Original Article

Maxillary Arch Effects Of Fixed Functional Appliances In Correction Of Class II Malocclusion: A Prospective Comparative Clinical Study

Mostafa Mohamed Mahmoud Dawaba[1*], Wesameldin Rafaat Ali Gouda[1], El-Hassanein Hussein ElHassanein[2], Hussein Shokry Hassan Ahmed[1], Mostafa Magdy Abd Elmonem[1]

1. Lecturer, Department of Orthodontics, Faculty of Dental Medicine, Al-Azhar University, Assiut, Egypt.
2. Lecturer, Department of Orthodontics, Faculty of Dental Medicine, Al-Azhar university, Cairo, Egypt.

DOI: 10.47750/pnr.2022.13.S05.441

Abstract

The Objective of this study was to compare skeletal and dental effects produced by two fixed functional appliances (Forsus Fatigue Resistance and Advancesync II) in patients with class II malocclusion. This study was conducted on 30 orthodontic patients with an age range from 14- to 16-year-old who were collected from the outpatient clinic at Orthodontic Department, Faculty of Dental Medicine, Al-Azhar University, Assiut, Egypt. They were randomly divided into 2 equal groups; each consisted of 15 patients, Group 1: Forsus appliance group. Group 2: Advancsync II group. The results showed non statistically significant differences between the two groups. Consequently, non-statistically significant differences were found in dentoalveolar parameters and skeletal parameters.

Key words: Fixed functional appliances, Forsus, Advancsync II, Class 2 malocclusion.

INTRODUCTION

Class II malocclusions are one of the most frequently encountered malocclusions in orthodontic practice. They are often the result of protruded maxilla, returned mandible, or a combination. In growing patients, growth modification is often attempted to achieve a harmonious relationship of the two jaws and good facial appearance. However, in adult patients with no growth potential, the options are limited by orthognathic surgery or orthodontic camouflage. [1-3]

The mesial movement of the lower dentition contributes to the correction of Class II malocclusion with the use of fixed functional appliances. Functional jaw orthopedics is a specific type of treatment for Class II dentoskeletal disharmonies associated with mandibular retrusion. It has been shown that, Functional jaw orthopedics produces different dentoskeletal results based on timing of treatment. [4, 6]

Fixed functional appliances are normally known as "non-compliance Class II correctors" giving incorrect idea about the assistance necessary during treatment. However, good assistance is essential for effective treatment, especially in case of skeletal modifications instead of dentoalveolar compensation. [7, 8]

The most suitable treatment strategy for class II malocclusion with deficient mandible is by using functional appliance either removable or fixed, therefore promoting mandibular growth via mandibular advancement. The main factor for choosing either removable or fixed functional appliance is patient compliance which can affect the efficacy of treatment. [9, 10]

The mechanism of mandibular adaptation to the forward posturing by fixed functional appliance is similar as that seen in removable functional appliance. The appliance is tooth borne and exerts its effects to the underlying bone via teeth by transmitting the forces developed as a result of the continuous forward posturing of the lower jaw [11, 12]

There is a little literature regarding the effect of fixed functional appliances on maxilla and maxillary dentition so this study was directed to evaluate skeletal and dental effects of fixed functional appliances on maxilla and maxillary teeth.

Patients and Methods

Study design
Study design was a prospective clinical study, which was done on 30 orthodontic patients which was divided into two groups, group A (Forsus), group B (Advancsync)

Sample size calculation
The sample size for this study was done according to previous studies [7, 13] depends on:
1. Acceptable level of significance $p<0.05$ (Type I or α error=5%). This means that we are ready to accept that the probability that the observed difference "false positive" due to chance is 5%.
2. Power of the study =0.80 The "power" of the study then is equal to (1 –β). This means that we are ready to accept a 10% failure to detect a difference when there is a difference "false negative", i.e. Type II or β error=10%).
3. Expected effect size=1.195
4. Standard deviation is the measure of dispersion or variability in the data. The sample size=30 patients: 10 for each group.

Ethical consideration
An informed consent form that explains every step in the research was given and discussed carefully with the patients and patient guardians before participation in the study and start our treatment steps.

Participants
This study was done on 30 patients who were collected from outpatient clinic at the Orthodontic Department, Faculty of Dental Medicine, Al-Azhar University, Assiut, Egypt.
They were randomly divided into two groups: each consisted of 15 patients as follows:
The first group consisted of 15 patients, who received Forsus Fatigue Resistance Device fixed functional appliance therapy, the second group consisted of 15 patients, who received Advancsync2 fixed functional appliance therapy.
The patients included in the study fulfilled the following criteria: Class II malocclusion, Retrognathic mandible confirmed by cephalometric radiograph, Increased overjet, Horizontal to average growth pattern, Positive pretreatment visual treatment objective and Cervical vertebral maturation index stages3, 4and 5.
The patients were excluded if they had the following criteria: Severe proclination of anterior teeth, Severe crowding of anterior teeth and Systemic disease affecting bone and general growth.

Intervention
For each patient in the study, the usually orthodontic records were taken before treatment:

Preoperative Patients' records
extra-oral and five intra-oral photographs. Panoramic radiograph, standardized lateral cephalometric radiograph, and orthodontic study cast model.
For each patient, two standardized cephalometry were obtained; one pre-installation of the appliance and another immediately after the removal of the appliance.

Operative procedures
Brackets: The maxillary and mandibular teeth were bonded with 0.022×0.028- inch slots Roth brackets***
Arch wire: After direct bonding of the brackets, installation of Nickel Titanium (Ni-Ti) arch wire****for leveling and alignment of teeth starting from 0.012" up to stainless-steel (St.St.) arch wire 0.019" ×0.025" in diameter.

Fig (1) Group 1 FFRD**: (A):** pre-operative lateral cephalometric radiograph**, (B):** Post-operative lateral cephalometric radiograph

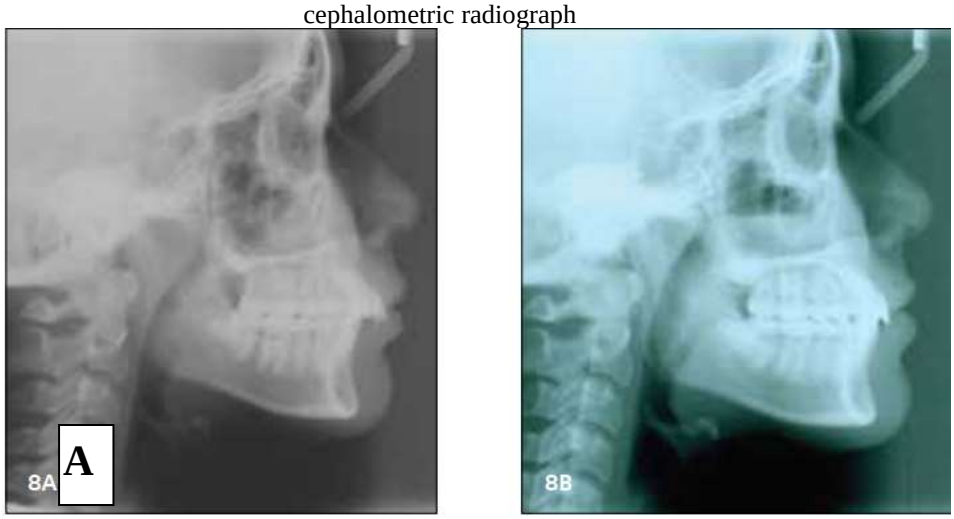

Fig (2) Group 2 Advancsync II**: (A):** pre-operative lateral cephalometric radiograph**, (B):** Post-operative lateral cephalometric radiograph

Statistical analysis

The mean and standard deviation values were calculated for each group. Data were explored for normality using Kolmogrov-Smimov and Shapiro-wilk test, showed parametric (normal distribution). Pre-treatment in Forsus group; there was very good inter-examiner agreement regarding all measurements with Cronbach's alpha values ranging from 0.8 to 0.909. Similarly, for AdvanSync2 group; there was very good inter-examiner agreement regarding all measurements with Cronbach's alpha values ranging from 0.771 to 0.903. The significance level was set $P \leq 0.05$. statical analysis was performed with IBM SPSS statistic version 20 for windows.

Results

Table (1): comparison of different variables, means values between groups

Variable / Groups	Before	After	P value	Mean change	Intergroup P value
	SNA° (degree)				
Group (1)	81.54 ±4.7	80.32 ±4.76	P=0.538	-1.21 ±0.06	P =0.321
Group (2)	81.41 ±4.6	80.55 ±4.77	P=0.535	-1.13 ±0.16	
	Co-A (mm)				
Group (1)	96.1 ±4.77	94.9 ±5.12	p=0.420	3.81 ±0.43	P =0.531
Group (2)	95.1 ±4.53	94.65 ±5.14	p=0.421	4.53 ±0.62	
	U1-SN° (degree)				
Group (1)	103.8 ±8.22	101.5 ±7.11	P=0.560	0.8 ±1.13	P =0.148

Group (2)	104.51±8.18	101.1 ±7.42	P=0.562	0.62 ±0.87	
	U1-PP (mm)				
Group (1)	21.16 ±2.81	20.1 ±2.7	P=0.007	2.05 ±0.12	P =0.087
Group (2)	21.21 ±2.77	20.32 ±2.61	P=0.006	2.13 ±0.17	
				2.09 ±0.14	

Variable	**U6-PP (mm)**	
Groups	**Mean change**	**Intergroup P value**
Group (1)	-1.58 ±0.16	P=0.094
Group (2)	-0.79 ±0.14	

Variable	**U6-Sv (mm)**	
Groups	**Mean change**	**Intergroup P value**
Group (1)	-1.16±0.39	P=0.067
Group (2)	-0.43±0.44	

Figure:(4)
A) pretreatment during treatment postreatment intraoral photo by forsus appliance
B) pretreatment during treatment postreatment intraoral photo by Advancsync appliance

Discussion

Skeletal measurements
Change in SNA
This study recorded SNA mean values for Group (1) (81.54º) before treatment, while after treatment the decreased to (80.32º) and mean values for Group (2) (81.41º) before treatment, while after treatment decreased to (80.55º).
The difference was statistically not significant. These results were in agreement with Vogt et al [13], Corcoran et al [14] and on the other hand it was contradicted by Sood et al [15].

Change in Co-A (mm)
The present study recorded Co-A (mm) mean values for Group (1) (96.1 mm) before treatment, while after treatment they increased to (96.5 mm). and mean values for Group (2) (95.1 mm) before treatment, while after treatment increased to (95.6 mm). The difference was statistically not significant. These results were in agreement with Vogt et al [13], Kaur et al [16] and on the other hand it did not agree with Gunay et al [17] and Jones et al [18].

Dental measurements
Change in U1-SN°
This study recorded reduction in U1-SN°(degree) for Group (1) from (103.8º) before treatment, while after treatment the decreased to (102.5º) and mean values for Group (2) (104.51º) before treatment, while after treatment decreased to (103.1º). The difference was statistically not significant.

Change in U1-PP (mm)
This study recorded a reduction in linear measurements of maxillary central incisor mean values for Group (1) (21.16 mm) before treatment, while after treatment the decreased to (20.1 mm). For Group (2) (21.21 mm) before treatment, while after treatment decreased to (20.32 mm). The difference was statistically not significant
The obtained results regarding changes in both U1-SN° and U1-PP (mm) were in agreement with Vogt et al [13], Kaur et al [16], Al- Jewair et al [19], but did not agree with Franchi et al [20].

Changes in U6-Sv (mm)
The present study recorded reduction in measurments of maxillary first molar linear mean values for Group (1) (44.18 mm) before treatment, while after treatment the decreased to (43.02 mm). The difference was statistically not significant and mean values for Group (2) (45.19 mm) before treatment, while after treatment inccreased to (44.76 mm) for U6-Sv (mm). The difference was statistically not significant.

Changes in U6-P (mm)
The present study recorded reduction in measurments of maxillary first molar linear mean values for Group (1) (18.72 mm) before treatment, while after treatment the decreased to (17.14 mm). The difference was statistically not significant and mean values for Group (2) (19.64 mm) before treatment, while after treatment inccreased to (18.85 mm). The difference was statistically not significant.

Conclusions

1. The treatment effects of Forsus Fatigue Resistance, Advancesync 2 in Class II correction were a combination of non-significant skeletal and dentoalveolar effects on maxilla.
2. When comparing these appliances' effects on maxilla there were non-significant different values between them in contributing to Class II malocclusion correction skeletally and dentally.

Recommendations

1. Further evaluation of dental and skeletal changes for the effects of fixed functional appliances that needs further long-term investigations specially in long term retention period.
2. Further evaluation of three dimensional changes of maxillary first permanent molars using cone beam computed tomography.

References

1. Suresh M, Akurathi R, Vivekanand SK, Shameem K. One Phase versus Two Phase Treatment in Mixed Dentition: A Critical Review. J Int Oral Health. 2015; 7: 144–7. PMCID: PMC4588783 PMID: 26464559.
2. Proffit WR Malocclusion and dentofacial deformity in contemporary society. In: Proffit WR, Fields HW, Sarver DM, Larson BE. Contemporary Orthodontics. 6th ed. Elsevier. 2019.
3. Vaibava SK, Gnanashanmugam, Kannan MS. Interceptive Orthodontics – A review. Eur J Mol Clin Med. 2020; 7(4) :1757-61. https://ejmcm.com/article_1903.html
4. Zhou L, Mok CW, Hagg U, et al. Anteroposterior dental arch and jaw base relationships in a population sample. Angle Orthod. 2008; 78:1023–9. DOI: 10.2319/100107-467.1
5. Tulloch JF, Proffit WR, Phillips C. Outcomes in 2-phase randomized clinical trial of early Class II treatment. Am J Orthod Dentofacial Orthop. 2004; 125:657–67. DOI: https://doi.org/10.1016/j.ajodo.2004.02.008
6. Marsico E, Gatto E, Burrascano M, Matrese G, Cordasco G. Effectiveness of orthodontic treatment with functional appliances on mandibular growth in the short term. Am J Orthod Dentofacial Orthop. 2011; 139:24–36. DOI: 10.1016/j.ajodo.2010.04.028
7. Tulloch JF, Phillips C, Proffit WR. Benefit of early Class II treatment: progress report of a two-phase randomized clinical trial. Am J Orthod Dentofacial Orthop. 1998; 113:62–72. DOI: 10.1016/S0889-5406(98)70277-X
8. Giuntini V, Baccetti T, Defraia E, et al. Mesial rotation of upper first molars in Class II division 1 malocclusion in the mixed dentition: a controlled blind study. Prog Orthod. 2011; 12:107–13. DOI: 10.1016/j.pio.2010.12.001
9. Ow A, Cheung LK. Skeletal stability and complications of bilateral sagittal split osteotomies and mandibular distraction osteogenesis: an evidenced-based review. J Oral Maxillofac Surg. 2009; 67:2344–53. DOI: 10.1016/j.joms.2008.07.003
10. Hägg U, Rabie ABM, Bendeus M, et al. Condylar growth and mandibular positioning with stepwise versus maximum jumping. Am J Orthod Dentofacial Orthop. 2008; 134:525–36. DOI: 10.1016/j.ajodo.2006.09.064
11. Meikle M. What do prospective randomized clinical trials tell us about the treatment of Class II malocclusions? A personal viewpoint. Eur J Orthod. 2005; 27:105–14. DOI: 10.1093/ejo/cji038
12. Björk A. Variations in the growth pattern of the human mandible: longitudinal radiographic study by the implant method. J Dent Res. 1963; 42:400–11. DOI: 10.1177/00220345630420014701
13. Vogt W. The Forsus Fatigue Resistant Device. J Clin Orthod. 2006; 40(6):368–77; quiz 358. PMID: 16804253.
14.Corcoran K, Dischinger T, Sheikh H. 'Orthodontic device for treating malocclusions'. U.S. patent 7,578,671. 25 August 2009.
15. Sood S. The Forsus Fatigue Resistant Device as a fixed functional appliance. J Clin Orthod. 2011; 45(8):463–6.
16. Kaur GJ, Gandhi G, Khanna M, Loomba A, Sharma A. A Cephalometric Evaluation and Comparison of Skeletal, Dentoalveolar, and Soft Tissue Changes Brought about by the Forsus Fatigue Resistant Device and PowerScope Fixed Functional Appliance. J. Indian Orthod. Soc. 2022; 56(3):227-36. DOI: 10.1177/03015742211004435
17.Gunay EA, Arun T, Nalbantgil D. Evaluation of the immediate dentofacial changes in late adolescent patients treated with the Forsus FRD. Eur J Dent. 2011; 5:423–32.
18. Jones G, Buschang PH, Kim KB, Oliver DR. Class II nonextraction patients treated with the Forsus fatigue resistant device versus intermaxillary elastics. Angle Orthod. 2008; 78:332–8. https://doi.org/10.2319/030607-115.1
19.Al-Jewair T, Preston CB, Moll EM, et al. A comparison of the MARA and the AdvanSync functional appliances in the treatment of class II malocclusion. Angle Orthod 2012; 82(5):907–14. https://doi.org/10.2319/090411-569.1
20. Franchi L, Alvetro L, Giuntini V, Masucci C, Defraia E, Baccetti T. Effectiveness of comprehensive fixed appliance treatment used with the Forsus Fatigue Resistant Device in Class II patients. Angle Orthod. 2011; 81(4):678–83. https://doi.org/10.2319/102710-629.1