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Comparison Of Soft Tissue Treatment Changes between Twin Force Bite Corrector and Forsus Fatigue Resistance Appliance

Research Article

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Abstract

Objective: The aim of this study was to compare the soft tissue changes after two fixed functional appliances Twin Force Bite Corrector and Forsus Fatigue Resistant Device treatment in patients with Class II division 1 malocclusion.
Materials and Methods: The sample consisted of 28 lateral cephalograms of 14 young adolescent patients, divided into two groups. Group 1 consisted of 7 patients treated with fixed functional appliances associated with fixed appliances, Twin Force Bite Corrector and initial mean overjet of 6.83 mm. Group 2 comprised 7 patients treated with fixed functional appliances associated with fixed appliances, Forsus Fatigue Resistant Device and initial mean overjet of 7.01 mm. t-Tests were used to compare treatment changes and the final cephalometric statuses between the groups.
Results: According to the results, there was no intergroup difference regarding the soft tissue changes.
Conclusion: Young adolescent patients treated with both the fixed functional appliances present similar soft tissue results. It is the clinician choice to select the appliance pertaining to the type of patient he is treating.
Clinical Significance: Since there is a paradigm shift of considering the soft tissue profile for orthodontic treatment planning, assessing the soft tissue changes is the new scope of research.

Keywords: Fixed Functional Appliance; Class II Malocclusion; Retrognathic Mandible; Soft Tissue Changes.

Introduction

In this contemporary society improvement in facial aesthetics has become an aspect of utmost importance. Facial aesthetics has also been recognized as one of the major motivations for seeking orthodontic treatment [1-4]. In order to pursue an excellence in facial aesthetic improvement, we are often faced with the need to predict soft tissue profile changes resulting from a variety of orthodontic appliances and techniques for the correction of the same type of malocclusion, especially concerning the differences between the treatment protocols [5]. This variety of options tends to cause concerns as to which treatment modality will provide the most improvement in the soft tissue profile.

Retrognathic profile is one of the characteristic features of class 2 division 1 patients. One of the goals of functional treatment is to achieve a straight profile. For correction of skeletal class II with retrognathic mandible either removable functional or fixed functional appliances can be used. Fixed functional appliances have the major advantage of not requiring patient compliance. They can be used along with the brackets. Their disadvantages are that they are difficult to clean and remove and are prone to breakage [6].

The Forsus Fatigue Resistant Device (3M Unitek Corp Monrovia, Calif) appliance consists of a push rod, that inserts into a telescoping cylinder [7, 8]. It is available in various sizes, hence a large inventory must be maintained, and chair side application time is increased as size selection is needed. There are numerous

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studies that have evaluated the effects of the Forsus [9-11] and compared it to intermaxillary elastics (Jones 2008) and untreated controls [10].

The Twin Force Bite Corrector (TFBC; Ortho Organizers Inc, Carlsbad, Calif) is a fixed, push-type intermaxillary appliance incorporating ball-and-socket joints, which permits a wide range of motion, lateral flexibility and full mandibular movement. There are studies and case reports which have evaluated the treatment effects of Twin Force Bite Corrector [12-16].

There are many previous studies which have evaluated the skeletal and dental effects of Twin Force Bite Corrector appliance and Forsus fatigue resistant device [11, 12, 17-19] but there are only a very few studies which have evaluated its effects on soft tissues. Previously our team had conducted numerous clinical trials [20] [21-25], *in vitro* studies [26-29], reviews [30-32] and case reports [33, 34] over the past few years. Now we are focusing on the paradigm shift in orthodontics and conducting studies.The aim of the study was to evaluate the changes in the facial soft tissues in skeletal class II patients with retrognathic mandible after treatment with the Twin Force Bite Corrector appliance and Forsus fatigue resistant device.

Materials and Methods

This study was approved by the institutional Ethical committee. A minimum sample size of 7 participants per group was proposed for 80% power at a significance level of 0.05 to demonstrate an inter-group post-treatment difference [35]. The sample was prospectively studied in the Department of Orthodontics and Dentofacial Orthopaedics, Saveetha Dental College, Chennai, Tamilnadu, India. The Initial lateral cephalograms of 14 patients with bilateral Class II molar relationship [36, 37] were divided into two groups. Additional selection criteria included no agenesis, supernumerary or lost teeth, maxillary arches without crowding, mandibular arches with slight or no crowding at pretreatment.

Group 1 consisted of 7 patients (3 boys, 4 girls) treated with Forsus Fatigue Resistant device associated with fixed appliances with initial and final mean ages of 12.71 and 15.16 years, respectively. The mean treatment time of fixed functional appliances was 0.72 years and the mean total treatment time was 2.44 years. This group had initial and final mean overjets of 6.57 and 2.28 mm, respectively. Four patients presented with complete bilateral Class II malocclusion and three patients presented with bilateral ¾ Class II malocclusion (Figure 1).

Group 2 consisted of 7 patients (1 boy, 7 girls) treated with Twin Force Bite Corrector appliances associated with fixed appliances with initial and final mean ages of 12.71 and 15.16 years, respectively. The mean treatment time of fixed functional appliances was 0.72 years and the mean total treatment time was 2.44 years. This group had initial and final mean overjets of 7.28 and 2.57 mm, respectively. Five patients presented with complete bilateral Class II malocclusion and two patients presented with bilateral ¾ Class II malocclusion (Figure 2 & 3).

The treatment sequence of the patients consisted of three treatment phases:

Phase 1: leveling and alignment of the maxillary and mandibular teeth ending with passive rectangular 19X25 stainless steel archwires.

Phase 2: placement of the fixed functional appliance that lasted until correction of the Class II anteroposterior discrepancy, with overcorrection of at least a quarter-cusp bilateral Class III molar relationship.

Phase 3: Active retention with the use of Class II intermaxillary elastics for 18 hours a day until the end of orthodontic treatment. The lateral cephalograms were obtained in centric occlusion, with the lips at rest. The initial and final lateral head films were digitally traced using FACAD software. (figure 1&2) Ten soft tissue variables were measured (Table 1). Skeletal maturity was assessed by using the cervical vertebral maturation (CVM) method [38].

Statistical Analysis

Normal distribution was tested and confirmed. t-Tests and Mann-Whitney test was used to compare the groups regarding the Class

Figure 1. Pre and Post functional extraoral profile photograph and lateral cephalogram of the patient usingForsus Fatigue Resistant Device (FFRD).

Figure 2. Pre and Post functional extraoral profile photograph and lateral cephalogram of the patient using Twin Force Bite Corrector (TFBC).

II malocclusion anteroposteriorocclusal severity and were also used to compare the initial and final cephalometric characteristics and the soft-tissue changes between the groups. Results were considered statistically significant at P < 0.05. These analyses were performed with SPSS Statistics software.

Results and Discussion

The results were compared regarding the pre and post treatment soft tissue changes of two groups. (figure 3) (Table 2, 3, 4 and 5). The results have shown that there is no statistically significant difference between the two groups. But when the results were compared within the groups, statistically significant results were found in H.NB angle in Forsus group ($p<0.05$). In the TFBC group, significant results were found in UL-E plane, UL-S Line, H-Pr and H.NB values.

Ideally, the sample should include only patients with full cusp Class II malocclusions. However, to have strictly comparable initial morphologic characteristics between the groups, it was necessary to include patients with bilateral ¾ cusp Class II malocclusions because both the appliance group did not have enough patients that presented with initial full cusp Class II malocclusions. But the overjet was similar to or greater than the previous studies of the soft tissue profile changes [35, 39, 40]. The use of two different types of fixed functional appliances in group 1 and group 2 should not interfere with the results, because regardless of the device, their overall mechanisms of action and general effects are similar [39, 41-46]. obviously, there are small differences in the effects of the appliances. [47] However, specific treatment effect comparisons with the different appliances were not the focus of this study. The focus was only to investigate whether non-extraction treatment with two different fixed functional appliances would produce different soft tissue changes.

The little difference in skeletal and dentoalveolar changes did not produce any significantly different soft tissue changes between the groups. These similar soft tissue changes would be expected [4, 35, 40, 48-51] because the changes in the anteroposterior apical base relationship and overjet were similar between the groups [40-51]. However, one could speculate the amount of soft tissue changes within the group is more statistically significant in Group 2 (TFBC). The amount of changes in the upper lip position is more in the TFBC group. The improvement of facial profile is combined with the upper lip retrusion but not with changes in the lower lip position. They state that both lips are supported by the upper incisors, thus significantly participating in the anteroposterior position of the upper lip in particular, while the lower incisors have no significant effect on the position of the lower lip. Similar results have been obtained in the previous study [52] examining the effects of the Herbst appliance in young adults with class II, division 1 malocclusion. Upper incisors retrusion, lower incisor protrusion and forward movement of the lower jaw affect overjet reduction. It is the most important consequence to the correction and straightening of the lower facial third soft tissue.

Changes produced by fixed functional appliances seem to restrict forward movement of the upper lip [53]. A relative surface reduction of the upper lip is the consequence of a number of factors. Most patients targeted for fixed functional appliance therapy have class II malocclusions, hence the reduction in the surface of the upper lip is caused by upper incisors, retrusion as well as maxillary growth inhibition. It also increases due to lower lip forward movement. In a study by Siqueira et al [54], Mandibular advance-

Figure 3. Graphical representation of the amount of soft tissue changes after the two different fixed functional appliance therapy (FFRD and TFBC).

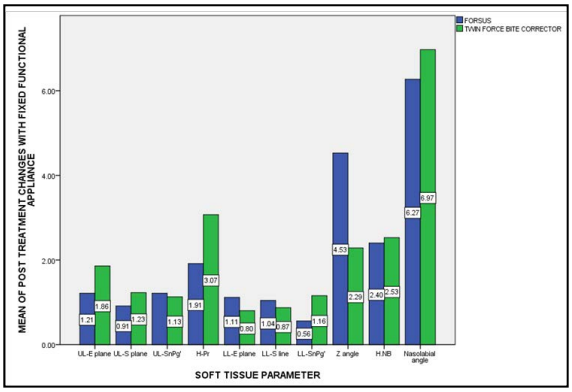

Table 1. Soft tissue cephalometric variables.

UL-E plane	Distance from the upper lip to the esthetic plane of Ricketts
UL-S Line	Distance from the upper lip to Steiner's S line (line from Pg' to Cl)
UL-SnPg'	Distance from the upper lip to the subnasale–soft tissue pogonion plane (line from Sn to Pg')
H-Pr	Distance between H line and the most anterior point on the nose
LL-E plane	Distance from the lower lip to the esthetic plane of Ricketts (line from Pg' to Pr)
LL- S Line	Distance from the lower lip to Steiner's S line
LL- SnPg'	Distance from the lower lip to the subnasale–soft tissue pogonion plane
Z angle	Angle formed by the intersection of Frankfort horizontal plane and a line connecting the soft tissue chin (Pg') and the most protrusive lip point
H.NB	H line (tangent to Pg' and UL) to NB line angle
Nasolabial angle	Cl.Sn.UL angle

Table 2. Comparison of cephalometric variables at pre-treatment (t-Test and Mann whitney test).

SOFT TISSUE VARIABLES	UNIT	GROUP 1 (FORSUS)		GROUP 2 (TFBC)		p VALUE
		MEAN	SD	MEAN	SD	
UL-E plane	mm	1.68	1.74	0.57	2.95	0.383
UL-S Line	mm	0.61	1.38	0.57	2.19	0.318
UL-SnPg'	mm	-5.043	1.06	-5.45	1.6	0.71
H-Pr	mm	-2.77	2.85	-1.02	4.81	0.383
LL-E plane	mm	-0.47	3.22	-0.58	2.83	0.805
LL- S Line	mm	-0.91	3.08	-1.05	2.5	1
LL- SnPg'	mm	-3.11	2.65	-3.05	1.61	1
Z angle	°	107.27	6.21	109	5.9	0.62
H.NB	°	13.92	4.24	13.01	5.01	0.535
Nasolabial angle	°	104.27	10.29	95.88	10.31	0.097

*Statistically significant at P < 0.05.

Table 3. Comparison of cephalometric variables of pre and post treatment using FORSUS appliance (t-Test and Wilcoxon signed rank test).

SOFT TISSUE VARIABLES	UNIT	PRE-TREATMENT		POST-TREATMENT		p VALUE
		MEAN	SD	MEAN	SD	
UL-E plane	mm	1.68	1.74	2.87	1.51	0.063*
UL-S Line	mm	0.61	1.38	1.73	1.19	0.075*
UL-SnPg'	mm	-5.04	1.06	-3.11	2.65	0.128*
H-Pr	mm	-2.77	2.85	-4.68	2.5	0.063*
LL-E plane	mm	-0.47	3.22	-0.53	2.2	0.496*
LL- S Line	mm	-0.91	3.08	-1.04	2.04	0.612*
LL- SnPg'	mm	-3.11	2.65	-3.5	1.84	0.917*
Z angle	°	107.27	6.21	106.71	6.91	0.236*
H.NB	°	13.92	4.24	11.52	4.74	0.018**
Nasolabial angle	°	104.27	10.29	101.6	8.99	0.310*

*P < 0.05- Statistically not significant.
**P > 0.05- Statistically significant.

Table 4. Comparison of cephalometric variables of pre and post treatment using TFBC (Tw in Force Bite Corrector) appliance (t-Test and Wilcoxon signed rank test).

SOFT TISSUE VARIABLES	UNIT	PRE-TREATMENT		POST- TREATMENT		p VALUE
		MEAN	SD	MEAN	SD	
UL-E plane	mm	0.57	2.95	2.57	3.26	0.018*
UL-S Line	mm	-0.57	2.19	0.8	2.94	0.018*
UL-SnPg'	mm	-5.45	1.6	-3.05	1.61	0.206**
H-Pr	mm	-1.02	4.81	-4.32	5.48	0.018*
LL-E plane	mm	-0.58	2.83	-0.73	2.75	0.735**
LL- S Line	mm	-1.05	2.5	-1.47	2.54	0.308**
LL- SnPg'	mm	-3.05	1.61	-3.84	1.93	0.128**
Z angle	°	109	5.9	107.28	5.38	0.310**
H.NB	°	13.01	5.01	10.57	6.07	0.028*
Nasolabial angle	°	95.88	10.31	101.4	12.13	0.176**

*P < 0.05- Statistically significant.
**P > 0.05- Statistically not significant.

Table 5. Comparison of cephalometric variables of amount of changes during the treatment using FFRD (Forsus Fatigue Resistant Device) and TFBC (Twin Force Bite Corrector) appliance (Mann Whitney Test).

SOFT TISSUE VARIABLES	UNIT	FFRD		TFBC		p VALUE
		MEAN	SD	MEAN	SD	
UL-E plane	mm	1.2	0.79	1.85	1.05	0.250*
UL-S Line	mm	0.91	0.95	1.22	1.13	0.850*
UL-SnPg'	mm	1.21	0.92	1.12	1.03	1.000*
H-Pr	mm	1.91	1.36	3.07	1.73	0.209*
LL-E plane	mm	1.11	1.04	0.8	0.49	0.620*
LL- S Line	mm	1.04	1.15	0.87	0.5	0.620*
LL- SnPg'	mm	0.55	0.49	1.15	0.53	0.053*
Z angle	°	4.52	4.25	2.28	2.77	0.165*
H.NB	°	2.4	1.43	2.52	1.63	0.710*
Nasolabial angle	°	6.27	3.81	6.97	7.27	0.805*

*P < 0.05- Statistically significant.
**P > 0.05- Statistically not significant.

ment by the mandibular protraction appliance (MPA) produces satisfactory results by reducing facial convexity. The treatment effect of this appliance is the correction of malocclusion through mesial displacement of the first mandibular molars, with the consequent protrusion of the lower lip. The lower lip also moves forward because of lower lip position changes.

Similar soft tissue results had also been demonstrated in the comparison of Class II non-extraction treatment primarily by distalizing the maxillary teeth with two-maxillary premolar extractions [35, 40]. The results of this study differ from a previous study [39], that found some differences when comparing soft tissue changes in Class II malocclusion patients treated with the Forsus appliance versus two-maxillary premolar extractions and retraction of the anterior teeth using temporary anchorage devices. However, the mentioned study [39] only evaluated the patients during 14 months, from the insertion of the Forsus appliance or beginning of en masse retractions until removal of the Forsus appliance or completion of en masse retraction. The different results observed could be consequent to the use of temporary anchorage devices and to the smaller observation period of their study.

Skeletal, dental and soft-tissue changes induced by the Jasper Jumper appliance in late adolescence, that uses the E line as a reference line, were not found to produce significant antero-posterior changes of the upper lip [55]. However, statistically significant protrusion of the lower lip was noted which is contrary to the findings observed in the current study.

The results of this study helps in the decision for one of these protocols, considering other variables than changes in the soft tissue profile. Therefore, the decision between Class II malocclusion treatment with Forsus Fatigue Resistant Device or Twin Force Bite Corrector should be based on variables such as patient compliance, mandibular incisors tipping at pre-treatment, cost-benefit ratio, and orthodontist and patient treatment preferences.

Limitations

Despite the inclusion of some patients with initial ¾ Class II molar relationship , it did not interfere with the results because the overjet was similar in the groups, it would be ideal to include only patients with complete Class II molar relation . Further studies with ideal sample compositions are necessary to confirm the current results.

Acknowledgement and Declarations

Saveetha Dental College and hospitals for the support in doing the research.

Conclusion

Soft tissue changes of Class II division 1 malocclusion treated with both the fixed functional appliances associated with fixed appliances are similar in all the patients.It is the clinician choice to select the appliance pertaining to the type of patient he is treating.

Clinical Significance

Since there is a paradigm shift of considering the soft tissue profile for orthodontic treatment planning, assessing the soft tissue changes is the new scope of research.Along with these parameters, the chin throat angle should also be taken into consideration to consider the soft tissue changes during treatment plan.

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