalometric findings, it was evident that patient required aligning of upper and lower anteriors, advancement of the lower jaw and bite opening

to achieve harmonious dental and skeletal relationships. It was decided to treat the patient with fixed orthodontic appliance (MBT prescription—0.022 slot, 3M Unitek, California, USA) and Forsus Fatigue Resistant Device (FRD) (3M Unitek Corp, California, USA) to advance the lower jaw and achieve the desired results (as the patient is in late stages of puberty).

Description of Forsus Fatigue Resistant Device

Forsus FRD (3M Unitek Corp, California, USA) is a three-piece, semirigid, telescoping system, incorporating a superelastic nickel titanium coil spring that can be assembled chairside in a relatively short amount of time. It is compatible with complete fixed orthodontic appliances and can be incorporated into preexisting appliances. The FRD (3M Unitek Corp, California, USA) attaches to the maxillary first molar and onto the mandibular archwire, distal to either the canine or first premolar bracket.

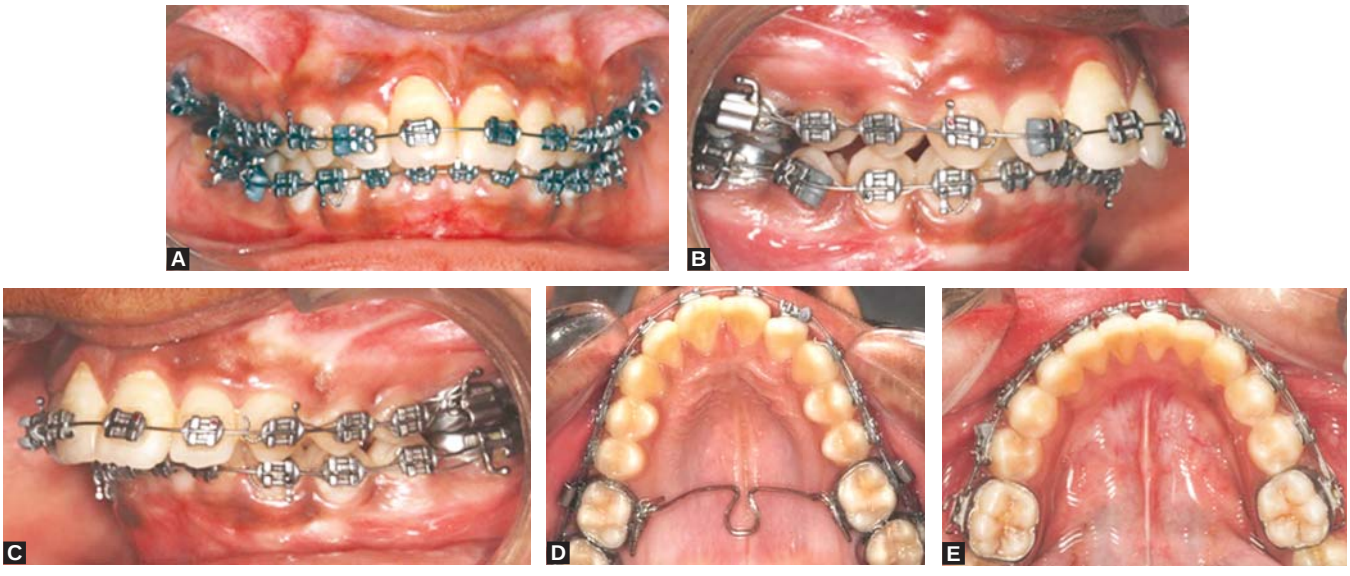
Interarch push spring produces about 200 gm of force when fully compressed. As the coil is compressed, opposing forces are transmitted to the sites of attachment.

The reason for calling it as 'fatigue resistant device' is that the linear compression spring assembly of Forsus can withstand up to 5 million cycles of loading. Appliance comprises of the following:

A. *Push rod*: Engaging the lower archwire directly or indirectly;
B. Compression spring assembly and
C. L-pin connecting spring assembly to molar.
It is available in four sizes : 25, 29, 32 and 35 mm.

Treatment Progress

Initial leveling and aligning (Figs 3A to E) was carried out using 0.016" NiTi wires followed by 0.019 × 0.025 NiTi wires. After the arches were leveled, 0.019 × 0.025 stainless steel wires were placed with labial root torque in the lower wire. Forsus FRD (3M Unitek Corp, California, USA) was given (Figs 4A to C) so as to position the mandible forward to reduce the facial convexity and to achieve a class I molar and canine relation bilaterally. The Forsus was given for a total of 5 months . Crimps were placed for the activation of the appliance at monthly intervals. After an active phase of 5 months Forsus was removed (Fig. 2D) and, class II elastics (light force) were given for retention. Settling of occlusion was done and fixed appliance was debonded (Figs 5A to H, 2E).



Figs 3A to E: Aligning archwire photographs

Figs 4A to C: With forsus and stabilization archwires

Figs 6A to H: Post-treatment photographs

RESULTS

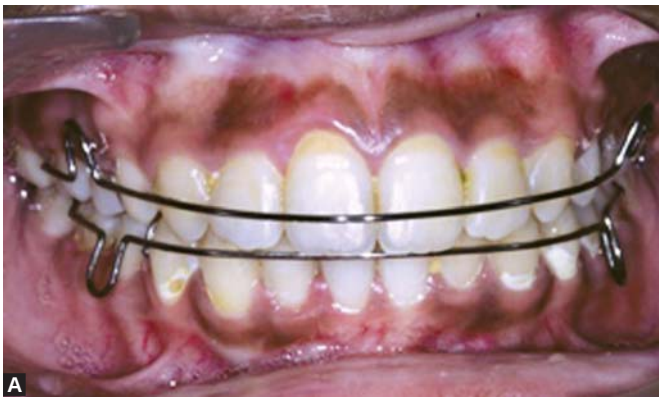
Cephalometric findings after the treatment showed ANB was decreased because of the retrusion of maxilla and protrusion of the mandible (see Table 1). There was mild decrease in the SNA angle and the SNB angle was increased which indicates forward positioning of the mandible. A class I molar relationship was achieved and the overjet was decreased. Removable retainers were delivered (Figs 6A to C). Begg wrap around retainer with ball-end clasps for retention was given in both arches. Patient was advised to wear retainers full-time for 5 months except while eating and brushing. After that, for 7 months part-time wear was advised. Patient was under observation for 1 year after debonding.

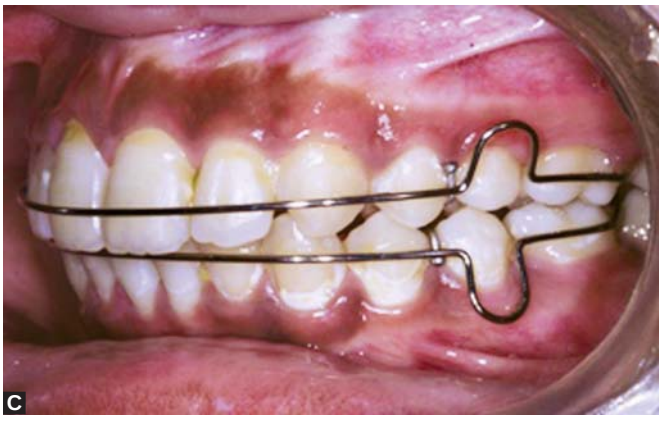
Clinical Considerations

1. *Appliance selection:* Preadjusted edgewise appliance is preferable. Prescriptions with more labial root torque in lower anteriors (MBT prescription) were more preferable.
2. *Archwire selection:* A 0.022 slot is preferable compared to 0.018 slot. Rigid rectangular stainless steel archwire (minimum of 0.019 × 0.025) is necessary in preadjusted edgewise appliance to combat the forces from Forsus appliance.
3. Incremental activation is better when compared to single stage advancement based on studies of Hagg and Rabie.[9,10]
4. To reduce injuries in lower vestibule and increase the comfort for the patient either modules or tubing should be engaged on to the pushrod.
5. To allow for pin adjustments and avoid restricted movement, leave 1 to 2 mm clearance between distal end of the upper tube and L-pin.

Biomechanical Considerations

1. Before applying Forsus, it is better to understand the force levels produced and the effects produced in all the three planes on lower canine and upper first molar.
2. Bonding of upper second molar and linking with a continuous rigid archwire prevents distal crown tipping and intrusion of first molar.





Figs 6A to C: Retainers

3. Full upper arch consolidation upto second molars is necessary to prevent molar distalization and to attain a complete arch distalization.
4. Lower arch consolidation using ligature from canine to canine makes the effects get distributed over six anteriors.
5. Adequate bendbacks in upper arch should be given to prevent distalization.
6. Adequate bendbacks in lower arch should be given to prevent proclining of lower anteriors.
7. Assuming the center of resistance of lower arch between premolar roots, force transmission as close to center of resistance of lower arch is, therefore, desirable. This is possible by modifying attachment (i.e. incorporating a hook in the archwire distal to lower canine) of Forsus on to the lower archwire (see Figs 4B and C).
8. A total of 10 degrees of labial root torque is given in lower canine-canine segment can minimize lower anterior tipping.
9. Alteration of force vector and incorporation of 10 degree labial root torque in lower archwire will minimize the effects on dentition (see Fig. 4A).

DISCUSSION

Significant profile improvement was seen in the patient that was attributed to retrusion of upper lip which may be due to lingual tipping of upper incisors. Forward movement of lower lip was found which may be due to lower incisor proclination and reduction of overjet, hence releasing the lower lip. Forward positioning of chin was observed, which may be because of increase in mandibular length. The correction is achieved by both dentoalveolar adaptation and by mandibular growth stimulation.

CONCLUSION

Forsus device is an effective alternative in treating moderate skeletal class II malocclusion. The Forsus FRD (3M Unitek Corp, California, USA) can be used instead of class II elastics in mild cases and in place of Herbst appliances in severe cases.

Alteration of force vector by modifying the archwire as shown in this case report while applying Forsus and incorporation of 10 degree torque in lower archwire minimizes the effects on dentition.

Engaging modules or tubing on to the pushrod and leaving 1 to 2 mm clearance between distal end of the upper tube and L-pin as shown in this case report will significantly improve the patient compliance.

CLINICAL SIGNIFICANCE

Much emphasis should be given to biomechanical considerations which were discussed in this article while treating patients with Forsus to prevent the unwanted effects and increase patient compliance.

Clinical considerations and certain modifications advised in this case report should be utilized while treating class II skeletal malocclusion with Forsus to eliminate the patient cooperation factor and make treatment time estimates much more accurate.

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