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"(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 that accompanies the treatment with fixed functional appliances.To overcome this problem, Aslanet al[5] 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.

[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.

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" 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-S5 with skeletal Class II (ANB 3^0-7^0) due to mandibular retrognathism, requiring skeletal mandibular sagittal correction.
- Presence of permanent dentition up to 2nd molar.
- Pre-treatment permanent dentition with atleast half cusp width of Class II molar relationship.
- Overjet of 5mm or more.
- SN/Gn-Go angle ranges between 25^0-32^0
- 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 10^0 was given in theanterior region of the mandibular wire and both archwires were cinched distal to the molar tube.

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[6] in 2001.

1. Appropriate size of Forsus appliance was selected by using the 3M gauge (Fig1).

Fig 1. Forsus appliance

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.

Fig 2. Forsus appliance supported with miniscrew implant anchorage

Patients were observed at 4 week intervals the micro implant were checked for stability and the appliance was checked for activation. Activation was performed as needed by crimping stoppers onto the push rod.

RECORDS COLLECTION

Records were collected at two intervals of time;

T0: After levelling and aligning i.e. upto 0.019" x 0.025" stainless steel wire and before placement of appliance

T1: When functional appliance was removed (6 months after insertion of appliance)

Lateral cephalograms were used for the evaluation of the changes in lower incisor inclination.

LOWER INCISOR INCLINATION

Angular measurement

- Lateral cephalogram tracings were evaluated and angular measurements were derived from it.
- The inclination of lower incisor was measured through two angular measurements namely lower incisor to NB line and IMPA.
- Lower incisor inclination measurements were tabulated to find the difference between T0,T1 and also between the two groups.
- Radiographs of three patients were randomly selected and retraced after 15 days by the same operator to assess the reliability of the measurements.

RESULTS

From the readings tabulated, the results were obtained are 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 readingsthan 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 readingsthan 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 readingsthan the pre functional readings(p=0.001).

Comparison between FRD and FMI groups

The meandifference inlower incisor inclination (L1 to NB) between T0 and T1 was11.20±0.4 for the Forsus group and3.00±2.39 for theForsus 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.

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

	FRD Angle (degree)				FMI Angle (degree)				Intergroup
Parameter	T0 Mean	T1 Mean	Difference between Pre and Post (T0-T1)	Intragroup p-value	T0 Mean	T1 Mean	Difference between T0 and T1 (T0-T1)	Intragroup p-value	p-value
L1 to NB	28.80±3.79	36.00±4.13	11.20±0.43	0.001**	25.20±4.39	28.20±2.39	3.00±2.39	0.001**	0.001**
IMPA	97.10±5.32	107.80±6.51	10.7±01.19	0.001**	97.60±6.14	102.0±7.68	4.40±1.54	0.001**	0.001**
	Unpaired t-test * Significant difference (p-value<0.05) ** Highly Significant difference (p-value<0.01) *** Very Highly Significant difference (p-value<0.001)								

The mean difference in lower incisor inclination (IMPA) at T0 and T1 for Forsus group was 10.7±01.19° and for Forsus with mini screw group was4.40±1.54 (p-value=0.001) showing that there was statistically highlysignificant increase in lower incisor inclination in the Forsus group.

Intra operative error

To check the intra operative error three patients from each group were randomly selected and the measurements were done again after 15 days. The mean error difference was measured between the two measurements. The error was evaluated by the Dahlberg's formula and Pearson's correlation coefficient.

The range of error according to the Dahlberg's formula in volumetric assessment was 0.217 to 0.364 in FRD group and 0.103 to 0.384 in FMI group which was statistically insignificant.

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)[7], Aziz T et al(2005)[8] reported lower incisor changes using the Forsus device, and they report changes in the 3^0-5^0 range. Similar lower incisor inclination changes have been shown with Class II elastics. Karacay S et al (2006)[9],Aras A et al (2011)[10], FranchiL et al(2011)[11],Nalbantgil D et al(2005)[12]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.

Karacay S et al (2006)[9], Jones G et al (2008)[13] Aras A et al (2011)[10] Oztoprak MO et al, (2012)[1] stated that during the treatment with fixed functional appliances, an unfavourable effect of flaring of the mandibular anteriors is seen, which limits the skeleton effects of the appliance. This was in concordance with results of the present study result that inclination of lower anteriors was significantly increased in the forsus group.

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 ElkordyaSA et al (2015)[14], Aslan BL (2014)[5] and Unal T et al (2014)[15] stating that lower incisor proclination can be restricted by using mini screw and mini plates along with Forsus. Turkkahraman H et al (2016)[16] have infact reported retrusion of lower incisors when miniplates were used in the lower anterior region to anchor the Forsus appliance.

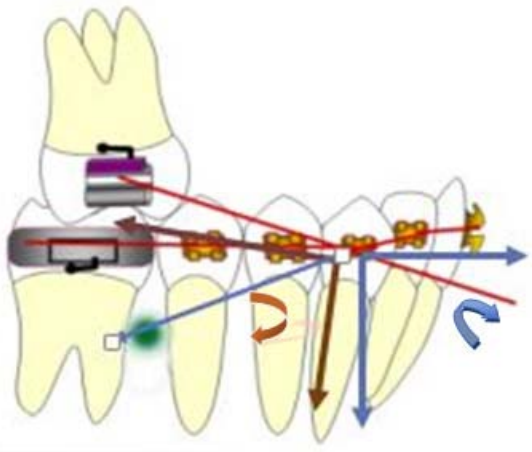

Fig 3.Vector diagram indicating the forces and moments acting on anteriors in Forsus with miniscrew implant anchorage

Conclusion:

The use of mini screw implants as additional anchorage with forsus FRB restricts the unwanted proclination of lower anteriors

References

1. Oztoprak MO, Nalbantgil D, Uyantar A, Arun T. A cephalometric comparative study of Class II correction with Sabbah Universal spring and Forsus FRD appliances. Eur J Dent 2012; 6:302- 10.
2. McNamara JA Jr. Components of Class II malocclusion in children 8 10 years of age. Angle Orthod 1981; 51:177 202.
3. Paquette D E, Beattie J R, Johnston L E. A long-term comparison of non-extraction and premolar extraction edgewise therapy in 'borderline' Class II patients. Am J Orthod Dentofac Orthop 1992; 102:1–14.
4. Paulose J, Antony PJ, Sureshkumar B, George SM, Mathew MM, Sebastian J. Powerscope a Class II corrector – A case report. Contemp Clin Dent 2016: 7; 221-5.
5. Aslan BI, Kucukkaraca E, Turkoz C, Dincer M. Treatment effects of the Forsus Fatigue Resistant Device used with miniscrew anchorage. Angle Orthod 2014; 84:76–87.
6. Vogt W. The Forsus fatigue resistant device. J Clin Orthod 2006: 6; 368-77.
7. Pandis N, Polychronopoulou A, Sifakakis I, MakouM,Eliades T. Effects of levelling of the Curve of Spee on the inclination of mandibular incisors and expansion of dental arches: a prospective clinical trial. Aust Orthod J 2010; 26:61–5.
8. Aziz T, Nassar U, Flores-Mir C. Prediction of lower incisor inclination during Xbow treatment based on initial cephalometric variables. Angle Orthod 2012; 82:472–9.
9. Karacay S, Akin E, Olmez H, Gurton AU, Sagdic D. Forsus Nitinol Flat Spring and Jasper Jumper corrections of Class II division 1 malocclusions. Angle Orthod 2006; 76:666-72.
10. Aras A, Ada E, Sarcaglu H, Gezer NS, Aras I. Comparison of treatments with the Forsus fatigue resistant device in relation to skeletal maturity: A cephalometric and magnetic resonance imaging study. Am J Orthod Dentofac Orthop 2011; 140:616-25.
11. Franchi L, Alvetro L, Giuntini V, Masucci C, Defraia E, Baccetti T. Effectiveness of comprehensive fixed appliance treatment used with the Forsus fixed resistant device in Class II patients. Angle Orthod 2011; 81: 678-83.
12. Nalbantgil D, Arun T, Sayinsu K, Isik F. Skeletal, dental and soft tissue changes induced by the Jasper jumper appliance in late adolescence. Angle Orthod 2005; 75: 426-36.
13. Jones G, Buschang PH, Kim KB, Oliver DR. Class II non-extraction patients treated with the Forsus Fatigue Resistant Device versus Intermaxillary elastics. Angle Orthod 2008; 78:332-9.
14. Elkordya SA, Fayed MMS, Abouelezz AM, Attia KH. Comparison of patient acceptance of the Forsus Fatigue Resistant Device with and without mini-implant anchorage: A randomized controlled trial. Am J Orthod Dentofac Orthop 2015; 148: 755-64.
15. Unal T, Celikoglu M, Candrli C. Evaluation of the effects of skeletal anchoraged Forsus FRD using miniplates inserted on mandibular symphysis: a new approach for the treatment of Class II malocclusion. Angle Orthod 2015; 85:413–9.
16. Turkkahraman H, Eliacik KS, Findik Y. Effects of miniplate anchored and conventional Forsus fatigue resistant devices in the treatment of Class II malocclusion. Angle Orthod (Preprint) 2016.