

Influence of two types of Functional Appliances on Lower Incisor Proclination: A Retrospective Cephalometric Study

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ABSTRACT

Background: To evaluate and compare the effect of Fixed Functional Appliance (Forsus FRD) and Removable Functional Appliance (Twin Block) on lower incisor proclination.

Materials & Methods: 12 Class II patients (7 boys, 5 girls. Mean age 15.75±1.8 years) treated with Forsus FRD (FFRD) were compared with 12 Class II patients (7 boys, 5 girls. Mean age 13±1.2 years) treated with Twin Block Appliance (TB). Cephalometric values of lower incisor inclination pretreatment (T1) and post-treatment (T2) were recorded & compared in each group with Paired *t*-tests & between the two groups with Independent sample *t*-tests

Results: In the FFRD group, the difference in T1 and T2 values was found to be statistically significant (Mean Difference - FFRD: L1-MP=-8.62°, L1-GoMe=-9.04°, L1-GoGn=-9°). In the TB group, the difference in T1 and T2 values was found to be statistically significant (Mean Difference - TB: L1-MP=-2.41°, L1-GoMe=-2.83°, L1-GoGn=-3.16°). In Inter-group comparisons, the FFRD group produced a significantly greater amount of lower incisor proclination with respect to the TB group (Mean difference - L1-MP=6.2°, L1-GoMe=6.2°, L1-GoGn=5.8°).

Conclusion: The Forsus FRD and the Twin Block appliance, both showed an increase in lower incisor proclination but it was significantly greater for the Forsus FRD group.

Keywords: Forsus Fatigue Resistant Device, Twin Block, Lower incisor proclination.

INTRODUCTION

Class II malocclusion, one of the most commonly observed problem in orthodontics, affects approximately one-third of the patients seeking orthodontic treatment. Patients with Class II malocclusions can exhibit maxillary protrusion, mandibular retrusion, or both, together with abnormal dental relationships and profile discrepancy. According to McNamara, mandibular

retrusion is the most common characteristic of this malocclusion.¹

One of the recommended therapeutic approaches to Class II malocclusion in growing patients is functional jaw orthopedics through the primary mechanism of mandibular advancement.² In patients with Class II malocclusions due to mandibular retrusion, removable and fixed

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functional appliances are used to stimulate the mandibular growth by forward positioning of the mandible.¹ Since its introduction by Clark, the Twin Block (TB) functional appliance has gained increasingly wide popularity among clinicians worldwide for the treatment of Class II malocclusion. By engaging upper and lower acrylic plates with interlocking bite-blocks, TB induces a favorable forward mandibular displacement upon closure.³ Significant proclination of lower incisors had been consistently reported by TB studies, further evaluated by a recent systematic review and meta-analysis.⁴

The Forsus Fatigue Resistant Device (3M Unitek Corp., Monrovia, Calif) is one of the various fixed functional devices commonly used by orthodontists. The appliance consists of a push rod that inserts into a telescoping cylinder and is attached to the mandibular arch wire distal to either the canine or first premolar bracket.⁵ However, dental changes proved to be more significant in the final results of this appliance than skeletal changes. These changes included mesial movement of the mandibular molars and proclination of the mandibular incisors, which in turn compromised the skeletal effects and could affect the long-term stability of the results.⁶

This complication of lower incisor proclination, generally acknowledged for functional appliances, is attributed to a protrusive effect on the lower incisors exerted by the lingual appliance components while the mandible attempts to rebound to normal resting posture.⁷

The purpose of this study was to evaluate and compare the effect of Fixed Functional Appliance (Forsus FRD) and Removable Functional Appliance (Twin Block) on lower incisor proclination.

MATERIALS AND METHODS

Sample Collection

This retrospective comparative study was carried out on 24 patients treated with either Forsus FRD (Fig.1) or Twin Block appliance (Fig.2) at the Department of Orthodontics and Dentofacial Orthopedics, CSMSS Dental College and Hospital, Aurangabad, Maharashtra. In this study 12 participants (7 boys, 5 girls. Mean age 15.75 ± 1.8 years) were treated with Forsus FRD (FFRD) and 12 participants (7 boys, 5 girls. Mean age 13 ± 1.2 years)

were treated with Twin Block Appliance (TB) (Table 1). Sex matching was done purposefully.



Fig 1: Forsus Fatigue Resistant Device



Fig 2: Twin Block Appliance

Table 1: Descriptive Statistics of the Groups (FFRD) and (TB).

Group	N	Mean Age	Std. Deviation
FFRD	12	15.75	1.815
TB	12	13.00	1.206

The inclusion criteria were as follows: Class II division 1 malocclusion with retrognathic mandible, pre-treatment ANB angle of 4° or more, pre-treatment overjet of 6-10 mm, and available pre-treatment (T1) and post-treatment (T2) cephalograms of adequate quality for accurate landmark identification. Exclusion criteria was pre-treatment Angle's Class I, Angle's Class II division 2 or Angle's Class III malocclusion. At an alpha level of 5% and power of 95%, it was calculated that 24 patients were required to detect a significant difference of 5° in lower incisor inclination angles.

Cephalometric Analysis

A number of skeletal and dental points were selected to determine lower incisor inclination (Fig. 3A). Lower incisor (L1) axis was constructed by a line connecting the incisal edge (L1i) and the root apex (L1a) of the most prominent lower incisor. Inclination of the long axes of lower incisors was estimated in relation to 3 different reference mandibular planes commonly used in cephalometrics (Fig. 3B): the tangent to the lower border of the mandible, the line drawn from Go to Me, and the line drawn from Go to Gn.⁸



Figure 3. Cephalometric landmarks (A) and mandibular reference planes (B) used in the study.

Statistical Analysis

Summary statistics (means, standard deviations) were calculated for all three variables. Paired *t*-tests were carried out to compare the change in incisor inclination (T1-T2) in each group and Independent sample *t*-tests were carried out to compare the change in incisor inclination (T2-T1) between groups. The significance level was set at 0.05. Statistical analysis was performed using SPSS for windows (v 22.0)

RESULTS

Lower incisor inclinations for T1 and T2 of both groups are summarized in Table 2.

Intra-Group Comparisons

In the Forsus FRD group the T1 and T2 values were compared and the difference was found to be statistically significant (Mean Difference - FFRD: L1-MP=-8.62°, L1-GoMe=-9.04°, L1-GoGn=-9°) [Table 3]. Thus a significant increase in lower incisor proclination was seen in Forsus FRD group.

In the Twin Block group the T1 and T2 values were compared and the difference was found to be statistically significant (Mean Difference - TB: L1-MP=-2.41°, L1-GoMe=-2.83°, L1-GoGn=-3.16°)[Table 4]. Thus a significant increase in lower incisor proclination was seen in Twin Block group.

Inter-Group Comparisons

Mean and SD of the Difference in pre-treatment and post-treatment values of lower incisor inclinations are summarized in Table 5.

Independent Sample *t*-test showed significant difference between the groups under the parameters L1-MP, L1-GoMe and L1-GoGn. (Table 6, Graph 1)

The Forsus FRD group produced a significantly greater amount of lower incisor proclination with respect to the Twin Block group. (Mean difference - L1-MP=6.2°, L1-GoMe=6.2°, L1-GoGn=5.8°)

DISCUSSION

A wide range of functional/orthopedic appliances are available for the correction of Class II skeletal and occlusal disharmonies, a type of malocclusion with a prevalence of 12-49% in different populations, with mandibular deficiency proved to be its most dominant component of this malocclusion.^{9,10} Among the different types of appliances, the Twin Block (TB) and the Forsus Fatigue Resistant Device are used often for the correction of Class II malocclusion. Proper positioning of lower incisors in the alveolar bone by use of orthodontics is essential to reach to a favorable anterior occlusal contacts. Increased incisor proclination and tooth movement out of the osseous envelope of the alveolar process may be associated with higher tendency for developing gingival recessions.¹¹ This is a retrospective cephalometric comparative study of the effect of these two commonly used appliances on lower incisor inclination. Significant differences were seen in the mean difference between T1 and T2 of all three parameters of lower incisor inclination between the two groups (Mean difference - L1-MP=6.2°, L1-GoMe=6.2°, L1-GoGn=5.8°). Thus a significantly greater increase in lower incisor proclination was seen in the Forsus FRD group with respect to the Twin Block group.

Many previous studies have reported an increase in lower incisor inclination with Forsus FRD^{2,12-16} and Twin Block appliance¹⁷⁻²⁴, but only a few studies have compared the effects of Forsus FRD and Twin Block, with each other. Tarvade et al²⁵, reported a statistically significant decrease in inclination of lower incisors with TB group (4.08°) and a significant increase with Forsus group (5.25°). The findings of this study are in accordance with Giuntini et al²⁶ who reported a significantly greater amount of mandibular incisor proclination in Forsus group with respect to either the TB or the control sample (2.9° and 5.6°, respectively). Similar finding to this study have been reported by Mahamad et al²⁷ & Hanoun et al²⁸ where a greater amount of proclination was found in the Forsus group.

Table 2: Lower Incisor Inclinations in FFRD and TB groups Before and After Treatment

Appliance	Sr. No.	Incisor Inclination					
		T1			T2		
		L1-MP	L1-GoMe	L1-GoGn	L1-MP	L1-GoMe	L1-GoGn
Forsus FRD (FFRD)	1.	109°	108°	112°	119°	120°	123°
	2.	118°	120°	122.5°	119°	123°	125°
	3.	91°	95°	98°	96.5°	100.5°	103°
	4.	102.5°	104°	108°	121°	121°	126°
	5.	99°	101°	104°	107°	110°	114°
	6.	89°	91°	95°	99°	100.5°	104.5°
	7.	86°	89°	93°	91°	94.5°	98.5°
	8.	93°	96°	99.5°	104°	106°	110°
	9.	98°	100°	103°	106°	109°	111°
	10.	93.5°	95°	99°	104°	105°	110°
	11.	110°	111°	115°	119°	121°	124°
	12.	98°	101°	104°	105°	109°	112°
Twin Block (TB)	1.	97°	98°	101°	102°	103°	106°
	2.	104°	108.5°	112°	104.5°	111°	115°
	3.	96°	95°	98.5°	94°	94°	97°
	4.	106°	108°	110°	112°	113°	116.5°
	5.	111°	113°	116°	106°	109°	113°
	6.	106.5°	107°	110°	110.5°	113.5°	116°
	7.	106°	108°	110°	107°	111°	114°
	8.	110°	113°	117°	109.5°	112°	115.5°
	9.	104.5°	107°	111°	112.5°	115°	118°
	10.	102.5°	104°	106°	107°	107°	110°
	11.	93.5°	93.5°	96°	96°	95°	99°
	12.	110°	109°	112°	115°	114.5°	117.5°

Table 3: Comparison between T1 & T2 values of Forsus FRD group

Difference between Pre - Post Values	Mean Difference	Std. Deviation	Std. Error Mean	t Value	df	P Value	Result
L1-MP	-8.625	4.211	1.216	-7.095	11	.000	Significant
L1-GoMe	-9.042	3.538	1.021	-8.852	11	.000	Significant
L1-GoGn	-9.000	3.873	1.118	-8.050	11	.000	Significant

Table 4: Comparison between T1 & T2 values of Twin Block group

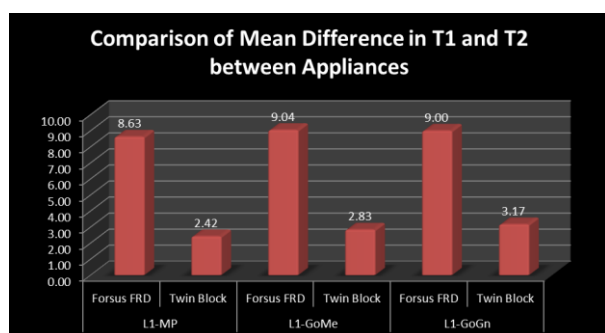
Difference between Pre - Post Values	Mean Difference	Std. Deviation	Std. Error Mean	t Value	df	P Value	Result
L1-MP	-2.417	3.728	1.076	-2.245	11	.046	Significant
L1-GoMe	-2.833	3.499	1.010	-2.805	11	.017	Significant
L1-GoGn	-3.167	3.380	.976	-3.245	11	.008	Significant

Table 5: Mean and SD of the Difference in T1 and T2 values.

Parameter	Appliance	Mean	Std. Deviation	Std. Error Mean
L1-MP	Forsus FRD	8.63	4.211	1.216
	Twin Block	2.42	3.728	1.076
L1-GoMe	Forsus FRD	9.04	3.538	1.021
	Twin Block	2.83	3.499	1.010
L1-GoGn	Forsus FRD	9.00	3.873	1.118
	Twin Block	3.17	3.380	.976

Table 6: Inter Group comparison of changes between T1 and T2.

Parameter	t-test for Equality of Means					Result
	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	
L1-MP	3.824	22	.001	6.208	1.624	Significant
L1-GoMe	4.322	22	.000	6.208	1.437	Significant
L1-GoGn	3.931	22	.001	5.833	1.484	Significant



Graph 1: Mean Difference between T1-T2 between appliances

CONCLUSION

This study compared the treatment effects of Forsus FRD and Twin Block appliance on lower incisor inclination. Both groups showed an increase in lower incisor proclination but it was significantly greater for the Forsus FRD group.

Thus the pre-treatment lower incisor proclination must be considered before choosing the type of appliance for the treatment of Class II malocclusion as the Forsus FRD tends to procline the lower incisors more than Twin Block.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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