Comparison of effects of Forsus FRD and miniscrew implant anchorage supported Forsus FRD on lower incisor inclination

Saurabh Sonar\(^{a}\), Ravinder Yadav\(^{b}\), Ashish Chopra\(^{c}\), Puneet Batra\(^{d}\)

**Objective:** This study was done to evaluate the effect of mini implant anchorage to control lower incisor inclination in treatment of Class II malocclusion with fixed functional appliance.

**Materials and Method:** 20 patients (12 males and 8 females) with Class II div 1 malocclusion with a mean age of 19.23±2.42 years were selected and randomly divided in two groups. All patients were treated using 0.022\(^{\text{th}}\) (MBT) with Forsus fatigue resistant device (3M Unitek). Group I consisted of 10 patients treated with Forsus fatigue resistant device (FRD) and Group II consisted of 10 patients treated with Forsus fatigue resistant device and miniscrew implant for anchorage (FMI). Lower incisor inclinations were measured on the lateral cephalograms and the data was statistically analyzed.

**Results:** The mean degree of lower incisor inclination at pre functional (T0) for FRD group was ; L1 to NB : 28.80° ± 3.79° and IMPA 97.10° ± 5.32°. At post functional stage (T1) L1 to NB was 36.00° ± 4.13° and IMPA 107.8° ± 6.51°. The mean degree of lower incisor inclination at pre functional (T0) for FMI group was ; L1 to NB : 25.20° ± 4.39° and IMPA 97.60° ± 6.14°. At post functional stage (T1) L1 to NB was 28.20° ± 2.39° and IMPA 102.0° ± 7.68°. The results showed that there was statistically highly significant increase in the inclination of the lower incisors in the FRD group compared to the FMI group (p=0.001).

**Conclusion:** Miniscrew implant anchorage is effective in minimizing the lower incisor proclination associated with fixed functional appliance treatment in Class II malocclusion.

Class II malocclusion is a frequently encountered problem among orthodontic patients.\(^1\) It involves maxillary protrusion, mandibular retrusion, or both along with compromised esthetics and dental relations. Historically, various treatment modalities have been used to correct Class II malocclusions. A lot of time and effort has been used, over the years, by researchers and clinicians alike to zero in on the most efficient and effective way to treat this malocclusion.\(^2\)

The most common options which have evolved are use of functional appliances (removable and fixed), camouflage involving upper premolar extractions and surgical corrections.\(^3\)

Fixed functional appliances are a popular choice in young adults, non-compliant patients and corrections involve reduction in overjet and a change to Class I molar relation through a combination of skeletal and dental changes.\(^4\) One of the major disadvantages is the lower incisor proclination which accompanies the treatment with fixed functional appliances. To overcome this problem, Aslanet \(^{a}\) used a Forsus FRD appliance combined with a miniscrew. The authors reported that the mandibular incisors protruded insignificantly (approximately 3.5 degree). This study was done to evaluate the effect of mini implant anchorage to control lower incisor inclination in treatment of Class II malocclusion with Forsus fatigue resistant device.

**MATERIALS AND METHOD**

The sample consisted of 20 young adult subjects (12 males and 8 females) from Department of Orthodontics & Dentofacial Orthopedics, Institute of Dental Studies and Technologies (IDST), Modinagar. The mean age was 19.3±2.059 years, all patients had Class II malocclusion due to mandibular retrognathism.

Prior to the commencement of the study all the participants were informed and written consent was obtained. Ethical clearance was obtained from the ethical committee of the college for this study. All subjects were treated using 0.022\(^{\text{th}}\) MBT and Forsus fatigue resistant device (3M Unitek) using consistent contemporary biomechanical principles. The software used for the statistical analysis was SPSS (Statistical Package for Social Sciences) version 16.0 and Epi-info version 3.0. The statistical tests used were Paired and Unpaired or independent samples t-test for comparison of mean value of two groups.

Following are the inclusion and exclusion criteria for sample selection.

**Inclusion criteria:**

- Patients with at least CVMI-S\(^{5}\) with skeletal Class II (ANB 30°-70°) due to mandibular retrognathism, requiring skeletal mandibular sagittal correction.
- Presence of permanent dentition up to 2\(^{\text{nd}}\) molar.
- Pre-treatment permanent dentition with at least half cusp width of Class II molar relationship.
- Overjet of 5mm or more.
- SN/Gn-Go angle ranges between 25°-32°
- Positive clinical visual treatment objective (VTO).
- No history of any systemic medical illness.

**Exclusion criteria:**

- Class II surgical cases.
- Pretreatment signs and symptoms of temporomandibular joint dysfunction.
- Facial asymmetry, cases having condylar resorption.
- Incompletely formed roots or any sign of root resorption.

The sequence of the wires placed was 0.014” NiTi, 0.016” NiTi, followed by 0.019” x 0.025” NiTi and finally 0.019” x 0.025” Stainless steel archwire. A reverse torque of 10° was given in the anterior region of the mandibular wire and both archwires were cinched distal to the molar tube.

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\(^{a}\) Professor, Dept. of Orthodontics and Dentofacial Orthopedics, IDST, Modinagar
\(^{b}\) Final yr. PG student, Dept. of Orthodontics and Dentofacial Orthopaedics, IDST, Modinagar
\(^{c}\) Reader, Dept. of Orthodontics and Dentofacial Orthopedics, IDST, Modinagar
\(^{d}\) Vice Principal, Professor and Head, Dept. of Orthodontics and Dentofacial Orthopedics, IDST, Modinagar
The patients were randomly divided in two groups of 10 patients each

- **Group I**: Sagittal correction was done with hybrid fixed functional appliance (Forsus fatigue resistant device) - FRD
- **Group II**: Sagittal correction was done with hybrid fixed functional appliance (Forsus fatigue resistant device along with mini screw implant anchorage) – FM

**PLACEMENT OF FORSUS FATIGUE RESISTANT DEVICE**

Forsus Fatigue Resistant device is a prefabricated hybrid fixed functional appliance given by William Vogt in 2001.

1. Appropriate size of Forsus appliance was selected by using the 3M gauge (Fig. 1).
2. Forsus FRD spring was secured in maxillary first molar head gear molar tube and distal to mandibular canine in the lower arch wire.
3. Patients were observed at 4 week intervals and activation was performed as needed by crimping stoppers onto the push rod.
4. The appliance was maintained in place for 6 months.
5. The Forsus fatigue resistant device was removed when a Class I molar relationship was achieved and second set of radiographs (T1) was obtained.

**PLACEMENT OF FORSUS FATIGUE RESISTANT DEVICE WITH MINI SCREW IMPLANT**

The AbsoAnchor mini implants (1.5 × 8; Dentos Inc. Korea) were inserted between the mandibular second premolar and molar root area bilaterally one week before Forsus fatigue resistant device placement. An indirect anchorage was established by using NITI coil spring with micro implant and distal wing of canine bracket bilaterally (Fig. 2) and all the teeth were ligated with continuous ligation with ligature wire.

**RESULTS**

From the readings tabulated, the results were obtained and discussed as follows:

**FRD GROUP**

The mean degree lower incisor inclination (L1 to NB) evaluated at pre functional (T0) was 28.80° ± 3.79° and post functional (T1) was 36.00° ± 4.13°. The results showed that there was a statistically significant increase in the post functional readings than the pre functional readings (p=0.001). (Table 1)

The mean degree lower incisor inclination (IMPA) evaluated at pre functional (T0) was 97.10° ± 5.32° and post functional (T1) was 107.80° ± 6.51°. The results showed that there was a statistically significant increase in the post functional readings than the pre functional readings (p=0.001). (Table 1)

**FMI GROUP**

The mean degree lower incisor inclination (L1 to NB) evaluated at pre functional (T0) was 25.20° ± 4.39° and post functional (T1) was 28.20° ± 4.39°. The results showed that there was a statistically significant increase in the post functional readings than the pre functional readings (p=0.001). (Table 1)

The mean degree lower incisor inclination (IMPA) evaluated at pre functional (T0) was 97.60° ± 6.14° and post functional (T1) was 102.00° ± 7.68°. The results showed that there was a statistically significant increase in the post functional readings than the pre functional readings (p=0.001).

**Comparison between FRD and FMI groups**

The mean difference in lower incisor inclination (L1 to NB) between T0 and T1 was 11.20° ± 0.4 for the Forsus group and 3.00 ± 2.39 for the Forsus with mini screw group (p-value=0.001) showing that there was a statistically high significant increase in lower incisor inclination in the Forsus group.
The mean difference in lower incisor inclination (IMPA) at T0 and T1 for Forsus group was $10.7\pm0.19\degree$ and for Forsus with mini screw group was $4.40\pm1.54\degree$ (p-value=0.001) showing that there was statistically highly significant increase in lower incisor inclination in the Forsus group.

**Discussion**

Although many appliance systems that correct Class II malocclusion using dental anchorage exist, one common side effect is proclination of the lower incisors. Fixed functional appliances are associated with exertion of heavy orthodontic force on lower anterior and upper posterior teeth. This deleterious effect causes proclination of lower incisors an undesired sequel of active orthodontic treatment. Various methods like labial root torqueing in the lower archwires have been followed to prevent this deleterious effect on the lower anteriors.

Pandis S et al (2010), Aziz T et al (2005) reported lower incisor changes using the Forsus device, and they report changes in the $3\degree$-$5\degree$ range. Similar lower incisor inclination changes have been shown with Class II elastics. Karacay S et al (2006), Aras A et al (2011), Franchi L et al (2011), Nalbantgil D et al (2005) suggested various options, such as using negative-torqued lower incisor brackets or using fixed functional appliances on sectional arches, to prevent incisor inclination, but none of these systems was successful.

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However in the FMI group shows statistically significant (p=0.001) less increase in the amount of lower anterior proclination as compared to the Forsus alone. Similar results were reported in the studies done by Elkordy SA et al (2015), Aslan BL (2014) and Unal T et al (2014) stating that lower incisor proclination can be restricted by using mini screw and mini plates along with Forsus. Turkkahraman H et al (2016) have in fact reported retraction of lower incisors when miniplates were used in the lower anterior region to anchor the Forsus appliance.

![Fig 3. Vector diagram indicating the forces and moments acting on anteriors in Forsus with miniscrew implant anchorage](Image)

**Table 1: Comparison of change in lower incisor inclination in FRD & FMI groups and between the two groups**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>FRD</th>
<th>FMI</th>
<th>Intergr</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T0 Mean</td>
<td>T1 Mean</td>
<td>Difference between Pre and Post (T0-T1)</td>
<td>Intragroup p-value</td>
</tr>
<tr>
<td>L1 to NB</td>
<td>28.80±3.79</td>
<td>36.00±4.13</td>
<td>11.20±0.43</td>
<td>0.001**</td>
</tr>
<tr>
<td>IMPA</td>
<td>97.10±6.32</td>
<td>107.80±6.51</td>
<td>10.70±1.19</td>
<td>0.001**</td>
</tr>
</tbody>
</table>

* Significant difference (p-value<0.05)
** Highly Significant difference (p-value<0.01)
*** Very Highly Significant difference (p-value<0.001)
**Conclusion:**
The use of mini screw implants as additional anchorage with forsus FRB restricts the unwanted proclination of lower anteriors

**References**