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Cephalometric Evaluation of Class II Patients Treated with Forsus Fatigue Resistant Device

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ABSTRACT

Background: The aim of this study was to evaluate changes, both skeletal and dental, after treatment of Class II malocclusion with comprehensive fixed orthodontic treatment which incorporated a Forsus fatigue resistant device. **Methods**: Pre- and post-treatment cephalometric radiographs of 16 patients with mean age of 12 +/- 1.18 years treated with the Forsus device were selected based on several criteria, including ANB angle and Angle's molar classification. Records were evaluated and compared to an untreated control group. The lateral cephalometric radiographs of control group were obtained from a longitudinal sample of an age estimation study using cervical vertebrae. The Student's t test was used, with a significance level of $P < 0.05$. **Results**: The treatment group showed a statistically significant reduction in values of ANB angle; SNA angle; and angle of convexity. Mandibular incisors showed significant proclination. The maxillary first molar showed no significant intrusion or distal movement. **Conclusion**: Correction of Class II malocclusion was achieved mainly by dental changes in the mandible in the form of proclination of mandibular incisors and some skeletal changes in the maxilla.

Keywords: Class II, Forsus Fatigue Resistant Device, FRD.

INTRODUCTION

Mandibular retrusion is as common a finding in Class II malocclusion and so is the occurence of Class II malocclusion in general population.[1] The ways in which a case of Class II malocclusion can be treated are multiple and include orthodontic camoflague, orthopaedic correction or orthognathic surgery. The disadvantage with most removable functional appliances is patient compliance. A fixed functional appliance which gained wide popularity was Herbst since it was not dependent on patient compliance. A fixed device called Forsus was introduced by Vogt and it consisted of nitinol flat-spring.[2] It was followed by the fatigue-resistant device L pin and the Forsus fatigue-resistant device EZ2 module [Figure 1]. The Forsus EZ2 module is an interarch push-spring composed of a spring module that attaches to the headgear tube and a push-rod that attaches to the lower archwire either mesial or distal to the first bicuspid.[3] The Forsus device has been widely used for treating Class II malocclusion cases. In one study, the Forsus nitinol flat-spring produced dental effects that accounted for about two-thirds of Class II correction.[4]Vogt reported that the Forsus device introduced intrusive forces on maxillary molars.[2] Karacay et al.[5] concluded that the Forsus nitinol flat-spring inhibited maxillary growth and caused significant dentoalveolar changes.

Figure 1: Forsus Fatigue Resistant Device (FRD) in association with complete fixed orthodontic appliance

There are two major schools of thought as to how the correction of Class II malocclusion takes place after Forsus use. One is that Forsus device corrected the molar relationship mostly through mandibular mesial molar movement and that the device is a substitute for Class II elastics.[6] Other group observed some positive changes in mandibular dimensions in a peak-growth group with distal tipping of maxillary molars.[7] The main aim of this study was to get a clear insight of how Class II correction takes place when treated with a Forsus appliance.

MATERIALS AND METHODS

The protocol of the present study was as follows: two groups were included in this study: a Forsus

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treatment group and an untreated control group. Data on treated subjects were obtained from a patients treated by post graduate scholars at Department of Orthodontics, Government Dental College Srinagar. The initial and final digital lateral cephalometric radiographs and intraoral photographs were taken as a part of routine record keeping [Figure 2]. The orthodontic practice uses a specific treatment protocol that includes preadjusted fixed appliances with brackets of minus 6 degrees root torque on the mandibular incisors, heavy rectangular stainless steel archwires (0.019 x 0.025-inch wires in an 0.022 inch slot size) when the Forsus device is inserted. The Forsus device is removed when an edge-to edge incisor relationship is achieved.

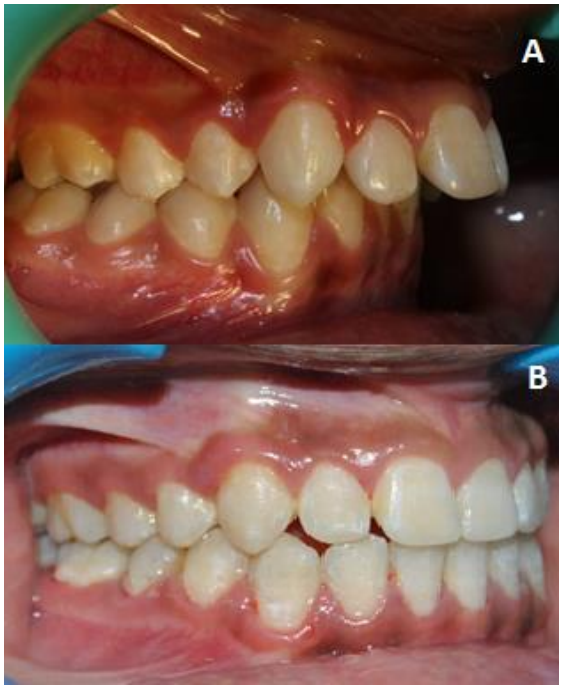

Figure 2: Pre (a) and Post (b) intraoral photographs taken as a part of routine record keeping

Subjects were included in this study if they met the following criteria: 1) ANB angle greater than or equal to 3 degrees; 2) Class II molar relationship; 3) treatment protocol that included the use of fixed orthodontic appliances, a Forsus device, and a limited duration (less than 6 months) of use of Class II elastics; 4) mild crowding in the lower arch based on pretreatment photographs 5) good-quality pretreatment (T1) and post-treatment (T2) cephalometric radiographs; 6) no other devices used to correct the Class II malocclusion; and 7) nonextraction treatment. Sixteen (8 males; 8 females) of treated subjects met the criteria. The untreated control group records consisted of 16 lateral cephalometric radiographs for each time point (pre- and post-treatment). The lateral cephalometric radiographs of control group were obtained from the longitudinal age estimation study using cervical vertebrae. The control subjects were matched (C1, C2) to the treatment group (T1, T2), based on the subjects' age and sex. All bilateral structures were bisected. The following measurements were used: mandibular incisor to mandibular plane angle; mandibular incisor to SN plane angle; mandibular length; ANB; SNA; SNB; angle of convexity; mandibular plane angle; and Y axis. The primary investigator manually traced, and collected the data of skeletal and dental measurements. To check for intra-examiner reliability, the cephalograms were retraced after a gap of two weeks by the same investigator. To check for inter examiner reliability the lateral cephalograms were traced by a senior faculty member of the same department. All measurements were recorded in Excel 2003 (Microsoft Corporation, Redmond, WA) and analyzed with SPSS version 16 (IBM, SPSS for Windows, Chicago, SPSS Inc.). Individual variables were assessed using the Shapiro-Wilk test for normality. The mean differences between pre- and post-treatment cephalometric radiographic measurements in the treatment group (T2 - T1) were compared with the mean differences in the matched control group (C2 - C1) using the Student's t test. The age range of the treatment group was between 11 and 14 years, with a mean of 12 +/- 1.18 years. The mean orthodontic treatment time was 22 +/- 5.40 months. The mean treatment duration using the Forsus device was 6 +/- 1.28 months, and the mean duration of Class II elastics use was 3.4 +/- 1.42 months.

RESULTS

The Pearson correlation was used to test intra- and interexaminer reliability. The correlation coefficient results were in the range of 0.96 to 0.99 for intra-examiner reliability and in the range of 0.92 to 0.98 for inter-examiner reliability. These findings show high positive correlations, which describe the reliability of the measurements. On comparison of the means of the pretreatment (T1) variables to those of the matched control group (C1), no statistically significant differences were found.

Skeletal changes: [Table 1]

The ANB angle decreased in both the treatment group and the control group (-1.78 +/- 1.05 degrees and -0.31 +/- 0.95 degrees, respectively), with the mean difference being statistically significant (-1.47 degrees; $P < 0.001$). The SNA angle was decreased in the treatment group (-0.70 +/- 1.42 degrees) and increased in the control group (+0.30 +/- 1.1 degrees), and the mean difference was statistically significant (-1.0 degrees; $P = 0.016$). Moreover, the angle of convexity was decreased in the treatment group (-3.88 +/- 2.50 degrees) and in

the control group (-1.30 +/- 2.16 degrees), and the mean difference was statistically significant (-2.58; P = 0.001).

Dental changes: [Table 2]

Inclination of mandibular incisors between the treatment and control group showed appreciable variation (+4.32 +/- 5.42 degrees vs. -1.28 +/- 3.74 degrees; P = 0.001). There was no statistically significant difference in angulation of maxillary incisors and anteroposterior and vertical positioning of maxillary first molars between the two groups.

Other parameters like changes in mandibular length, SNB angle, mandibular plane angle, and y axis were not statistically significant when comparing the two groups.

Table 1: Statistical comparison of the pre-treatment (T1) and post-treatment skeletal (T2) changes between the treatment and the control group.

Parameter	Forsus	Control	Difference	P Value
SNA°	-0.70 +/- 1.42	+0.30 +/- 1.1	1.0	<0.016*
SNB°	+1.20+/-1.22	+0.59 +/-0.93	+0.61	0.119
ANB°	-1.78 +/- 1.05	-0.31 +/- 0.95	-1.47	<0.001*
Angle of Convexity°	-3.88 +/- 2.50	-1.30 +/- 2.16	-2.58	<0.001*
MPA°	-0.44 +/-1.99	-1.50 +/-1.84	+1.06	0.076
Y Axis°	+0.38 +/-0.89	-0.33 +/-1.71	+0.71	0.133
Mand. Length (mm)	+4.67 +/-3.13	+4.29 +/-2.95	+0.38	0.684

Table 2: Statistical comparison of the pre-treatment (T1) and post-treatment (T2) dental changes between the treatment and the control group.

Parameter	Forsus	Control	Difference	P Value
L1 - MP°	+4.32 +/- 5.42.	-1.28 +/- 3.74	+5.6	<0.001*
U6 – X Axis°	+2.05 +/- 1.97	+1.67 +/- 1.40	+0.38	0.499
U6 – Y Axis°	-2.14 +/- 1.70	-2.15 +/- 1.70	+0.02	0.970
U1 -SN°	-0.40 +/- 6.65	-1.83 +/- 3.46	+1.43	0.412

DISCUSSION

The aim of the present study was to assess the dental, skeletal, and soft tissue changes produced by a fixed interarch appliance for Class II treatment, the FRD, within a comprehensive orthodontic treatment with preadjusted fixed appliances. Significant features of this study were the analysis of patients treated consecutively by a single operator, in conjunction with the use of an historical sample of untreated Class II controls at the same skeletal maturation phases as the treated subjects, for the evaluation of treatment effectiveness vs physiological growth in Class II malocclusion. Radiographic tracings and superimposition were done by a single investigator and the study addressed mandibular arch crowding, which has not been addressed in most studies exploring the treatment effects of the Forsus device. It also addressed using class II elastics after the removal of the Forsus device and before debonding, as it is a common practice to use it for retention because the Forsus device is commonly removed before the finishing and detailing stage is finalized.[6]

The most relevant skeletal changes occurred in the maxillary region, and they were confirmed by all the angular and linear measurements used in the present study. These changes revealed a significant effect of the FRD protocol in restraining sagittal growth of the maxilla. The maxillary changes accounted for significant improvements in maxillo-mandibular sagittal relationships in the form of improvement of ANB angle. Maintaining the pretreatment position and angulation of the mandibular incisors provides more stable results.[7] The changes at the dentoalveolar level showed a reverse pattern with respect to the skeletal changes. In fact, the upper incisor exhibited modest changes, while the mandibular dentition displayed highly significant modifications. The FRD protocol produced a large amount of mesial movement of the lower arch, with proclination of the lower incisors. This finding was comparable to results reported using the Forsus EZ2 module device (6.3°) and the Forsus fatigue-resistant device (5.2°).[8,9] The amount of proclination was slightly greater than results reported using the Forsus nitinol flat-spring (3.08°) or the splint-type Herbst device (3.85°) and was less than results reported Jasper jumper (7.9°),[5,10,11] or Forsus fatigue-resistant device (9.29°).[12] The present study found no significant maxillary molar intrusion or distal movement, which is comparable to results reported by Jones et al.[13] The present study showed a significant improvement in ANB angle, but on examination of the SNA and SNB angles independently, the mean differences were significant in the maxilla but not in the mandible. These findings are similar to results reported in a systematic review and a study by Aelbers, which reported statistically significant reductions in intermaxillary discrepancy using the Herbst appliance and headgear, respectively, for Class II correction.[10,14]

The outcomes reported in the current study refer to the end of comprehensive Class II treatment, without follow-up observation.

CONCLUSION

The FRD protocol led to a successful correction of Class II malocclusion by improving ANB angle. The protocol had a greater skeletal effect on the maxilla by restraining the sagittal advancement of the maxilla. The effects on the mandible were mainly at the dentoalveolar level, with a large amount of proclination of the lower incisors.

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