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Marwa El-shaarawy
Dentist at Ministry of Health, Egypt, marwaelshaarawy@azhar.edu.eg

Ahmed Salama
Professor and Head of Orthodontic Department, Faculty of Dental Medicine for Girls, Al-Azhar University, Cairo, Egypt, drsalama007@gmail.com

Fatma Abd El-Samad
Professor of Orthodontic, Faculty of Dental Medicine for Girls, Al-Azhar University, Cairo, Egypt, fatmaaziz2004@gmail.com

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Assessment of the Treatment Outcomes of Skeletal Class III Malocclusion Using Forsus Fatigue Resistant Device Versus Intermaxillary Elastics

Marwa A. El-shaarawy[1*], Ahmed E. Salama[2], Fatma A. Abd el-Samad[3]

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azhardentj@azhar.edu.eg

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ABSTRACT

Purpose: This research aimed to evaluate the effect of treatment with Forsus Fatigue Resistant Device (FFRD) and traditional Class III elastics in treating class III malocclusion. **Patients and Methods:** The present study was applied to twenty female patients divided into two groups equally and randomly with age ranged from 14 to 16 years old, Group I treated with inverted FFRD which was attached to the mandibular first molar extra-oral tube and distal to the bracket of the maxillary canine and conventional class III elastics used in Group II. **Results:** Significant increase revealed in ANB angle in both groups while, there was significant decrease in S-A distance in FFRD group while, in relation to vertical skeletal measurement SN to mandibular plane angle (SN-MP) there was significant decrease in FFRD group and significant increase in intermaxillary elastic group. There was also significant proclination in maxillary anterior teeth and significant retroclination of the mandibular one. **Conclusions:** In class III malocclusion the use of inverted FFRD and elastics is successful treatment method to improve the maxilla-mandibular relationship by improving anteroposterior relationship (ANB angle). The FFRD is suggested in uncooperative patients as it did not require patient cooperation as class III elastics.

KEYWORDS

Class III, FFRD, Intermaxillary Elastics.

INTRODUCTION

One of the most well-known malocclusion is skeletal Class III malocclusion. As a result of its multifactorial etiology; skeletal class III malocclusion is a challenging problem for orthodontists to manage[(1)]. The severity of class III malocclusions increases till final growth is

1. Paper extracted from Master Thesis titled "Assessment of the Treatment Outcomes of Skeletal Class III Malocclusion Using Forsus Fatigue Resistant Device Versus Intermaxillary Elastics".

2. Dentist at Ministry of Health, Egypt.
3. Professor and Head of Orthodontic Department, Faculty of Dental Medicine for Girls, Al-Azhar University, Cairo, Egypt
4. Professor of Orthodontic, Faculty of Dental Medicine for Girls, Al-Azhar University, Cairo, Egypt

* Corresponding author email: marwaelshaarawy@hotmail.com

finished; as it is a discrepancy that is usually related to growth. Facial changes can influence a patient's self-confidence and interpersonal relationships [2]. Within different races and geographic regions the prevalence of Angle class III malocclusion differ greatly [3].

Class III malocclusions are of three types: 1. Dental: maxillary or mandibular incisors incorrect position or inclination, 2. Pseudo: the mandible is moved forward to obtain maximum intercuspation as a result of premature dental contacts. 3. Skeletal: maxillary or mandibular discrepancies or combination [4].

Class III malocclusion etiology may be due to each of the following: 1. Genetic causes: Hapsburg royal family is the most popular example of inheritance. A prognathic mandibular jaw and hence a class III malocclusion is the prominent criteria of this family. Thirty three of the forty person from the family with their records available presented with prognathic mandible and as a result a class III malocclusion. 2. Environmental causes: development of class III malocclusion was contributed by different environmental causes. Those factors including enlarged tonsils, the ectopic eruption of the upper central incisor, nasal breathing with difficulty, congenital anatomic defects, the pituitary gland diseases (as in acromegaly) and protruding the mandible as a result of large tongue size or respiratory problems, which may result development of class III[5].

In early life skeletal class III malocclusion expresses itself, maxillary constriction is often associated with it and is not a self-correcting disharmony. It has been found that it is better to make intervention early in deciduous dentition, or pre-pubertal growth [4]. Growing patient with class III malocclusion treatment include growth modification, in non-growing patients orthognathic surgery or camouflage treatment [6]. Treatment options for growing patients with class III malocclusion include removable functional appliance which may be Intra-oral like bionator III or frankel III or Extra-oral like face mask, chin cap or reversed headgear [7-9].

In a trial to influence and permanently change the surrounding hard tissues, a functional appliance is a device that interfere with a patient's functional environment [8]. Fixed Functional Appliance has some benefits over the removable one. Removable functional appliances are difficult as a result of their large size and poor stability in the mouth and patient adaptation. So, to eliminate the problems of removable functional appliance, fixed functional appliances have been introduced by Emil Herbst as class II correctors [10,11].

Forsus Fatigue Resistant Device (FFRD) is a three piece telescoping system that was first introduced by Bill Vogt in 2006 by the help of 3M Unitek [12]. Patient tolerance was highly accepted to FFRD, although it causes wasting of precious time specifically in cases with minimal remaining amount of growth as, it needs finished levelling and alignment stage [13].

A recent study used inverted FFRD anchored to miniscrew for correction of class III and found that inverted FFRD increased forward maxillary growth with no significant increase in maxillary anterior teeth proclination, mandibular teeth distalization, maxillary incisors, mandibular molar intrusion and esthetic facial profile improvement as a result of upper lip protrusion and retrusion of lower one[14].

Class III elastics is a conventional treatment option of camouflaging class III malocclusion. Previous study found that the effect of the class III elastic resulted in occlusal plane angle and interincisal angle significant reduction, proclination of maxillary and mandibular incisors, mandibular molars distal tipping, mandibular incisors extrusion and also extrusion of the maxillary molars, ANB angle, mandibular plane angle, y-axis angle, and overjet increased[15].

The purpose of the research was to evaluate the different treatment results between FFRD and conventional class III elastics in class III malocclusion treatment.

MATERIAL AND METHODS

The present study was done on 20 female patients aged 14-16 years old. These participants were selected from those coming to the Orthodontic clinic, Faculty of Dental Medicine for Girls, Al Azhar University. This study obtained the approval from the committee of ethics at the Faculty Dental Medicine of Al-Azhar University, Cairo, Egypt (REC-OR-17-103).

The benefits and nature of the inclusion in the study were explained to participants and their parents, the signature were obtained on the consents before any further procedures. The inclusion criteria: Molar relationship of Angle class III, skeletal class III from mild to moderate, patient age ranged from 14 years old to 16 years old, no history of previous orthodontic treatment, no craniofacial deformity in the craniofacial area, no systemic disease that may affect bone, good oral hygiene, high motivation and cooperation and no medication affect rate of tooth movement i.e Ibuprofin.

The study groups: This study consisted of twenty female patients ten in each group, the first group treated with FFRD and the second control (conventional treatment) group with conventional class III elastics with age ranged from 14 to 16 years old. Transpalatal arch (TPA) was fabricated and cemented on the first maxillary molar and that was to counteract the buccal forces. Lingual arch (LA) was fabricated and cemented on the first mandibular molars to minimize buccal tipping of the mandibular molars due to buccally applied forces from the FFRD on these molars and also restrict expansion of the arch and lateral movement of the molars. Mini 2000 bracket (Ormco Cooperation) with 0.022 ×0.028 slot was bonded. All patient were subjected to levelling and alignment until 0.019×0.025 Stainless steel wire was passively engaged in both arches and pattern of figure eight were ligated and the wire is cinched back.

For the FFRD group, measure the distance from the distal margin of the maxillary canine bracket to the distal margin of the mandibular headgear tube with the Forsus ruler to select the ideal size of the push rod, then the FFRD (EZ module) was engaged to the mandibular first molar in a reversed manner. The selected push rod was crimped distal to the maxillary canine bracket around the maxillary arch wire. The patient was instructed to open his mouth widely, compress the spring and insert the rod as shown in (Fig. 1).

Figure (1) Intraoral view of FFRD in class III

The patients were evaluated every 2 weeks. Reactivation may be needed, to obtain 1.5 mm of activation a crimp was compressed on the push rod after compressing the spring by 2.5 mm above the push rod stopper. After class I molar and canine relation and normal overjet were achieved the appliance was removed, then the occlusion was finalized with intermaxillary elastics. The force delivered by FFRD nearly about 200 grams and about 184 grams for 6.5 oz force [16,17]

For the control (conventional treatment) group, the same steps but class III elastics was used instead of FFRD with ¼-in size (Wildlife elastics; American Orthodontics, Wisconsin, USA). After the patient had an edge to edge occlusion, the elastics were changed to 3/16 in size elastics.

Skeletal and dental changes were evaluated from the lateral cephalograms taken with the same cephalostat by the same technician just before insertion and immediately after removal of the FFRD, for the control (conventional treatment) group the cephalometry was taken with the same time intervals which was about 5 months.

RESULTS

The results of the skeletal measurements are shown in the following Tables**:**

Table (1): *Mean, standard deviation values and results of repeated measures ANOVA test for the changes in SNA° within each group*

Group	Pre-treatment		Post-treatment		*P*-value	*Effect size (Partial Eta Squared)*
	Mean	SD	Mean	SD		
Group I	80.78	3.16	82.32	3.91	0.085	0.156
Group II	77.85	5.52	79.22	4.84	0.062	0.180

**: Significant at P ≤ 0.05*

Table (2) *Mean, standard deviation values and results of repeated measures ANOVA test for the changes in S-A and N-ANS (mm) within each group*

Measurements	Group	Pre-treatment		Post-treatment		P-value	Effect size (Partial Eta Squared)
		Mean	SD	Mean	SD		
S-A (mm)	Group I	75.55	9.83	69.2	12.51	0.027*	0.243
	Group II	67.48	6.74	65.96	8.17	0.571	0.018
N-ANS (mm)	Group I	48.41	5.11	44.69	7.51	0.356	0.048
	Group II	49.86	13.68	41.69	4.77	0.052	0.194

**Significant level p≤ 0.05*

Table (3): *Mean, standard deviation values and results of repeated measures ANOVA test for the changes in SNB° and SN-MP° within each group*

Measurements	Group	Pre-treatment		Post-treatment		P-value	Effect size (Partial Eta Squared)
		Mean	SD	Mean	SD		
SNB (°)	Group I	81.82	3.83	81.7	4.23	0.835	0.002
	Group II	80.99	3.99	80.03	3.26	0.121	0.128
SN-MP (°)	Group I	36.3	5.2	35.13	5.9	0.040*	0.214
	Group II	34.91	6.31	36.13	5.96	0.034*	0.227

**: Significant at P ≤ 0.05*

Table (4): *Median, range values and results of Wilcoxon signed-rank test for the changes in ANB° within each group*

Group	Pre-treatment		Post-treatment		*P*-value	*Effect size (d)*
	Median	Range	Median	Range		
Group I	-0.45	-4.64 – 3.85	0.38	-3.5 – 3.96	0.007*	3.285
Group II	-3.34	-8.45 – 1.12	-1.33	-3.62 – 3.42	0.005*	3.829

**: Significant at P ≤ 0.05*

The result of dental measurements are shown in Table (5,6).

Table (5): *Median, range values and results of Wilcoxon signed-rank test for the changes in overjet (mm) within each group*

Group	Pre-treatment		Post-treatment		*P*-value	*Effect size (d)*
	Median	Range	Median	Range		
Group I	-1.65	-3.84 – 1.58	3.16	1.69 – 4.99	0.005*	3.829
Group II	-2.49	-5.84 – 0.5	3.05	2.14 – 4.77	0.005*	3.829

**: Significant at P ≤ 0.05*

Table (6): *Mean, standard deviation values and results of repeated measures ANOVA test for the changes in U1-SN°, U1-NA°, Interincisal angle, IMPA and L1-NB° within each group*

Measurements	Group	Pre-treatment		Post-treatment		P-value	Effect size (Partial Eta Squared)
		Mean	SD	Mean	SD		
U1-SN (°)	Group I	109.8	5.69	116.59	4.42	0.002*	0.419
	Group II	107.15	6.89	112.76	6.38	0.008*	0.329
IMPA (°)	Group I	91.45	7.39	87.85	5.93	0.005*	0.368
	Group II	89.41	5.81	85.22	4.21	0.001*	0.442

**: Significant at P ≤ 0.05*

DISCUSSION

Class III malocclusion is one of the most difficult malocclusion to treat, among the most commonly used methods is conventional class III elastics which require a high patient cooperation thus introduction of class III treatment option by fixed functional appliance to overcome the need for the patient compliance is a new treatment modality. The fixed functional appliance like FFRD usually used for correction of class II malocclusion and researches proved its efficacy in treating this type of malocclusion, there was only a research on a typodont to understand the biomechanical aspect of inverted FFRD to use it in treatment of class III malocclusion [17]. So, the present study used an inverted FFRD in a true clinical trial to prove whether it was effective or not in correcting class III malocclusion and to overcome the need for the patient cooperation and compare it with the conventional class III intermaxillary elastics to investigate their effect on skeletal and dental structures in class III patients.

The present study showed that in both treatment groups there was no significant increase in SNA angle after treatment which not in agree with previous study [14] that proved significant forward movement of maxilla. While S-A distance showed significant decrease which indicates upward and backward movement of the maxilla which occurred as a result of vertically directed force of FFRD.

The present study showed that the relation of mandible to cranial base not significantly decreased in both treated group after treatment which agree with previous studies [14,15,17] this mean that both treatment strategies has no effect on anteroposterior position of the mandible.

In relation to ANB angle showed significant increase in both groups after treatment which agree with other studies [14,15,17] which was due to upward and back ward rotation of the maxilla in FFRD group and clockwise rotation of the mandibular plane in elastic group.

While, SN-MP angle showed significant decrease (anti-clockwise rotation of the mandible) after treatment in FFRD (Group I) this was due to backward and downward directed force of FFRD in posterior region and this agree with previous study [17] and not agree with other study [14]. While, in Group II (intermaxillary elastics) there was significant increase in SN-MP angle (clockwise rotation of the mandible) and this in in agree with the study [15].

The present study showed that there was significant increase (proclination) in U1-SN angle in both groups after treatment due to upward directed force in FFRD group and mesial directed force in elastic group which agree with other studies [14,15,17]. When talking about the mandibular dental measurements; the present study found that the IMPA showed significant decrease in both treatment groups and L1-NB angle showed significant decrease in group I which mean mandibular incisors retroclination, this agree with previous studies [14,15] which occur as a result of distally directed force of FFRD and intermaxillary elastics.

CONCLUSION

Within the limitations and findings of the present study, it could be concluded that FFRD and class III elastics are effective in treatment of class III malocclusion improving maxilla-mandibular relationship. FFRD is indicated in patients with increased lower anterior facial height, while intermaxillary class III is indicated in patients with decreased lower anterior face height. Class I molar and canine relation and overjet correction could be achieved by both treatment strategies. FFRD suggested in uncooperative patients.

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RECOMMENDATIONS

1. It is recommended to make further studies on younger age in mixed dentition to see the orthopedic effect of FFRD.
2. Further studies needed to see the effect on temporomandibular joint.

Conflict of Interest

No conflict of interest was found in this study.

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REFERENCES

1. Proffit WR, Fields HW, Larson B, Sarver D. Contemporary Orthodontics-e-Book. 6th ed.; 2018.
2. Kondo E. and Aoba TJ. Nonsurgical and nonextraction treatment of skeletal Class III open bite: its long-term stability. Am J Orthod Dentofacial Orthop 2000;117:267-87.
3. Hashim H.A. Nonsurgical Treatment Approach of Class III Malocclusion: Case Report. Adv Dent & Oral Health 2020;12: 178-84.
4. Zere E, Chaudhar P.K, Sharan J, Dhingra K. and Tiwari K. Developing Class III malocclusions: challenges and solutions. Clinical, Cosmetic and Investigational Dentistry, 2018;10: 99–116.
5. Jaradat M. An Overview of Class III Malocclusion (Prevalence, Etiology and Management). JAMMR. 2018; 25:1-13.

6. Vanlaecken R, Williams M.O, Razmus T, Gunel E, Martin C, and Ngan P. Class III correction using an inter-arch spring-loaded module. Progress in Orthodontics.2014; 15:1-11.

7. Mandall N. et al. Early class III protraction facemask treatment reduces the need for orthognathic surgery: amulti-centre, two-arm parallel randomized, controlled trial. Journal of Orthodontics, 2016; 43:164-75.

8. Shahid F, Alam M.K, Irshad M, Rayan Alswilem R. and Kiran Ganji k. Forsus Fatigue Resistant Device a Fixed Functional Appliances: An Update. International Medical Journal. 2017; 24: 132 – 35.

9. Azamian Z, Shirban F. Treatment options for Class III malocclusion in growing patients with emphasis on maxillary protraction. Scientifica (Cairo) 2016; 2016:1–9.

10. Akan B. Veli I. Evaluation of soft-tissue changes in young adults treated with the Forsus fatigue-resistant device. Am J Orthod Dentofacial Orthop. 2020;157:481-9.

11. Arvind TR. and Jain R.K Skeletally anchored forsus fatigue resistant device for correction of Class II malocclusions—A systematic review and meta-analysis. Orthod Craniofac Res. 2020; 1: 52-61.

12. Prateek S, Sandhya J. Fixed functional appliances–An overview. Int J Curr Res. 2017; 9:47407-14.

13. Elkordy S, Abdeldayem R, Fayed M, Negm I, El Ghoul D. and Abouelezz A. Evaluation of the splint-supported Forsus Fatigue Resistant Device in skeletal Class II growing subjects. Angle Orthod. 2021;91:9–21.

14. Eissa O, ElShennawy M, Gaballah S, ElMehy GH. and El-Bialy T. Treatment of Class III malocclusion using mini-screw-anchored inverted Forsus FRD:Controlled clinical trial. Angle Orthod. 2018; 88: 692-701.

15. Nakamura M, Kawanabi N, Kataoka T, Murakami T, Yamashiro T. and Kamioka H. Comparative evaluation of treatment outcomes between temporary anchorage devices and Class III elastics in Class III malocclusions. Am J Orthod Dentofacial Orthop 2017;151:1116-24.

16. Rafighi A, Sohrabi A, Moslemzadeh SH, Mardani Z. Assessing Pain and Cooperation Levels of Orthodontic Patients Treated with Medium and Heavy Intermaxillary Elastics: a Randomized Clinical Trial. Archives of Pharmacy Practice. 2019 ;1:1:19.

17. El-Sheikh M, Godfrey K, Manosudprasit M. and Wiwattanateepa N. An inverted forsus for class III treatment: A pilot typodont study. 2003; 1: 19-24.