Indian Board of Orthodontics Case Report: Management of Skeletal Class II Division I Malocclusion With Single-Phase Fixed Orthodontic Treatment Along With Forsus FRD Fixed Functional Appliance

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Abstract
This case report was submitted to the board under category II for the Indian Board of Orthodontics examination in November 2017. This case report illustrated the treatment of class II division I malocclusion by pre-adjusted appliance along with Forsus Fatigue Resistance Device (FRD) fixed functional appliance (single-phase treatment) in a 13.6 year-old female patient whose growth was about to cease. The summary of the treatment, various records, treatment progress, and critical appraisal are reprinted here with minimal editing and reformatting, and hence, the presentation resembles the actual documents submitted to the board.

Keywords
IBO Case Report, Forsus Fatigue Resistance Device, Fixed Functional Appliance, Single Phase Treatment

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Introduction
Class II malocclusion is a frequently encountered problem in orthodontic patients. The presence of skeletal class II malocclusion in adult patients is challenging, and patients often have high expectations regarding results. According to McNamara,1 the most common characteristic of class II malocclusion is mandibular retrognathism rather than maxillary protrusion.1 Functional orthopedic appliances are mostly used to treat class II malocclusion originated from mandibular retrusion.2,3 Choice of appliance whether removable or fixed depends on existing anteroposterior discrepancy, growth period, and compliance of patient. Patients with class II mandibular retrusion in whom growth is about to cease are mostly treated with fixed functional appliances which do not require patient’s compliance.4,6

The following case report illustrates the treatment of class II division I malocclusion using fixed functional appliance (Forsus Fatigue Resistance Device [FRD]) in a 13.6 year-old female patient.

Case Report
AV, a 13-year 6-month-old female, presented with the chief complaint of forwardly placed upper front teeth. She presented with convex profile, class II skeletal base with retrognathic mandible, horizontal growth pattern, Class II molar and canine relation on right and left side, with mild crowding in lower anteriors. Model analysis revealed a space availability of 1.5 mm in the maxillary arch and space requirement of 1.5 mm in the mandibular arch. The patient was treated with non-extraction by fixed functional appliance—Forsus Fatigue Resistance Device (FRD) as a single-phase treatment. The appliance used was pre-adjusted edgewise appliance with slot size 0.018” × 0.025”, MBT (3M orthodontics).

Section I: Pretreatment Assessment Details
- Initials: AV
- Sex: Female
- Date of birth: December 5, 2002

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• Age at start of treatment: 13 years, 6 months
• Patient’s complaints: A 13.6 year-old female reported with a chief complaint of forwardly placed upper front teeth.
• She had not given any significant medical, family, and dental history.

Clinical Examination: Extra-Oral Features
Extra-oral examination revealed good general health of patient with mesomorphic body type and mesoprosopic facial type. Patient was having orthognathic maxilla, retrognathic mandible, decreased mandibular plane angle, convex facial profile, and upward tipped nose with incompetent lips. Mentolabial sulcus and chin was found average. Pretreatment extra-oral photographs are shown in Figure 1.

Clinical Examination: Intraoral Features
Pretreatment intraoral photographs are shown in Figure 2.

• Soft tissues: No abnormality detected
• Oral hygiene: Good
• Erupted teeth present:

| Maxillary Arch | Mandibular Arch |
|---------------|----------------|
| 7 6 5 4 3 2 1 | 1 2 3 4 5 6 7 |
| 7 6 5 4 3 2 1 | 1 2 3 4 5 6 7 |

• General dental condition: Good dental and periodontal health.

Crowding/Spacing
• Maxillary arch: V-shaped symmetrical arch with proclined upper anteriors along with mild spacing present between lateral incisor and canine bilaterally
• Mandibular arch: U-shaped asymmetrical arch with mild crowding in the anterior region with rotated canines and second premolars bilaterally

Occlusal Features
• Incisor relationship: Class II division 1
• Overjet (mm): 14 mm
• Overbite: 7 mm
• Centre lines: Lower dental midline shifted toward right side.
• Left buccal segment relationship: Class II molar relation, class II canine relation
• Right buccal segment relationship: Class II molar relation, class II canine relation
• Cross bite: Scissor bite: 14, 24
• Rotations: Distobuccal rotation with both lower second premolar and distolingual rotation with both lower canines
• Curve of Spee: Exaggerated
• Model Analysis: Ashley Howe’s analysis indicated that this was a borderline case; Carey’s analysis indicated that this was a non-extraction case; Pont’s analysis indicated that expansion was required in premolar and molar regions; and Bolton’s analysis showed overall maxillary excess by 1.08 mm and anterior maxillary excess by 0.66 mm.

General Radiographic Examination
Pre-treatment radiographs taken
Orthopantomogram on June 1, 2016 (Figure 3)
Lateral Cephalogram on June 1, 2016 (Figure 4)

Figure 1. Pretreatment Extra-Oral Photographs. (a) Frontal view with lips at rest; (b) right profile view; and (c) three-quarter view with smile.
Source: Patient records.

Figure 2. Pretreatment Intraoral Photographs. (a) Maxillary occlusal view; (b) right buccal view; (c) anterior view; (d) left buccal view; and (e) mandibular occlusal view.
Source: Patient records.
Relevant Radiographic Findings

The normal complement of permanent teeth was present with no abnormalities of the surrounding structures and regions; additionally, there were no abnormalities in the tooth form. The third molars in maxillary arch were congenitally absent and were unerupted in mandibular arch. The alveolar crestal bone level of the teeth present was within the normal limits of the cemento-enamel junction (CEJ).

Pretreatment Cephalometric Interpretation

Pretreatment cephalometric values are given in Table 1.

Table 1. Pretreatment Cephalometric Analysis.

| Variable                        | Pretreatment | Normal |
|---------------------------------|--------------|--------|
| Sagittal skeletal relationship  |              |        |
| SNA                             | 74°          | 82°    |
| SNB                             | 68°          | 80°    |
| ANB                             | 6°           | 2°     |
| Wits appraisal                  | 7 mm         | 0 mm   |
| Dental base relationship        |              |        |
| Upper incisor to NA (mm/deg)    | +12 mm/37°   | 4 mm/22° |
| Lower incisor to NB (mm/deg)    | +5 mm/19°    | 4 mm/25° |
| Upper incisor to SN plane       | 110°         | 102°   |
| IMPA                            | 97°          | 90°    |
| Dental relationship             |              |        |
| Interincisal angle              | 117°         | 131°   |
| Lower incisor to A-Pog line     | −2 mm        | 0–2 mm |
| Overbite                        | +7 mm        | 3.2 + 0.7 mm |
| Overjet                         | +14 mm       | 3.2 + 0.4 mm |
| Vertical skeletal relationship   |              |        |
| Maxillary–mandibular plane angle| 23°          | 25°    |
| SN plane–mandibular plane       | 31°          | 32°    |
| Upper anterior face height (Na-ANS) | 58 mm    |        |
| Lower anterior face height (ANS-Me) | 66 mm      |        |
| Face height ratio               | 58.66 = 0.87 | 55.64 = 0.85 |
| Jarabak ratio (S-Go/N-Me)       | 77/121 = 63.63 % | <62 vertical >65 horizontal |
| Maxillary length (ANS-PNS)      | 57 mm        |        |
| Mandibular length–effective (McNamara) (Co-Gn) | 109 mm    |        |
| Soft tissues                    |              |        |
| Lower lip to Rickets’ E-plane   | −4.5 mm      | −2 mm  |
| Nasolabial angle                | 104°         | 95°-110° |

Source:
- Skeletal class II base with retrognathic maxilla and retrognathic mandible
- Horizontal growth pattern
- Convex profile
- Incompetent lips.
Diagnostic Summary

The skeletal and dental relationships confirm a Class II skeletal base malocclusion due to retrognathic mandible along with Class II molar and canine relation on right and left side with proclinated upper anteriors and mildly crowded lower anteriors. In model analysis, Bolton ratio showed minimal excess of maxillary tooth material. Cephalometric analysis revealed skeletal class II base with retrognathic maxilla, retrognathic mandible, horizontal growth pattern. Overall diagnosis was Class II skeletal bases with retrognathic maxilla, retrognathic mandible, horizontal growth pattern, Class II molar relation on right and left side with proclined upper anteriors and mild crowding in lower arch, and convex profile with incompetent lips.

Problem List

1. Skeletal class II base due to retrognathic mandible
2. Proclined upper anteriors and mild crowding in lower arch
3. Class II molar and canine relation on right and left side
4. Increased overjet
5. Deep bite
6. Incompetent lips.

Aims and Objectives of Treatment

1. Correction of the class II skeletal base
2. To improve profile and smile
3. To correct proclination of upper anteriors
4. To relieve crowding in lower arch
5. To achieve class I molar and canine relation on both sides
6. To reduce overjet
7. To correct deep bite
8. To establish functional occlusion
9. To ensure long-term stability.

Treatment Plan

- The case was treated with non-extraction using a fixed functional appliance like Forsus FRD along with a pre-adjusted edgewise appliance with slot size 0.018” × 0.025”, MBT (3M Orthodontics).
- Proposed retention strategy: Long-term upper Hawley’s retainer with reverse anterior inclined plane and lower bonded retainer from canine to canine.
- Prognosis for stability: Good.

Section 2: Treatment

Treatment Progress

- Start of active treatment: June 2, 2016
- Age at start of active treatment: 13 years 6 months
- End of active treatment: November 9, 2017
- Active treatment time: 17 months
- End of retention: Long-term upper Hawley’s retainer with reverse anterior inclined plane and lower bonded retainer from canine to canine.

Key Stages in Treatment Progress

Key stages in treatment progress of this patient are given in Table 2.

Mid-treatment extra-oral and intraoral photographs are shown in Figures 5 and 6.

Mid-treatment extra-oral and intraoral photographs with Forsus FRD appliance are shown in Figures 7 and 8.

Table 2. Key Stages in Treatment Progress.

| Date             | Stage                                                                 |
|------------------|----------------------------------------------------------------------|
| June 1, 2016     | Pretreatment records collected and direct bonding done with upper arch and 0.014” NiTi engaged. |
| June 17, 2016    | Direct bonding done with lower arch and 0.014” NiTi engaged.         |
| August 23, 2016  | Upper and lower 0.016” × 0.022” preformed NiTi wire engaged.        |
| September 27,    | Upper and lower 0.017” × 0.025” preformed NiTi wire engaged.        |
| 2016             |                                                                      |
| March 4, 2017    | Upper and lower 0.017” × 0.025” SS wire engaged.                    |
| April 15, 2017   | Mid-stage records taken. Forsus FRD placed (29 mm).                  |
| November 9,      | Stage records taken, debonding done, impression made, and photographs taken. |
| 2017             |                                                                      |
| November 11,     | Maxillary retainer with anterior reverse inclined plane and mandibular lingual bonded permanent retainer delivered. |
| 2017             |                                                                      |

Source:

Figure 5. Mid-treatment Extra-Oral Photographs. (a) Frontal view with lips at rest; (b) right profile view; and (c) three-quarter view with smile.

Source: Patient records.
• Right buccal segment relationship: Canine class I and molar class I relation
• Crossbites: Scissor bite with 14, 24 corrected
• Functional occlusal features: No functional Shift and TMJ functions with full range of mandibular movements
• Other occlusal features: Curve of Spee leveled.

Complications Encountered During Treatment
No complications were encountered during the entire treatment.

Radiographs Taken Toward/at the End of Treatment
Orthopantomogram (November 9, 2017) (Figure 11)
Lateral cephalogram (November 9, 2017) (Figure 12)

Section 3: Post-treatment Assessment
Post-treatment extra-oral and intraoral photographs are shown in Figures 9 and 10.

Occlusal Features
• Incisor relationship: Class I
• Overjet (mm): 2 mm
• Overbite: 2 mm
• Centre lines: Almost coinciding
• Left buccal segment relationship: Canine class I and molar class I relation
Figure 11. Post-treatment Orthopantomogram.
Source: Patient records.

Figure 12. Post-treatment Lateral Cephalogram.
Source: Patient records.

Post-treatment Cephalometric Interpretation
- Post-treatment cephalometric comparison is given in Table 3.
- Skeletal Effects: Maxillary–mandibular relation was improved.
- Dental effects: Ideal overjet and overbite were achieved.
- Class I molar and canine relationship was achieved.
- Midline almost coinciding
- Soft tissue effects: Profile showed a marked improvement.
- Lip competency achieved.

Cephalometric Superimpositions
Cephalometric superimpositions are shown in Figures 13 and 14.

Section 4: Critical Appraisal
AV was successfully treated by fixed functional appliance over 17 months. The aims of treatment were accomplished,

Table 3. Post-treatment Cephalometric Comparison.

| Variable                        | Pre-treatment | Post-treatment |
|---------------------------------|---------------|----------------|
| Sagittal skeletal relationship  |               |                |
| SNA                             | 74°           | 73.5°          |
| SNB                             | 68°           | 70°            |
| ANB                             | 6             | 3.5°           |
| Wits appraisal                  | 7 mm          | −1 mm          |
| Dental base relationship        |               |                |
| Upper incisor to NA (mm/deg)    | 12 mm/37°     | +7 mm/22°      |
| Lower incisor to NB (mm/deg)    | 5 mm/19°      | +8 mm/35°      |
| Upper incisor to SN plane       | 110°          | 94°            |
| IMPA                            | 97°           | 110°           |
| Dental relationship             |               |                |
| Interincisal angle              | 117°          | 121°           |
| Lower incisor to A-Pog line     | −2 mm         | +5 mm          |
| Overbite                        | 7 mm          | +2 mm          |
| Overjet                         | 14 mm         | +2 mm          |
| Vertical skeletal relationship  |               |                |
| Maxillary–mandibular plane angle| 23°           | 24°            |
| SN plane–mandibular plane angle | 31°           | 28°            |
| Upper anterior face height      | 58 mm         | 55 mm          |
| Lower anterior face height      | 66 mm         | 65 mm          |
| Face height ratio               | 58/66 = 0.87  | 55.65 = 0.84   |
| Jarabak ratio                   | 77/121 = 63.63% | 78/118 = 66.1% |
| Maxillary length                | 57 mm         | 52 mm          |
| Mandibular length—effective(McNamara) | 109 mm   | 108 mm.        |
| Soft tissues                    |               |                |
| Lower lip to Ricketts E-plane   | −4.5 mm       | +1.5 mm        |
| Nasolabial angle                | 104°          | 113°           |

Source:
and the patient’s concerns were addressed appropriately. AV was notably pleased with the treatment outcome. Good occlusal and aesthetic results were achieved, and this was reflected in her post-treatment smile.

- Skeletal base relationship was improved.
- Ideal overjet and overbite was achieved.
- Class I molar and canine relation was achieved.
- Profile was improved markedly.
• Lip competency was achieved.
• Good functional occlusion was achieved.

Declaration of Patient Consent

The other clarify that they have obtained all appropriate patient forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patient understands that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Declaration of Conflicting of Interests

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