Original Research Article

A comparison of treatment effects produced by AdvanSync and forsus fatigue resistant device in growing class II patients - An *In-Vivo* study

Saumya Upadhyay [1]*, **Jyothikiran Hurkadle**[2], **Suma Shankarappa**[2],
Raghunath N Rao[2], **Madhuvanthi Gopalakrishnan** [2]

[1]*Dept. of Orthodontics, Peoples Dental Academy, Bhopal, Madhya Pradesh, India*
[2]*JSS Dental College and Hospital, Mysore, Karnataka, India*

A R T I C L E   I N F O

A B S T R A C T

Introduction: Class II malocclusion second most common malocclusion after class I. The prevalence of Class II malocclusion was reported 19.56% globally(2) and 14.6% in India. Management of class II malocclusion becomes intricate because of its variable etiology and the age at which the patient presents to the orthodontists. During 1900 first fixed functional appliances (FFA) emerged and then plethora of appliances followed. Amongst various appliances AdvanSync[TM] appears to be the latest addition to FFA in orthodontist's arsenal whereas Forsus[TM] Fatigue Resistance Device (FFRD) is the most widely accepted and used FFA.

Aims & Objectives: The aim of this study is to compare the differences in the skeletal, dentoalveolar and soft tissue changes produced by AdvanSync[TM]2 and FFRD.

Materials and Methods: The sample comprised of 30 patients presented to the Department of Orthodontics and Dentofacial Orthopaedics, as outpatients. Total 15 patients in each group were treated and analyzed using Lateral cephalograms at two time period, pretreatment and post functional orthodontic treatment.

Results: Both the appliances were effective in normalising class II malocclusions with mandibular deficiency. Both the appliances showed more of dentoalveolar effects when compared to skeletal. They both have a positive effect on the profile.

Conclusion: The FFRD and AdvanSync[TM]2 both the appliances were effective in treating class II division malocclusion. AdvanSync[TM]2 demonstrated greater headgear effect but less mandibular advancement as compared to FFRD. Both appliances caused significant dentoalveloar changes and soft tissue changes.

For reprints contact: reprint@ipinnovative.com

1. Introduction

Angle first described Class II malocclusion in the 1890s. It is second most common malocclusion after class I.[1] The prevalence of Class II malocclusion was reported 19.56% globally[2] and 14.6% in India.[3]

The class II malocclusion problem can be attributed to either retrognathic mandible or prognathic maxilla or a combination of both. Retrusion of mandible was found to be the most common etiological factor in this malocclusion.[4]

Management of class II malocclusion becomes intricate because of its variable etiology[5] and the age at which the patient presents to the orthodontists. During 1900s first fixed functional appliances (FFA) emerged and then plethora of appliances followed. If timed correctly, FFA can be an asset in patients with lesser growth potential[6] and also helps in avoiding any future invasive surgical interventions during adulthood.[7] he latest appliances are designed to decrease

* *Corresponding author.*
E-mail address: drsaumyaupadhyay@gmail.com (S. Upadhyay).

the treatment duration and reduce the need for patient co-operation[8] while allowing complete utilisation of growth left.

Amongst various appliances AdvanSync[TM]2 molar to molar appliance appears to be the latest addition to FFA in orthodontist's arsenal for treating class II malocclusion with mandibular retrusion whereas Forsus[TM] Fatigue Resistance Device (FFRD) is the most widely accepted and used FFA.

FFRD has some disadvantages like it can only be installed after pre functional levelling and alignment is achieved till 19X25 SS wire, frequent dislodgement, causes lower incisor proclination, and requires extensive anchorage preparation.

AdvanSync[TM]2 and MARA appliances allows concurrent full fixed treatment as there is no need to level and align both arches before installation which is beneficial in terms of growth considerations as well as duration of the treatment. AdvanSync[TM]2 has shorter arms and is engaged from molar to molar which reduces direct force transfer on mandibular canine thereby reducing lower incisor proclination effect

Therefore, understanding the appliance design, treatment processes, and comparison of the treatment effects of various FFA will enable better treatment planning and help in obtaining optimal results.

The aim of this study was to compare the differences in the skeletal, dentoalveolar and soft tissue changes produced by the AdvanSync[TM]2 and the Forsus[TM] Fatigue Resistance Device fixed functional appliances in growing patients, to correct class II division I malocclusion, due to retrognathic mandible.

2. Materials and Methods

3. Method of collection of data and ethical clearance

The sample comprised of patients who reported to the Department as outpatients. Patient selection was done based on inclusion and exclusion criterias of the study. The sample size was taken as 10 per group, Group 1 (AdvanSync[TM]2) and Group 2 (Forsus[TM] Fatigue Resistance Device). The investigation was approved by the Institutional Ethics Committee after critically reviewing the research protocol and registration number 59/2020 was assigned to this study.

3.1. Sample size calculation

We sought a desired level of significance (α) of 0.05, which corresponds to a 95% confidence level, to determine the necessary sample size for this paper. The required power (β), which equals 80% power, was set at 0.20. For the population under study, an estimated standard deviation (σ) of 4.70 was considered.

The following equation is used to determine the necessary sample size (n):

$$n = (Z\alpha + Z\beta)^2 \times \sigma^2 / d^2$$

This computation yielded an approximate sample size (n) of 19. The sample size, however, was rounded up to the nearest whole number because it had to be a whole number, yielding a sample size of 20.

Table 1:

Inclusion criteria	Exclusion criteria
1. Adolescent males and females patients having class II div I malocclusion due to mandibular retrusion	1. Class II patients with vertical growth pattern
2. Molars in at least end-on to full cusp class II relationship	2. Patients requiring extraction treatment protocol
3. No missing teeth	3. Patients who have signs and symptoms of temporomandibular joint disorder.
4. Patient requiring a non-extraction treatment plan.	4. Patients who have signs and symptoms of temporomandibular joint disorder.
5. ANB angle greater than 3°	5. Patients who have class II malocclusion because of prognathic maxilla and orthognathic mandible.
6. Patients having decreased lower anterior facial height	6. Adult patient.
7. Average or horizontal growth pattern	
8. Absence of any signs and symptoms of temporomandibular joint disorder	
9. Positive visual treatment objective [VTO] 10. Age range between 12-16 years	
Withdrawal criteria: 1. Patient who discontinues from the study during the research. 2. Patient who has migrated from the area.	

3.2. Methodology

In Group 1 patients

Alginate impressions were taken, and the appropriate size of AdvanSync[TM]2 (ORMCO) molar band was chosen and cemented. A telescopic rod was connected to housing on U6 and L6 molar bands, based on the desired activation. Midline correction was achieved by adding c spacers during monthly appointments. The appliance was installed without leveling and aligning, along with bonding from the second premolar to second premolar. Lower anteriors utilized Damon low torque brackets to prevent proclination. It was advised to use figure-eight-lacing from molar to molar.

Wire adjustments were made during subsequent appointments, gradually activating the appliance until achieving a overcorrected class 1 canine and molar relation

3.3. Group 2 patients

Subjects were fully banded and bonded to achieve levelling and alignment till 19X25 SS wire was placed in both the arches and cinched. Labial root torque was incorporated in

the wires.

Measurements were taken using the gauge provided with the appliance and suitable length was chosen for Forsus™ Fatigue Resistance Device fatigue resistant device (3M unitek). The EZ module was inserted into the molar buccal tube from mesial side unitil it clicks into the place. (Suppl Figure 4). Split crimps were used for activation of appliance during the subsequent appointments until overcorrected class 1 canine and molar relation was achieved

In both the groups, appliances were removed and fixed orthodontic treatment was continued to achieve adequate occlusion and finish.

3.4. Radiographic method

Lateral cephalograms and photographs were taken as part of the routine diagnostic records. They were taken at two times, pre treatment (T1) and post functional orthodontic treatment (T2). The measurements were done by three operators and average was taken. A total of 9 angular,12 linear measurements and 10 soft tissue variables were considered in cephalometric analysis. (Suppl Figure 5)

Figure 1: Advan sync 2 fixedfunctional appliance kit
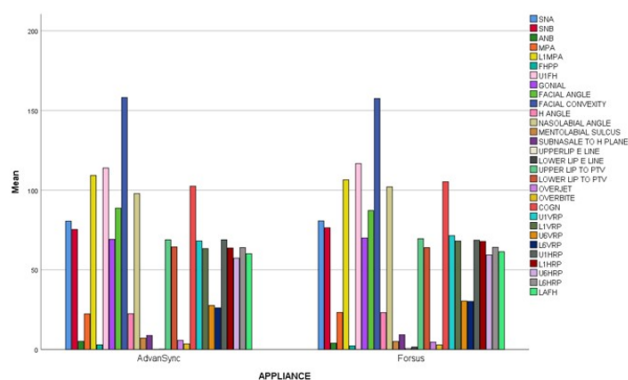
Graph 1: Overall comparision of advansync™ 2 Appliacnce and forsus™ Fatigue ressitance device appliance for linear, angular and soft tissue measurements.

4. Results

Data was analysed using SPSS software version 26, and checked for normality using Kolmegorov smirnov test. Data was normality distributed. Comparison of pre-operative and post-operative changes in linear, angular and soft tissue measurements among AdvanSync™2 appliance and Forsus™ Fatigue Resistance Device appliance was carried out using paired T test. Comparison of AdvanSync™2 appliance and Forsus™ Fatigue Resistance Device appliance for overall linear, angular and soft tissue measurements was done using unpaired t test. The level of significance was kept as less than 0.05.

The overall Comparison of AdvanSync™2 appliance and Forsus™ Fatigue Resistance Device appliance, using

Figure 2: Introral pictures of advan Sync 2 fixed functional appliance

unpaired T test in total study population for linear, angular and soft tissue measurements, showed significant difference among SNA angle, U1FH, H angle, subnasale to H plane, lower lip E line, upper lip to Ptm, overjet, L6HRP. (Table 1 and Graph 1).

At individual level comparisons, skeletal parameters showed positive improvement in majority parameters of both the appliances. Initially the pre-operative(T1) and post-operative(T2) changes in cephalometric analysis using paired T test, among AdvanSync™2 appliance and Forsus™ Fatigue Resistance Device appliance group. (Tables 2 and 3)

Table 2: Comparison of Advan Sync™2 appliance andForsus™ Fatigue Resistance Device appliance mean difference for overall linear, angular and soft tissue measurements. (Unpaired T test)

	Variables	AdvanSync™2 appliance Mean difference	Forsus™ Fatigue Resistance Device appliance - Mean difference	P value
Angular	SNA	1.150	0.900	0.028*
	SNB	-0.900	-2.200	0.198
	ANB	2.050	2.600	0.712
	MPA	-1.300	1.100	0.168
	L1MPA	-2.100	7.100	0.097
	FHPP	-0.900	1.300	0.402
	U1FH	10.300	6.700	0.002*
	Gonial	-1.800	-1.400	0.047
	Facial Angle	-0.600	-2.600	0.248
	Facial Convexity157.6	-1.000	-3.600	0.404
SOFT TISSUE	H Angle	1.900	2.300	0.02*
	Nasolabial Angle	-8.900	-13.700	0.401
	Mentolabial Sulcus	1.900	2.000	0.821
	Subnasale To H Plane	1.500	2.200	0.001*
	Upperlip E Line	0.700	1.000	0.027
	Lower Lip E Line	-1.100	0.000	0.015*
	Upper Lip To Ptv	1.300	0.000	0.015*
	Lower Lip To Ptv	-2.000	-2.000	0.411
	Overjet	4.950	3.300	0.014*
	Overbite	1.400	1.600	0.6
	COGN	-3.800	-2.900	0.565
	U1VRP	0.900	1.100	0.921
	L1VRP	-0.300	-0.700	0.759
LINEAR	U6VRP	2.200	-0.200	0.534
	L6VRP	-1.300	-1.000	0.341
	U1HRP	-2.700	-1.300	0.799
	L1HRP	-4.800	-1.300	0.574
	U6HRP	-0.900	-5.100	0.206
	L6HRP	-3.000	-1.300	0.006*
	LAFH	-3.000	-2.000	0.774

*Signifucane <0.05

Figure 3: FFRD fixed functional appliance kit with measuring scale

5. Discussion

There are several treatment approaches being employed to address class II malocclusion. In this study, lateral cephalogram was chosen to study and compare the treatment effects of AdvanSync™2 and FFRD. It is a widely used diagnostic tool for examining skeletal, dental, and soft tissue craniofacial morphology. In this study, horizontal reference plane and vertical reference planes were derived to give standardization for correlation of pre-treatment and post functional orthodontic treatment results.[9]

The goal of adopting a functional appliance is to take advantage of remaining active growth phase and assist forward jaw posture, which cause the condylar head to develop and the glenoid fossa to remodel.[10] It has been observed that the efficiency of treatment of mandibular growth deficiencies is significantly dependent on the biological responsiveness of the condylar cartilage,

Table 3: Measurements among AdvanSync^{TM}2 appliance (paired T test)

	Variables	Mean ± SD	Mean ± SD	Mean difference	P VALUE
Angular	SNA	81.10 ±3.213	79.95 ±3.166	1.150	.000*
	SNB	74.95 ±3.166	75.80 ±3.048	-0.900	.000*
	ANB	6.20±1.398	4.15±0.669	2.050	.015
	MPA	21.70±4.448	23.00±5.055	-1.300	.000*
	L1MPA	108.20±7.005	110.30±4.809	-2.100	.000*
	FHPP	2.50±1.900	3.40±2.951	-0.900	.006*
	U1FH	119.00±14.937	108.70±8.744	10.300	.044*
	GONIAL	68.20±4.849	70.00±4.876	-1.800	.000*
	FACIAL ANGLE	88.40±1.776	89.00±4.714	-0.600	1.000
	FACIAL CONVEXITY157.6	157.60±6.222	158.60±5.441	-1.000	.000*
SOFT TISSUE	H ANGLE	23.40±3.534	21.50±3.206	1.900	.001*
	NASOLABIAL ANGLE	93.40±9.732	102.30±13.233	-8.900	.004*
	MENTOLABIAL SULCUS	8.10±1.370	6.20±1.619	1.900	.001*
	SUBNASALE TO H PLANE	9.50±2.550	8.00±2.667	1.500	.055*
	UPPERLIP E LINE	0.50±2.506	-.20±1.814	0.700	.129
	LOWER LIP E LINE	-0.35±3.448	0.75±2.252	-1.100	.011*
	UPPER LIP TO PTV	69.50±4.478	68.20±4.417	1.300	.003*
	LOWER LIP TO PTV	63.40±5.358	65.40±5.910	-2.000	.003*
LINEAR	OVERJET	8.25±3.066	3.30±0.483	4.950	.260
	OVERBITE	4.20±1.033	2.80±0.632	1.400	.508
	COGN	100.60±5.854	104.40±5.038	-3.800	.000*
	U1VRP	68.60±6.867	67.70±6.961	0.900	.009*
	L1VRP	63.20±6.179	63.50±7.153	-0.300	.000*
	U6VRP	28.80±5.308	26.60±6.257	2.200	.000*
	L6VRP	25.50±5.662	26.80±6.546	-1.300	.001*
	U1HRP	67.50±2.759	70.20±4.392	-2.700	.001*
	L1HRP	61.30±3.302	66.10±5.152	-4.800	.002*
	U6HRP	56.90±2.378	57.80±4.185	-0.900	.000*
	L6HRP	62.40±2.319	65.40±3.502	-3.000	.000*
	LAFH	58.60±4.088	61.60±3.307	-3.000	.004*

*Significance <0.05

which sequentially is dependent on the mandibular growth rate.[11] The resulting skeletal changes have been attributed to morphologic adaptations to altered muscular tone and a shift in masticatory muscle traction direction. A myostatic reflex is elicited, resulting in isometric contractions that stimulate the protractor muscles while inhibiting the mandibular retractor muscles.[12,13]

Forsus^{TM} Fatigue Resistance Device is a widely accepted FFA. It is attached from maxillary molar buccal tube to lower archwire distal to the mandibular canine which leads to direct force on incisor causing proclination.[14] The other disadvantages include cheek irritation and frequent dislodgement of rod. The cases treated with the appliance requires levelling and aligning of both the arches and should be kept in 19x25 SS prior to installation. It is amongst the

drawbacks when the patient has minimal growth potential left.

AdvanSync^{TM}2 appliance is a molar to molar appliance which elimination direct force on canine and permits simultaneous orthodontic and orthopaedic corrections as it is not necessary to align and level the arches prior to its placement. Therefore, it becomes possible to capitalize on residual growth and reduce the duration of treatment. The appliance is approximately half the size of the former FFRD. It fits more conveniently in the back of the mouth due to its smaller size.

All the fixed functional appliances invariably cause lower incisor flaring. Gandedkar and Celikoglu et al.[13] study showed that it was one of the consistent drawback of all the FFA. This study also compared the effect on lower incisor

Table 4: Comparison of pre-operative and post-operative changes in linear, angular and soft tissue measurements amongForsus[TM] Fatigue Resistance Device appliance. (Paired T test)

	Varuables	Mean ± SD	Mean ± SD	Mean difference	P Value
Angular	SNA	81.10±1.792	80.20±1.874	0.900	.000*
	SNB	75.30±1.494	77.50±2.461	-2.200	.031*
	ANB	5.30±1.252	2.70±1.160	2.600	.116
	MPA	23.80±3.360	22.70±3.622	1.100	.000*
	L1MPA	110.00±7.846	102.90±9.620	7.100	.101
	FHPP	2.90±4.095	1.60±.503	1.300	.002*
	U1FH	120.00±5.011	113.30±270	6.700	.173
	GONIAL	69.30±3.164	70.70±2.359	-1.400	.000*
	FACIAL ANGLE	85.90±1.197	88.50±.850	-2.600	.445
Soft Tissue	FACIAL CONVEXITY	155.70±3.713	159.30±4.322	-3.600	.005*
	H ANGLE	24.30±1.252	22.00±.789	2.300	.010
	NASOLABIAL ANGLE	95.20±6.250	108.90±6.008	-13.700	.611
	MENTOLABIAL SULCUS	6.00±1.414	4.00±1.155	2.000	.013*
	SUBNASALE TO H PLANE	10.30±.949	8.10±.994	2.200	.371
	UPPERLIP E LINE	1.10±1.595	.10±1.197	1.000	.507
	LOWER LIP E LINE	1.60±2.271	1.60±.699	0.000	.074
	UPPER LIP TO PTV	69.50±6.399	69.50±5.911	0.000	.002*
	LOWER LIP TO PTV	62.90±6.557	64.90±5.744	-2.000	.000*
Linear	OVERJET	6.30±1.767	3.00±1.054	3.300	.000*
	OVERBITE	3.70±1.059	2.10±.316	1.600	.213
	COGN	103.80±5.959	106.70±6.533	-2.900	.000*
	U1VRP	72.00±5.774	70.90±.460	1.100	.000*
	L1VRP	67.70±5.498	68.40±6.467	-700	.000*
	U6VRP	30.30±6.667	30.50±6.671	-.200	.000*
	L6VRP	29.70±6.567	30.70±433	-1.000	.009*
	U1HRP	68.00±3.333	69.30±4.296	-1.300	.346
	L1HRP	67.20±4.984	68.50±4.062	-1.300	.006*
	U6HRP	56.80±9.151	61.90±3.784	-5.100	.901
	L6HRP	63.50±6.258	64.80±5.554	-1.300	.012*
	LAFH	60.30±3.164	62.30±.093	-2.000	.000*

*Significance <0.05

inclination by both the devices. AdvanSync[TM]2 caused comparatively less proclination than the FFRD

The appliance were inserted at a mean age of 12-14 years of age with CVMI[(16)] 3-5 for 6-8 months. The findings demonstrated that, at the conclusion of the functional appliance period, only minor differences, predominantly dentoalveolar, existed between two appliances.

There are several scientific literatures on the therapeutic effects of Forsus[TM] Fatigue Resistance Device, but relatively few[15] on the AdvanSync[TM]2 device. There is a scarce literature comparing the treatment effects of FFRD with the AdvanSync[TM]2 appliance. Therefore, this study was done to compare and analyze the effects of two most

used appliances.

The treatment effects of both the appliances can be divided into three broad categories –

Skeletal, Dentoalveolar and Soft tissue changes on maxilla and mandible

Skeletal effects

The mandibular effects can be attributed to anterior force[14] generated from the appliances while forward positioning of the mandible and maxillary effects can be attributed to reciprocal effect of the mandibular advancement caused by the appliance.[16]

Both the appliances showed increase in SNB angle (p<0.05), suggesting mandibular advancement. There was

Figure 4: Introral pictures of forsusfatigue resistant device
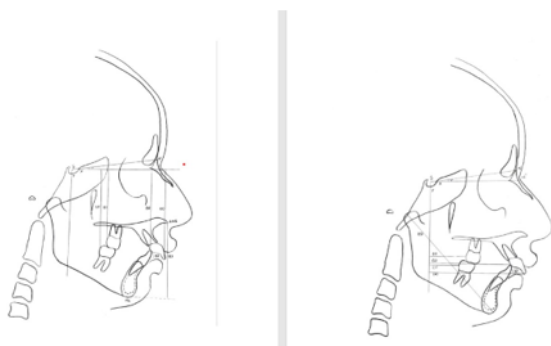

Figure 5: Left- Soft tissue landmarks – 1.Glabella (G') 2. Soft tissue nasion (N') 3. Pronasale (Po)4. Subnasale(Sn') 5. Labrale superius (Ls) 6. Soft tissue Pogonion (Pog') 7. Soft tissue Menton (Me') Right -Hard tissue landmarks – 1. Nasion(N) 2. Sella (S) 3. Porion (Po) 4.Condylion (Co) 5.Pterygomaxillary point(Ptm) 6.Orbitale (Or) 7. Posterior nasal spine (PNS) 8. Anterior nasal spine (ANS) 9. Point A (A)10. Point B(B) 11. Gonion (Go) 12. Pogonion (Pg) 13. Gnathion (Gn) 14. Menton(Me')

significant increase in mandibular length in both groups. (group 1= and group 2=). AdvanSync[TM]2 finding were consistent with the all previous studies except study which compared treatment effects of MARA and AdvanSync[TM]2 [17]

Both the appliances showed reduction in SNA angle but was more with AdvanSync[TM]2 appliance. Studies Raghav P et al. [18] and Jayachandran S et al concluded that AdvanSync[TM]2 has headgear like effect. [19] Group 2 findings were consistent with the previous published studies. [20–22)]

Decrease in ANB was seen with both the appliances which suggests improvement in relative anteroposterior position between the maxilla and mandible. [8]

The mandibular plane angle, gonial angle as observed by comparison cephalometric analysis showed increase in value in Group 1 therefore must be used cautiously in patients with vertical growth pattern. [15] Group 2 had less significant effects on mandibular plane angle and gonial angle than AdvanSync[TM]2.

There was significant increase in lower anterior facial height with AdvanSync[TM]2 group when compared to Forsus[TM] Fatigue Resistance Device group and was found to be consistent with all previous studies. [12,15,23]

Dentoalveolar Effects

The most important drawback of Fixed Functional Appliance is lower incisor proclination. Though some of the proclination changes can be attributed to relative intrusion. [24] FFRD group showed more proclination in L1MP angle and intrusion of lower anteriors than AdvanSync[TM]2group which was consistent with the previous studies. [15] Low torque brackets (-11°) were used in combination with AdvanSync[TM]2 appliance which might have prevented flaring of lower anteriors.

Both the appliances showed significant changes in the U1FH angle, U1HRP and U1VRP distance which suggests retroclination , extrusion and distalisation maxillary anteriors. [8,15,24] The extrusion of upper incisors was more in to AdvanSync[TM]2group.

Mesialisation and intrusion of the L6(15) was more with AdvanSync[TM]2. It can attributed to direct reciprocal force transfer to molar since it is a molar to molar appliance

Both the appliances showed distalisation and extrusion effect on upper molars but was significant with FFRD. The dentoalveolar effects were consistent with the previous studies. [25]

Al jewair et al [24] concluded that there was no significant effect on U6, which is not in accordance with present study. The evaluation of dentoalveolar effect of Forsus[TM] Fatigue Resistance Device showed similar effects to the previous study [26] except U6 extrusion.

Soft Tissue Changes

In modern orthodontics, facial esthetics is one of the primary factors motivating the patient to seek orthodontic treatment. Thus, the assessment of the patient's facial

soft tissue is of great importance during orthodontic diagnosis and treatment planning. Pre and post treatment values showed significant soft tissue changes by both the appliances which resulted in improved facial esthetics

Soft tissue analysis of AdvanSync^{TM}2 group revealed significant increase in linear distance of lower lip from E line and PTV suggesting protrusion and forward displacement of lower lip. There was decrease seen in upper lip to Eline and PTV distance suggesting reduction protrusion of upper lip.

Comparison of pre-treatment to post-treatment Cephalometric values suggested improvement in H angle and nasolabial angle which indicates improvement in profile. FFRD showed more significant soft tissue changes in terms of facial convexity. This was in accordance with previous study [8] but the other studies did not report any significance change.[15] Both the appliances showed increase in the facial angle but was not statistically significant.[27]

6. Conclusion

This study concluded that –

1. Both the appliance were established as reliable as they were effective in correcting Class II malocclusions with mandibular retrusion.
2. The AdvanSync^{TM}2 Class II corrector enabled correction of the Class II malocclusion with shortened treatment time and was more comfortable for the patient as it is smaller in size and without the rod getting dislodged frequently as inFFRD. Maxillary restriction was more significant and mandibular advancement was higher in FFRD group.
3. Intrusion, mesialisation of lower molars and distalisation of upper molars was seen. FFRD caused significant extrusion and distalisation of upper molars.
4. Both the appliances led to lower incisor proclination but it was lesser with AdvanSync^{TM}2 appliance.
5. Both the appliance showed retroclination and extrusion of upper incisor. It was more with AdvanSync^{TM}2 appliance.
6. Pre and post treatment values showed significant soft tissue changes by both the appliances which resulted in improved facial esthetics.

7. Scope for Future Studies

1. AdvanSync^{TM}2 is molar to molar appliance, thus upper and lower molar bear the forces exerted during forward positioning. Second molar bonding will be useful to minimise distalisation effects on upper molars and mesiolingual rotation and intrusion of lower molars along with figure of 8 from molar to molar.
2. Because of the scarce literature, further researches are needed to provide a proof of these effects which will

enable us to utilise the full potential of the appliances.
3. Number of patients can be increased and 3D Imaging can be used in further studie

References

1. Ferrazzano GF, Cantile T, Sangianantoni G, Ingenito A, Rengo S, Alcidi B. Oral health status and Unmet Restorative Treatment Needs (UTN) in disadvantaged migrant and not migrant children in Italy. *Eur J Paediatr Dent*. 2019;20(1):10–4.
2. Alhammadi MS, Halboub E, Fayed MS, Labib A, El-Saaidi C. Global distribution of malocclusion traits: A systematic review. *Dental Press J Orthod*. 2018;23(6):1–10.
3. Balachandran P, Janakiram C. Prevalence of malocclusion among 8-15 years old children, India - A systematic review and meta-analysis. *J Oral Biol Craniofac Res*. 2021;11(2):192–201.
4. Fisk GV, Culbert MR, Grainger RM, Hemrend B, Moyers R. The morphology and physiology of distoclusion. A summary of our present knowledge. *Am J Orthod*. 1953;39(1):3–12.
5. Dolce C, Mansour DA, Mcgorray SP, Wheeler TT. Intrarater agreement about the etiology of Class II malocclusion and treatment approach. *Am J Orthod Dentofac Orthop*. 2012;141(1):17–23.
6. Ruf S, Pancherz H. Herbst/multibracket appliance treatment of Class II division 1 malocclusions in early and late adulthood. A prospective cephalometric study of consecutively treated subjects. *Eur J Orthod*. 2006;28(4):352–60.
7. O'reilly MT, Yanniello GJ. Mandibular growth changes and maturation of cervical ertebrae. A longitudinal cephalometric study. *Angle Orthod*. 1988;58(2):179–84.
8. Mofty ME, Ibrahim SA, El-Shall OS, Tawfik WA. Evaluation of Dentoskeletal Changes Accompanying the Treatment of Class II Malocclusion by Advansync Appliance versus Intermaxillary Coil Spring Mechanics. *Al-Azhar Dent J Girls*. 2018;5(4):373–83.
9. Cozza P, Baccetti T, Franchi L, Toffol D, Mcnamara L. Mandibular changes produced by functional appliances in Class II malocclusion: A systematic review. *Am J Orthod Dentofac Orthop*. 2006;129(5):599–600.
10. Nalamliang N, Thongudomporn U. Masticatory Muscle Responses to Mandibular Forward Positioning Appliances. *J DENT ASSOC THAI*. 2020;20(2).
11. Celikoglu M, Unal T, Bayram M, Candirli C. Treatment of a skeletal class II malocclusion using fixed functional appliance with miniplate anchorage. *Eur J Dent*. 2014;8(2):276–80.
12. Thushar BK, Verma S. Treatment outcomes in the sagittal and vertical dimensions with the AdvanSync2 class II corrector-a case series. *J Contemp Orthod*. 2018;2(3):38–50.
13. Cericato GO, Bittencourt M, Paranhos LR. Validity of the assessment method of skeletal maturation by cervical vertebrae: A systematic review and meta-analysis. . *Dentomaxillofac Radiol*. 2015;44(4):20140270.
14. Borghei S, Broadbent J, Stevens R, Chaudhry K, Subramani K. Orthodontists' preference on type of rigid fixed functional appliance for skeletal Class II correction: A survey study. *J Clin Exp Dent*. 2020;12(10):958–63.
15. Jayachandran S, Wiltshire WA, Hayasaki SM, Pinheiro F. Comparison of AdvanSync and intermaxillary elastics in the correction of Class II malocclusions: A retrospective clinical study. *Am J Orthod Dentofac Orthop*. 2016;150(6):979–88.

16. Thushar BK, Verma S. Treatment outcomes in the sagittal and vertical dimensions with the AdvanSync2 class II corrector-a case series. *J Contemp Orthod*. 2018;2(3):14–26.

17. Thushar BK, Verma S. Treatment outcomes in the sagittal and vertical dimensions with the AdvanSync2 class II corrector-a case series. *J Contemp Orthod*. 2018;2(3):14–26.

18. Goyal M, Madhok S, Mishra S, Kumar S. evaluation of the dentoskeletal and soft tissue profile changes in skeletal class ii patients treated with advansync tm 2 fixed functional appliance -a prospective clinical trial evaluation of the dentoskeletal and soft tissue profile changes in skeletal. *TMU J Dent*. 2019;4:2–8.

19. Mir CF, Major MP, Major PW. Soft tissue changes with fixed functional appliances in class II division 1: A systematic review. *Angle Orthod*. 2006;76(4):712–32.

20. Li H, Ren X, Hu Y, Tan L. Effects of the forsus fatigue-resistant device on skeletal class ii malocclusion correction. *J Contemp Dent Pract*. 2020;21(1):105–17.

21. Giuntini V, Vangelisti A, Masucci C, Defraia E, Mcnamara JA, Franchi L. Treatment effects produced by the Twin-block appliance vs the Forsus Fatigue Resistant Device in growing Class II patients. *Angle Orthod*. 2015;85(5):784–93.

22. Raghav P, Mathur S, Amit K, Mohan S. Therapeutic effectiveness of advansync2 at different stages of skeletal maturity in skeletal class ii malocclusion: A single-blind clinical trial. *APOS Trends Orthod*. 2020;10(2):111–20.

23. Goyal M, Madhok S, Mishra S, Kumar S. evaluation of the dentoskeletal and soft tissue profile changes in skeletal class ii patients treated with AdvanSync^TM2tm 2 fixed functional appliance -a prospective clinical trial evaluation of the dentoskeletal and soft tissue profile changes in skeletal. *TMU J Dent*. 2019;4(3):2–8.

24. Preston AJT, Moll CB, Dischinger EM. A comparison of the MARA and the AdvanSync functional appliances in the treatment of Class II malocclusion. *Angle Orthod*. 2012;82(5):907–21.

25. Arora V, Sharma R, Chowdhary S. Comparative evaluation of treatment effects between two fixed functional appliances for correction of Class II malocclusion: A single-center, randomized controlled trial. *Angle Orthod*. 2018;88(3):259–66.

26. Cacciatore G, Ghislanzoni L, Alvetro L, Giuntini V, Franchi L. Treatment and posttreatment effects induced by the Forsus^TM Fatigue Resistance Device appliance: A controlled clinical study. *Angle Orthod*. 2014;84(6):1010–7.

27. Thushar BK, Verma S. Treatment outcomes in the sagittal and vertical dimensions with the AdvanSync2 class II corrector-a case series. *J Contemp Orthod*. 2018;2(3):14–26.

Author's biography

Saumya Upadhyay, Senior Lecturer https://orcid.org/0009-0009-1904-8200

Jyothikiran Hurkadle, Professor

Suma Shankarappa, Reader

Raghunath N Rao, Professor

Madhuvanthi Gopalakrishnan, Post Graduate Student https://orcid.org/0009-0002-8194-6596