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# Non-Extraction Treatment of Class II division 1 Malocclusion Using the Forsus Fatigue Resistant Device – Case Report

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**Abstract**

Devices commonly used for correction of Class II malocclusions can be classified as extra-oral (headgear), intra-arch or inter-arch. The intra-arch devices are either removable (Cetlin or sagittal appliance) or fixed appliances (Distal-jet, Jones-jig, etc). Fixed intra-arch appliances often depend on a Nance button for anchorage. Interarch devices, which use the mandibular arch for anchorage, can be removable or fixed. They can pull (Class II elastics) or push (Frankel, Herbst, Japer jumper). The Forsus Fatigue resistant device is an inter-arch push spring that produces 200g of force when fully compressed, the force levels being comparable to heavy Class II elastics. The Forsus FRD has be effective in correcting Class II division 1 malocclusions without the need for patient compliance and considerably reducing chair-side time. The optimum force levels increase patient comfort and provides faster resolution of Class II skeletal base maxillo-mandibular relationship.

**Keywords:** Class II division 1 malocclusions, Forsus Fatigue Resistant Device, Fixed functional appliance, Non-compliance appliance.

## Introduction

In the everyday practice of an orthodontist, the most frequently observed skeletal discrepancy is Class II malocclusion. The variations of skeletal morphology of Class II division 1 malocclusion are mandibular retrognathia and (or) maxillary prognathism. According to McNamara's report, Class II malocclusion is primarily caused by mandibular retrusion rather than maxillary protrusion[1]. Removable or fixed mandibular advancement appliances have been proven to be effective to correct skeletal class II malocclusion before or during the pubertal growth spurt. In orthodontics, patient noncompliance with the treatment has been a concern for over 40 years and several recent publications attest to this phenomenon[2-6]. The introduction of fixed appliances in orthodontics aims to address two significant drawbacks of removable functional appliances, which are the patient's requirement for compliance and the inability to combine functional appliance usage with multibracket therapy to reduce treatment time[7].

Several compliance-free appliances for mandibular anterior repositioning have been studied in conjunction with fixed appliances in orthodontic research. The Eureka Spring appliance has been found to be effective in correcting Class II malocclusions without causing an increase in vertical dimension, while the Jasper Jumper appliance has demonstrated similar results by improving both the skeletal imbalance and profile of growing Class II patients [8-9]. Very recently, it was reported by other authors that a combination of

favourable maxillary and mandibular dentoskeletal effects leading to correction of Class II malocclusion induced by the Mandibular Protraction Appliance-IV[10].

To address issues related to breakage observed with the Jasper Jumper appliance, the Forsus FRD (3M Unitek Corp, Monrovia, Calif) was created as a hybrid fixed functional appliance. The FRD is a three-piece (L pin module) or two-piece (EZ2 module) system, composed of a telescoping spring that attaches at the upper first molar and a push-rod positioned distal to either the bracket of the canine or the first premolar, on the lower archwire. The clinical application of the FRD was described by William Vogt[11] in 2006 and was evaluated in a sample of 34 Class II patients (in comparison with a group treated with fixed appliances and Class II elastics) by Jones *et al*[12].

The spring and rod of the FRD appliance generate a force that is both equal and opposite to the dentition of the maxilla and mandible. Distal and intrusive movement of maxillary molars, mesial movement of mandibular molars, retrusion of maxillary incisors, labial tipping of mandibular incisors has been reported in previous studies with this appliance. Patients generally tend to accept the appliance quite well, although they may encounter some initial discomfort and functional restrictions that usually fade away with time.

Features of the Forsus FRD are as follows: easy installation, consistent force - correct activation of the module exerts approximately 200 grams of force with consistent light forces being applied by Forsus device, durable design - the unique co-axial spring design addresses the issue of fatigue failure, patient friendly, hygiene, predictable, versatile.

**The Forsus FRD has the following parts:**

1. Module: L-pin type and EZ2 type.
2. Push rods of various lengths – 22mm,25mm,29mm, 32mm,35mm,38mm.
3. Meausrement gauge
4. Split Crimps - 1.5mm activation

**Classification of Non-compliance Intermaxillary Appliances:**

**1. Rigid intermaxillary appliances:**

Herbst appliance
Biopedic appliance
Ritto appliance
Mandibular protraction appliance
Mandibular Anterior Repositioning Appliance (MARA)

**2. Flexible intermaxillary appliances:**

Jasper Jumper
Scandee Tubular Jumper
Flex developer
Adjustable Bite Corrector
Klapper Super Spring II
Churro Jumper
Forsus Nitinol Flat Spring

**3. Hybrid appliances:**

Eureka Spring
Sabbagh Universal spring

Forsus Fatigue Resistant Device
Twin Force Bite Corrector

**Case Report**

A 12-year-old male reported to the Department of Orthodontics and Dentofacial Orthopaedics with the chief complaint of proclined upper front teeth. He had good general health with no significant medical history.

Extra-oral examination showed apparently symmetrical face, mesoprosopic face, convex facial profile with posterior divergence of face. Lips were incompetent. Upper lip was short and hypotonic. Nasolabial angle was normal. Lower anterior facial height was reduced.

Intra-oral examination revealed the presence of all permanent teeth except upper and lower third molars with Angle's Class II molar relation, Class II canine relation on both sides and Class II division 1 incisor relation. Mild lower anterior crowding was present. There was an increased overjet of 10 mm. Deep bite was present. Upper midline and lower midline coincide with the facial midline. The Curve of Spee was 5.5 mm. Lingual rolling of the lower buccal segment was observed. Upper and lower first and second pre-molars on the right side were in scissor bite relation.

The patient's oral hygiene was satisfactory. Labial and lingual frenum were in normal position. A functional analysis indicated normal maximum mouth opening with no deviations of the mandible. There was absence of clicking, crepitus, or tenderness in the temporomandibular joint.

Radiographic examination revealed the presence of all permanent teeth in the Orthopantomogram. Photographic analysis showed bilateraly symetrical face. Lips were incompetent. Nose and chin are centered within the central fifth of face. Interpupilary distance was greater than the size of the mouth. Lower facial height was decreased. Nasolabial angle was found to be obtuse with a value of 93 degrees.

Arch perimeter analysis indicated space deficiency of 7mm in upper arch. Carey's analysis indicated space deficiency of 8mm in lower arch. Ashley Howe's analysis showed it was a non-extraction case in upper arch and a boderline case in the lower arch. Ponts index showed upper arch width was decreased 1.5 mm in premolar region and 4.13 mm in molar region thereby suggesting that arch-expansion could be selected as a space gaining procedure. Bolton's overall ratio of 90.4 % and anterior ratio of 73.1% indicated maxillary overall and anterior tooth material excess respectively.

Various cephalometric analysis suggested that the patient had skeletal Class II maxillary-mandibular relations, horizontal growth pattern, proclined upper and lower incisors and protrusive upper and lower lips.

Skeletal maturity indication study was done using hand wrist radiographs and cervical vertebrae (second, third and fourth vertebrae). Fishman skeletal maturity index indicated SMI Stage 3 with epiphysis as wide as diaphysis of middle phalanx of the fifth finger suggesting that the patient was in the accelerating growth velocity period. Hassel and Farman CVMI classification stated that the patient was Stage 3 also called transition phase. Corresponds to acceleration of growth towards peak height velocity with 25% to 65% of adolescent growth expected.

After careful clinical examination and assessment, the case was diagnosed as Angle's Class II division 1 malocclusion with orthognathic maxilla and retrognathic mandible on a Class II skeletal base with proclined upper incisors and mild lower anterior crowding.

According to the problem list, an ideal treatment plan was devised for the patient for correction of the existing malocclusion and achievement of ideal soft tissue balance. A non-extraction treatment plan in conjuction with mandibular advancement was planned.
The pre-adjusted Edgewise appliance with 0.022" inch slots (MBT prescription) was selected for fixed orthodontic mechanotherapy and Forsus Fatigue Resistant Device for mandibular advancement in conjunction with fixed orthodontic appliance.

**Phase I: Levelling and Alignment**
Banding of all the first molars were done using 180" x 0.006" molar bands with tube for engagement of head gear in the upper molars.
An upper anterior inclined plane was fabricated with acrylic and was solder onto the molar bands of the upper molars on the palatal aspect. This served two purposes: caused the opening of the bite to facilitate bonding of the lower arch and habitual anterior positioning of the mandible for the initial phases of orthodontic treatment. This appliance was removed once levelling and alignment was complete.
The levelling and alignment was continued with 0.017" x 0.025" inch Nitinol wire followed by 0.019" x 0.025" inch Nitinol. Finally, 0.021" x 0.025" inch stainless steel wire was ligated onto the brackets along with arch consolidation to form a single maxillary and mandibular unit respectively. The lower arch wire had a few modifications: negative torque in the anterior segment and "U" loops between canine and first pre-molar brackets bilaterlally for engagement of the appliance to the arch wire. "U" loop fabrication prevents de-bonding of the canine brackets during active orthopaedic correction phase. The negative torque or labial root torque in the lower anterior segment was incorporated in the arch-wire to prevent the labial tipping or flaring of the lower incisors during the active orthopaedic correction phase.

**Phase II: Orthopaedic correction**
Prior to engagement of the Forsus FRD few modifications of the lower arch wire were done: negative torque in the anterior segment and "U" loops between canine and first pre-molar brackets bilaterally for engagement of the appliance to the arch wire. "U" loop fabrication prevents de-bonding of the canine brackets during active orthopaedic correction phase. Tight cinching back of the both upper and lower arch-wires should be done to create rigid upper and lower dental segments.
The measurement gauge provided was placed on the distal aspect of the upper first-molar head gear tube and lower "U" loops and the reading was measured. This reading indicated the size of the push rod to be used.
The "L-pin" module was placed in the head-gear tube from the distal aspect of the tube with the ball end of the module facing buccally. The free end of the L-pin that was coming out of the tube mesially was cinched in a gingival and distal direction and stabilised. The pus-rod was engaged onto the "U" of the lower arch wire. The spring module and push rod were then engaged into one another and the patient was asked to bite. Rolling interference of the device during chewing was checked. The compression of the spring module by the push-rod gives the required activation for mandibular advancement. Mandibular advancement was carried out until over-correction of molar, canine and incisor relation was achieved.

**Phase III: Finishing and Detailing**
After correction was achieved the Forsus FRD was removed. A stage of 0.019" x 0.025" inch Nitinol was placed for correcting the root positions that might have altered during active orthopaedic correction phase.

Settling of occlusion was done using vertical intermaxillary intra-oral elastics in Class II pattern on round Nitinol wire in lower arch and anterior sectional rigid stainless steel arch-wire in the upper arch.

**Retention Phase**

Removable Hawley's retainer with upper anterior inclined plane was used for retention for a period of 1 year with a full-time wear protocol.

**Results**

The initial phase of levelling and alignment involved the periodic changing of arch wires and was achieved in around 7 months' time. The active mandibular advancement period lasted for 5 months during which Class I molar, canine and incisor relations were achieved. An over-correction was also achieved. The Forsus FRD was kept passive for a period of 6 months after overcorrection after which finishing and settling of occlusion was carried out.

**Figure 1**: Pre-Treatment frontal and smile views

**Figure 2:** Pre-treatment right and left profile views


a.


b.


c.


d.


e.

**Figure 3**: Intraoral views (a: lateral left; b: lateral right; c: frontal; d: maxillary arch; e: mandibular arch)

**Figure 4**: Pre-treatment Orthopantomogram

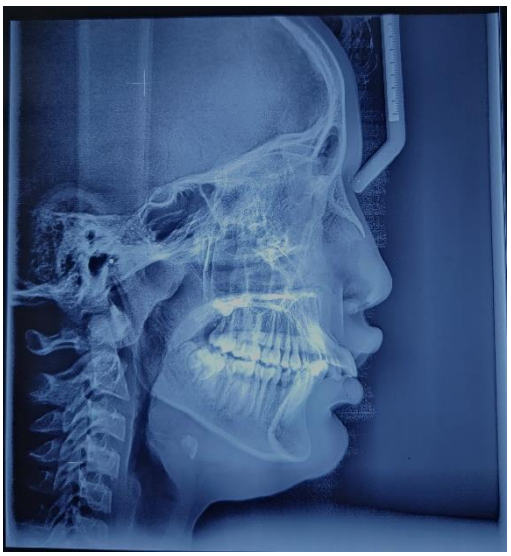


**Figure 5**: Pre-treatment Lateral Cephalogram

a.

b.

c.

d.

e.

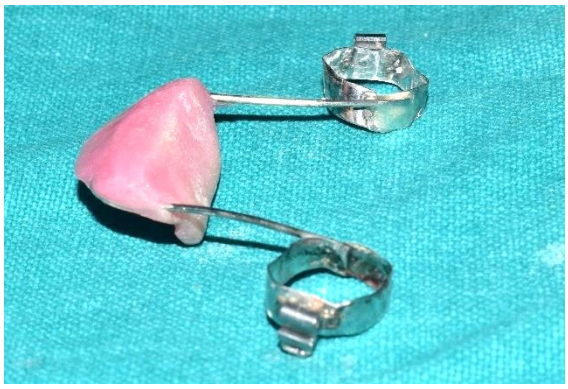
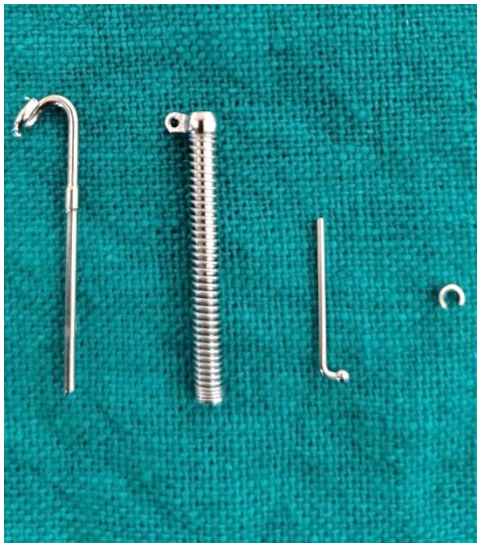


**Figure 6**: a & b : left and right post-bonding lateral views; c. post-bonding frontal view; d. post-bonding occlusal view of maxillary arch with the upperp anterior inclined plane; e. the reverse anterior inclined plane appliance soldered onto the molar bands.

**Figure 7**: Placement of Forsus fatigue Resistant Device after initial levelling and alignment

a.



b.

**Figure 8**: a. Various parts of the Forsus Fatigue resistant device from left to right ( 25 mm push rod, co-axial spring module, L-pin, crimpable hook); b. Forsus Fatigue Resistant Device assembled ( L-pin module type)

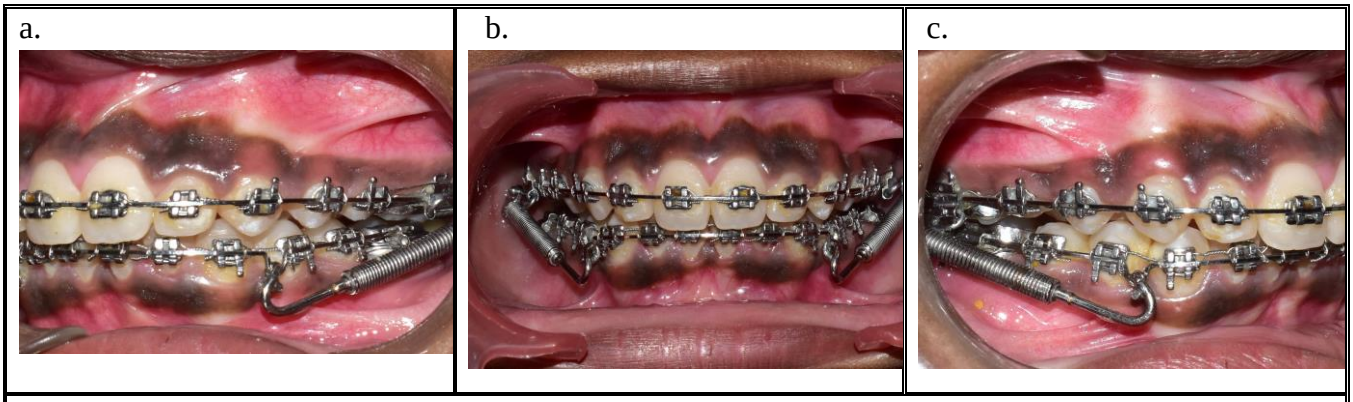



**Figure 9:** Post correction intra-oral photographs; a. left buccal view; b. frontal view; c. right buccal view.


**Figure 10:** Post correction extra-oral photographs; a. frontal view b. frontal smiling view (note: the gummy smile appearance of the patient due to a short upper lip length).


**Figure 11:** Post-correction extra-oral profile photographs; a. left profile view; b. right profile view.

## Conclusion

The Forsus fatigue resistant device proved to be an effective tool for correction of Class II division 1 malocclusion. The ease of application reduces chair-side time and low continuous force delivery system provides rapid skeletal correction while making it comfortable for the patient. The changes observed during this case report can be summarised as follows:

1. Differential response to the Forsus FRD was observed. Skeletal and dentoalveolar effects played differentially in skeletal class II correction.
2. After the completion of the treatment, notable enhancements were observed in the sagittal intermaxillary relationships of the dentoalveolar region, accompanied by a minor impact on the maxilla similar to that of headgear.
3. Dento-alveolar effects included distalization of the maxillary dentition with significant mandibular molar mesial movement.

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