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Original Article

Comparative evaluation of soft tissue changes one year post-treatment in Twin Block and FORSUS FRD treated patients

Lt Col Dinesh Chander Chaudhary^{a,*}, Col Prasanna Kumar^b,
Lt Col Mohit Sharma^c, Lt Col Karan Nehra^c

^a Clasified Specialist (Orthodontics), Army Dental Centre (R&R), Delhi Cantt, New Delhi 110010, India

^b Professor (Orthodontics), Department of Dental Surgery, Armed Forces Medical College, Pune 411040, India

^c Associate Professor (Orthodontics), Department of Dental Surgery, Armed Forces Medical College, Pune 411040, India

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ABSTRACT

Background: The objective of this study was to compare and evaluate the effects of two functional treatment modalities, namely, Twin Block (TB) and FORSUS fatigue resistant device (FORSUS FRD) on facial soft tissues before and at one-year post-treatment.

Methods: This was a retrospective cephalometric study involving 10 patients with skeletal class II abnormalities in each group. The mean age of patients was 12.5 ± 1.5 and 13.5 ± 1 years and treatment duration 20 ± 2 and 18 ± 2 months, respectively for TB and FORSUS FRD groups, respectively. The pre-treatment (T0) and one-year post-treatment cephalograms (T1) were compared for evaluation. Data were analysed using a paired t-test and independent sample t-test for within-group and between-group comparisons, respectively.

Results: The groups were compared at T0 and T1, and treatment/observation differences (T1 – T0) were evaluated with paired samples t-test at $P < 0.05$ level and unpaired sample t-test for group comparison. Statistically significant treatment changes were found for soft tissue changes in both TB and FORSUS FRD groups. Between the two groups, TB showed significant increase in the LAFH compared to the FORSUS FRD group.

Conclusion: Statistically significant soft tissue changes were observed after TB and FORSUS FRD appliance therapy, resulting in improvement of facial balance and aesthetics. Both, TB and FORSUS FRD, have similar effects on soft tissues, but the effect of TB on LAFH and that of FORSUS on mentolabial sulcus was more profound.

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* Corresponding author. Tel.: +91 8826217840.

E-mail address: drdinesh2424@yahoo.co.in (D.C. Chaudhary).

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Introduction

Class II malocclusion with a mandibular deficiency/maxillary prognathism or a combination of the two has been the focus of orthodontists' attention long before the inception of speciality. Various treatment modalities, such as growth modification with varied appliances or camouflage treatment, have been used to improve aesthetics and function, with existence of two well-known schools of thought. But, the efficacy of functional appliances no longer needs to be proved, be it for their skeletal, dentoalveolar or soft tissue effects, with enormous literature substantiating their advantageous use.^{1–6}

Aesthetic improvement continues to be the driving force in the majority of patients seeking orthodontic treatment,⁷ with functional benefit as a co-consequence. Straight profiles have been considered to be more aesthetic^{8–12} and thus functional appliance treatment revolves around the objective of attaining straighter profile with balanced facial proportions. The improvement in facial aesthetics occurs by a combination of skeletal and dental changes to varying degrees depending on the type of appliance. Different removable and fixed functional appliances are being used for the treatment of skeletal class II malocclusion in growing patients. The advantage of fixed functional appliances lay in their circumventing the patient compliance problem, usually associated with routinely used removable functional appliances.

The skeletal and dentoalveolar effects of functional appliances are almost always accepted by researchers;^{13–15} however, with regard to aesthetic improvement, evaluation of soft tissue profile alterations after treatment with functional appliances is of great importance. The ultimate test for treatment lies in its ability to bring about visible changes and its long-term stability in terms of aesthetics and function.

McDonagh¹³ et al. reported a change in pogonion position and improvements in lateral soft tissue profile after treating class II patients with the modified Twin Block (TB). With regard to evaluating lateral cephalograms after treating class II division 1 patients using the mini block and the modified TB, Gohilot¹⁶ et al. noticed that the modified TB had a greater effect on the facial soft tissue profile. Quintão¹⁵ et al. also reported total facial profile improvement, appropriate soft tissue pogonion and upper lip repositioning on evaluation of treated class II division 1 patients. A clinical study by Varlik¹⁷ et al. on class II division 1 patients using modified activator and modified TB appliances revealed noticeable changes in soft tissue within both groups. Baysal¹⁸ et al. evaluated the soft tissue effects of TB and Herbst appliance in patients with class II division 1 malocclusion with mandibular retrognathia.

The positive effects of TB on improvement of facial aesthetics have been widely studied and so is the Herbst. But the recent addition, FORSUS FRD; a hybrid appliance, to the armamentarium of the fixed functional appliances has not been extensively evaluated. So, the aim of this study was to compare the changes in the facial soft tissue profiles of patients treated with TB and FORSUS FRD in skeletal and dental class II patients based on pre-treatment and one-year post-treatment cephalometric records. One-year post-treatment comparison aimed at evaluating the worthwhile long-term stability of the results.

Methods and material

This retrospective cephalometric study was carried at a tertiary care dental centre. The pre-treatment (T1) and one-year post-treatment (T2) cephalograms of 10 patients, each in TB and FORSUS functional appliance groups, were evaluated for soft tissue profile changes.

The inclusion criteria were as follows:

- 1) Presence of a skeletal class II and Angle's class II division 1 or division 2 abnormality with ANB differential ranging 5–7 degrees.
- 2) Appropriate age and growth for treatment prior to/at peak of growth (based on cervical vertebra stage CVMI 3–4).
- 3) CVMI stage 3 patients with well-aligned arches were subjected to TB treatment while CVMI stage 4 patients and those in CVMI stage 3 but, in need of pre-functional orthodontics, were assigned to FORSUS FRD group.
- 4) No prior orthodontic treatment.

The mean age of patients was 12.5 ± 1.5 and 13.5 ± 1 years and treatment duration was 20 ± 2 and 18 ± 2 months, respectively for TB and FORSUS FRD group, respectively. The age and sex matching was ruled out due to limited sample size, and this study can be considered as a pilot study.

The profile measurements were taken as per Subtelney, Holdaway and McNamara's description. The parameters evaluated were: middle third of face height (N'-Sn), lower third facial height (Sn-Me'), soft tissue profile angle (N'-Sn-Pog'), Holdaway angle (NB-tangent to upper lip through Pog'), soft tissue chin thickness (horizontal distance between Pog-Pog'), nasolabial angle and mentolabial sulcus angle (Fig. 1). To determine the measurement error, 5 lateral cephalograms were randomly chosen, retraced and measured.

The tracing error was found to be $0.5 \text{ mm} \pm 0.1 \text{ mm}$ in line measurements and 0.25 ± 0.25 degrees in angle measurements. Data were analysed using SPSS (16.0 version). The paired t-test was used to compare alterations pre- and post-treatment, and the two groups were compared using an independent samples t-test.

Result

There was definite improvement in the soft tissue parameters in both groups leading to improved aesthetics. The TB group (Table 1) exhibited statistically significant ($P < 0.05$) changes in all the studied parameters, namely, middle 1/3rd of face height, soft tissue LAFH, soft tissue profile angle, Holdaway angle, nasolabial angle and mentolabial sulcus angle while FORSUS FRD group (Table 2) did not show significant change in soft tissue chin thickness and middle 1/3rd of face height between pre- and one-year post-treatment. The changes in the middle 1/3rd of face height in TB group were statistically significant but clinically insignificant due to small magnitude of change and may be associated with normal growth.

Inter-group comparison (Table 3) showed that improvements in TB group were more compared to FORSUS FRD group in all parameters but statistically significant difference was

Fig. 1 – Landmarks and measurements used. N – nasion, N' – soft tissue nasion, Sn – subnasale, Pog – pogonion, Pog' – soft tissue pogonion, Me' – soft tissue menton.

found in the improvement of LAFH. Although TB can be used to suit all kinds of patients, they can be substituted with FORSUS in patients with unreliable compliance and/or normal or mildly increased LAFH.

Discussion

TB and Herbst appliances are among the most popular functional appliances.¹⁹ Recent years have seen rapid increase in the use of hybrid fixed functional appliance, FORSUS Fatigue resistant device. Though the soft tissue effects of TB have been evaluated in detail, few studies have compared the soft tissue effects of TB with FORSUS. Thus, the aim of this retrospective

study was to evaluate and compare the soft tissue effects of these appliances.

One of the major concerns for functional appliance treatment is the treatment timing. Maximum treatment effects with functional appliances could be achieved when mandibular growth spurt was included in the treatment period.²⁰ Thus, the treatment of the sample in question was undertaken in the active growth phase to elicit maximum skeletal response for favourable soft tissue adaptation.

Arash et al.²¹ evaluated the soft tissue effects of modified activator and TB. They found significant alterations in both groups in terms of reduction of facial convexity ($P = 0.004$) and total anterior facial height (0.003 and 0.008, respectively for TB and Activator). The LAFH improvement was better in the TB

Table 1 – Comparison Twin Block group.

Parameter→	Height middle 1/3 face (mm)		LAFH (mm)		Soft tissue profile angle		Holdaway angle		Chin thickness (mm)		NL angle		Mentolabial sulcus angle	
Patient↓	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	54	54	54	58	156	163	18	10	11	10	109	126	95	120
2	55	56	45	52	148	152	25	17	9	9	104	102	67	110
3	50.5	52	58	61	151	158.5	20	14	9	10.5	100	102	96	86
4	58	61	55.5	63	151	154.5	22	19	8	7	117	121	104	113
5	54	55	45	51	161	166.5	13	11.5	13	13	92.5	90	75	76
6	52	54	51	56	155	160	22	15	8	10	92	108	123	117
7	52	54	45	51	154.5	156	16.5	12	9.5	6.5	110	120	75	107
8	50	54	48	54	155	162	19	12	12	12	90	99	95	114
9	54	54	43	46	143	153	19.5	16	8.5	10	124	117	74	107
10	51	52.5	45	50	156	162	17	12	10	10	85	92	74	95
Mean	53.05	54.65	48.95	54.2	153	158.75	19.2	13.85	9.8	9.8	102.35	107	87.8	104.5
SD	24.3	2.5	5.3	5.3	5	4.77	3.36	2.8	1.7	1.97	12.7	12.69	17.7	14.3
P value	0.003		0.000		0.000		0.000		1.000		0.005		0.015	

Table 2 – Comparison FORSUS FRD group.

Parameter→	Height middle 1/3 face (mm)		LAFH (mm)		Soft tissue profile angle		Holdaway angle		Chin thickness (mm)		NL angle		Mentolabial sulcus angle	
Patient↓	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	57	58	51	56	157	161	17	14	13	13	103	107	59	79
2	51	51	53	56	160	163	20	14	14	13	97	104	92	117
3	59	60	60	63	154	160	22	16	11	13	105	107	79	100
4	58	59	55	59	158	163	19	15	14	14	94	97.5	75	110
5	56	56	53	57	157	156	18	14	10.5	11	89	102	62	96
6	56	57	56	56	153	161	16	13	13	14	107	109	100	109
7	63	63	56	58	162	164	13	10	13.5	15	97	100	85	88
8	57	59	57	60	160	167	17	13	13	14	77	85	95	100
9	51	52	50	53	157	162	18	14	13	13	88	101	75	100
10	52	52	48	51	153	158	18	15	11.5	11	87	95	62	85
Mean	56	56.7	53.9	56.9	157.1	161.5	17.8	13.8	12.65	13.1	94.4	100.75	78.4	98.4
SD	3.8	3.9	3.6	3.4	3.07	3.1	2.4	1.6	1.22	1.29	9.35	7	14.5	11.9
P value	0.10		0.000		0.000		0.000		0.159		0.001		0.000	

group. Similar result was found in our study with statistically significant improvement in LAFH with TB. The results of FORSUS in our study were comparable to results of Activator group.

Gohilot et al.¹⁶ on comparing two fixed functional appliances, namely Herbst and FORSUS, found that there was favourable reduction in facial profile convexity, improving aesthetics in both groups.

Flores-Mir et al.²² in a systematic review on the soft tissue changes with fixed functional appliances in class II division 1 malocclusion stated that fixed functional appliances produce some significant statistical changes in the soft tissue profile. At the same time, they cautioned that the magnitude of the changes may not be perceived as clinically significant. But the present study, taking into account one-year post-treatment results, infers that significant soft tissue changes were maintained one-year post-treatment. But we also agree with Flores-Mir that most of these results are based on second level evidence and long-term controlled clinical trials are required. Also, there is a need for three-dimensional quantification of soft tissue changes.

Baysal et al.¹⁸ in the study of soft tissue changes with TB and Herbst found that there was highly significant ($P < 0.001$) changes in the angle of convexity, H-angle and mentolabial sulcus angle in both groups. Though significant H-angle

improvement existed, the post-treatment H angle values were not within the ideal range as stated by Holdaway (1983). In the present study also, the results were comparable to Baysal, though the fixed functional appliance varied. There was a marked decrease in the skeletal convexity, reduction in H-angle, improvement in LAFH, mentolabial sulcus and nasolabial angle. Similarly, although the H-angle decreased considerably, the values were not within the ideal range stated by Holdaway, proving that racial differences rule out the applicability of universal standards. The improvement in mentolabial sulcus was more in Herbst fixed functional group compared to TB.

The effects of two groups though were consistent in results their mechanism of action varied. In TB group, the effect was more due to growth modification and increased skeletal changes in the mandible while the effect in FORSUS group was more due to dentoalveolar changes in the maxillary and mandibular arches. The retrusive effect on the maxillary dentition was more in the FORSUS FRD group compared to TB group. This produced relatively more flattened upper lip, eliminated the lower lip trap and significantly improved the mentolabial sulcus.

According to these results, it may be concluded that TB therapy would result in greater advancement of mandibular soft tissues than FORSUS FRD group but the overall influence on facial profile may not have significant clinical variation owing to the certain differences in the mechanism of action of two appliances. The soft tissue changes though indirectly reflect the treatment effect on hard tissues, the co-relation may not be in direct proportion.

Conclusion

1. Statistically significant soft tissue changes were observed after TB and FORSUS FRD appliance therapy, resulting in improvement of facial balance and aesthetics.
2. Both, TB and FORSUS FRD, have similar effects on soft tissues but the effect of TB on LAFH and that of FORSUS on mentolabial sulcus was more profound.
3. Although TB can be used in most patients requiring functional jaw orthopaedics, FORSUS can be substituted

Table 3 – Comparison between groups.

Parameter	Twin Block ^a (mm)	FORSUS FRD ^a (mm)	P value ^b
Middle 1/3 face height	1.8	0.875	0.064
LAFH	5.27	3.125	0.003
Soft tissue profile angle	5.67	4.5	0.258
Holdaway angle	5.38	4.125	0.111
Chin thickness	0.2	0.625	0.426
NL angle	7.4	5.4	0.06
ML sulcus angle	19.428	20.5	0.625

^a Mean difference b/w pre- and one-year post-treatment.

^b Level of significance $P < 0.05$.

in uncooperative patients and/or in patients with normal to mildly increased LAFH.

4. The soft tissue changes though indirectly reflect the treatment effect on hard tissues, the co-relation may not be in direct proportion for TB and FORSUS FRD appliance.

Conflict of interest

The authors have none to declare.

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