

Comparative Evaluation of Skeletal, Dentoalveolar and Soft Tissue Effects between the Forsus FRD and Advansync2 Fixed Functional Appliances in Treating Skeletal Class II Malocclusion – A Randomised Clinical Trial

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ABSTRACT

Aim: To evaluate and Compare Skeletal, Dentoalveolar and Soft tissue effects of the Forsus FRD and AdvanSync2 Fixed Functional Appliances for correction of Angle's Class II Division 1 Malocclusion.

Material and Methods: Twenty Participants were selected and randomly divided into Group 1 (Forsus FRD) and Group 2 (AdvanSync2). In Group I: After alignment and levelling, with tightly cinched 0.019*0.025 Stainless Steel Arch Wires in both upper and lower arches along with Trans-Palatal Arch in Maxilla for additional Anchorage, Forsus FRD Fixed Functional Appliance were inserted. In Group II: Pre-Adjusted Edgewise fixed Mechanotherapy with 0.022 MBT bracket system were bonded in both the upper and the lower arches. AdvanSync2 Appliance was installed simultaneously along with initiation of Aligning and levelling on the same appointment. Lateral Cephalograms were taken at time intervals T0 (Before Starting Fixed-Functional appliance therapy) & T1 (After completion of Fixed-Functional appliance therapy) were analyzed with selected skeletal, dental and soft-tissue parameters on Dolphin Imaging Software (Version 11.5).

Results: Comparison between two groups suggest that the Forsus FRD group and AdvanSync2 Group showed similar pre and post treatment Skeletal, Dentoalveolar and soft tissue Effects except AdvanSync2 group showed significantly higher Angle SNA-T1-T0 difference ($p < 0.001$) and Advansync2 group has a significantly greater angle FMA-T1 and FMA-T1-T0 ($p < 0.001$) difference compared to the Forsus FRD group. U6-NF Angular-T1 and U6-NF Angular-T1-T0 difference is significantly higher ($p < 0.001$) in Forsus FRD group and that L6- MP Angular-T1 and L6- MP Angular-T1-T0 ($p < 0.001$) difference is significantly higher in AdvanSync2 group.

Conclusion: Both Forsus FRD and Advansync2 Fixed Functional Appliance aid in the treatment of Class II malocclusion in post-pubertal patients with maximum Dentoalveolar alterations, minimum Skeletal alterations and mild Soft Tissue alteration. AdvanSync2 Fixed Functional Appliance reported headgear effect on maxilla unlike Forsus FRD. Compared to Forsus FRD, AdvanSync2 Fixed Functional Appliance reported significant increase in facial divergence. AdvanSync2 Fixed Functional Appliance reported mesial tipping of mandibular

first permanent molars unlike Forsus FRD. Compared to AdvanSync2, Forsus FRD appliance reported significant distal tipping of maxillary first molars.

KEYWORDS

Fixed Functional Appliance, AdvanSync2 appliance, Forsus Fatigue Resistance Device

INTRODUCTION

In 1890, Dr. Edward H. Angle divided malocclusion into three categories: Class I, Class II, and Class III. Skeletal Class II malocclusion can occur for a variety of reasons, including prognathic maxilla, retrognathic mandible, or a combination of these, resulting in a convex soft tissue profile.

Angle's Class II Division (1) Malocclusions are a primary concern of Orthodontics, affecting one-third of patients needing orthodontic treatment. In most populations, the prevalence is between 15 and 30%. Class II malocclusion, like other forms of malocclusions, is caused by a combination of hereditary and environmental causes (2)

Skeletal class II division 1 malocclusion in growing patients can be treated with headgear if the maxilla is prognathic, myofunctional therapy can correct mandibular retrognathism, and if both are present, headgear and myofunctional therapy can be combined to correct it. In non-growing patients, a Fixed Functional Appliance or Orthodontic Camouflage can be done to address mild to moderate class II malocclusion and to resolve severe class II malocclusions Orthognathic surgeries are done.

There are various types of intermaxillary appliances used to treat Class II malocclusion. Emil Herbst created his appliance in the early 1900s, and Pancherz reintroduced it in the late 1970s based on Kingsley's concept of "jumping the bite" in 1880 (4). Throughout history, numerous design variations have been used. The Herbst appliance is a fixed intermaxillary appliance that is noted for its effectiveness in treating class II malocclusions.

Functional appliances are classified into removable and fixed categories, with numerous designs within each group (5). Patient adaptation to removable functional appliances is problematic due to their Bulkiness and lack of stability in the oral cavity (6). Fixed functional appliances were created to address the shortcomings of removable functional appliances. Removable functional appliances include the Activator, Bionator, Frankel Regulator, and Twin Block. Korrodi Ritto (7) classifies fixed functional appliances as rigid (Herbst, MARA), flexible (Churro Jumper, Jasper Jumper) and hybrid (Forsus FRD, AdvanSync2) appliance.

The Forsus FRD is a three-piece (L pin module) or two-piece (EZ2 module) appliance consisting of a telescoping spring attached to the upper first molar and a push rod connected to the lower arch wire, distal to either the permanent canine or first premolar bracket. The FRD spring and rod apply an equal and opposing force to the maxillary and mandibular dentitions. Patients generally accept the appliance, while there may be some initial discomfort and functional limits that resolve over time (8).

AdvanSync2 (Ormco Co., Glendora, California, United States), a fixed functional appliance designed by Terry Dischinger in 2008, is a recent modification of the Herbst appliance. The AdvanSync2 was developed to be used in conjunction with Fixed Mechanotherapy. The telescoping mechanism constantly positions the mandible forward upon closure, with the purpose of promoting correction the Class II malocclusion. It is a molar-to-molar device with telescopic rods connecting the maxillary and mandibular arches. It is less bulky than the traditional Herbst appliance and has been shown to minimize treatment time by up to 6 to 9 months. It is far more comfortable to patients because it generates less discomfort and is

cosmetically pleasing because it is not visible in the mouth (9). The appliance helps maintain the mandible in a consistent forward position, stimulating further growth in a more favourable direction (10).

In current scenario, Forsus FRD and AdvanSync2 are gaining popularity due to comparatively better skeletal and dentoalveolar corrections, good patient compliance, minimal discomfort and reduced treatment time when compared to other techniques. Thus, the current study aims to compare and evaluate the pre- and post-treatment dentoalveolar, skeletal and soft tissue effects induced by Forsus FRD Appliance and AdvanSync2 Appliance.

Need of the Study:

After appraising the literature till 5th March, 2022 from PubMed, Google Scholar and Research Gate there were no studies found comparing dentoalveolar, skeletal and soft tissue changes between Forsus FRD and AdvanSync2. Due to its simplicity and versatility, in present day to day clinical practice Forsus is very popular fixed functional appliance. There are studies that compare Forsus FRD with Twin block¹¹, Jasper Jumper¹², Class II elastics¹³. AdvanSync2⁹ is a newer variety of fixed functional appliance, gaining popularity because of its compact design and reduction in overall treatment time. Hence, to derive the best appliance among Forsus and AdvanSync2 in terms of Skeletal, Dento-alveolar and soft tissue effects with best possible results in optimal time period becomes a need of an hour.

Aim & Objectives

Aim: To evaluate and Compare Skeletal, Dentoalveolar and Soft tissue effects of the Forsus FRD and AdvanSync2 Fixed Functional Appliances for correction of Angle's Class II Division 1 Malocclusion.

Objectives:

1. To evaluate the changes in Skeletal, Dento-Alveolar and Soft Tissue Parameters of Angles Class II division 1 malocclusion subjects with Forsus FRD.
2. To evaluate the changes in Skeletal, Dento-Alveolar and Soft Tissue Parameters of Angles Class II division 1 malocclusion subjects with AdvanSync2 Appliance
3. To compare the changes in Skeletal, Dento-Alveolar and Soft Tissue Parameters of Angles Class II division 1 malocclusion subjects between Forsus FRD and AdvanSync2 Fixed Functional Appliance

MATERIALS AND METHODS

A. Study design: -

Place of the Study: Department of Orthodontics and Dentofacial Orthopaedics, K. M. Shah Dental College & Hospital, Sumandeep Vidyapeeth Deemed to be University.

Source of Sample: Patients with Skeletal Class II malocclusion in the department of Orthodontics and Dentofacial Orthopaedics who necessitate Fixed Orthodontic Mechanotherapy (Pre-adjusted Edgewise) along with Fixed Functional Appliance.

Sample Description:

Sample size was calculated from studies conducted by Santosh Jayachandra et al¹⁷ and Akan et al²⁸, considering mean difference in improvement of skeletal measurement between two groups as 1.88 with SD 1.35, minimum 16 samples (8 per group) required to achieve 95% confidence with 80% power.

$$n = 2 \times (Z \cdot SD/d)^2$$

Where, Z = z-value corresponding to confidence and power = 2.802

SD = 1.35

d = Mean difference = 1.88

Assuming 20% loss to follow-up (Drop out), final sample size will be $16+4 = 20$ i.e. 10 per group.

Time Scale of the Study: Study was started after obtaining SVIEC approval and was completed within 18 months from the date of approval.

Selection Criteria:

A. Inclusion Criteria:

1. Angle's Class II Division 1 Malocclusion excluding subdivision
2. Skeletal Maturity Indicator shows CVMI Stage IV, V or VI i.e. after Peak Pubertal Growth Spurt
3. Non-Extraction Case
4. Orthognathic Maxilla ($SNA = 82 \pm 2$)
5. Retrognathic Mandible ($SNB \leq 77^\circ$)
6. ANB angle $\geq 5^\circ$
7. Horizontal Or Average Growth Pattern
8. Overjet > 4 mm and < 10 mm
9. Maxillary midline coincident with facial midline
10. Lower Incisor position should be upright on basal bone or suitable for up righting
11. Minimal crowding in dental arches (> 4 mm)
12. No functional lateral mandibular shift during closure
13. Positive Visual Treatment Objective (VTO)
14. Completely erupted permanent dentition except Third Molars

B. Exclusion Criteria:

Any Developmental Craniofacial Anomalies
Patient with Primary or Mixed Dentition
Anterior Open Bite
Vertical Growth Pattern

A. Equipment and Material used for the study: -

1. Dolphin Imaging Software (Version 11.5)
2. Glass Ionomer Cement (Luting Consistency)
3. Curing Light (Wood Pecker)
4. Forsus FRD Appliance Kit (3M Unitek)
5. AdvanSyn2 Appliance Kit (Ormco Corporation)
6. Diagnostic Instruments like Mouth mirror, Explorer & Tweezers.
7. Orthodontic Plier set (GDC)
8. Orthodontic Wiers (G&H)
9. Camera with Photographic Studio Setup (1500 D Canon)
10. Set of intra-oral Photographic Mirrors
11. Alginate Impression Material (DPI)
12. Orthokal (Orthodontic stone Class III)

B. Methodology: -

After Ethical approval from Sumandeep Vidyapeeth Institutional Ethical Committee (SVIEC), the study was conducted in the Department of Orthodontics and Dentofacial Orthopaedics, K. M. Shah Dental College & Hospital. The participants were selected as per the inclusion and exclusion criteria. The selected participants were introduced to the aims, objectives and methodology of the study with the help of Participant Information Sheet. A signed written Informed Consent was obtained from all the Patients. All the participants will be randomly and

equally distributed to Group-I: Forsus FRD 15 Appliance and Group -II: AdvanSync2 Appliance by the Process of Randomization using Python Software (Fig-1).

Fig 1: Process of Randomization using computerized software

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CA\Python27\python.exe

Welcome to the computer aided patient randomisation software
Enter total number of patients: 20

List of unique number codes assigned to each patient
[1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20]
The software generated randomised distribution is as follows:

ADV Sync2  should be used for patients with the following patient code :
[16, 12, 5, 6, 20, 7, 13, 11, 2, 8]

FRD  should be used for patients with the following patient code :
[10, 1, 3, 19, 18, 9, 15, 17, 4, 14]

.....Press Enter To Exit..... _

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All the required treatment records were taken at time frames T_0 (Before starting Fixed-Functional appliance therapy) and T_1 (After completion of Fixed-Functional appliance therapy). Lateral Cephalograms at time intervals T_0 & T_1 were further analysed with selected skeletal, dental and soft-tissue parameters (Table-1) on Dolphin Imaging Software (Version 11.5) (Fig: 2) to conclude the treatment results.

Table-1: Skeletal, Dental and Soft Tissue Parameters

Sr. No.	Type of Parameter	Name of Parameter	Description	Normal Value
Skeletal Parameters				
1.	Maxillary Skeletal Angular	Angle SNA	Angle between SN to point A- Specifies position of Maxilla irt. Cranial Base (Orthognathic, Prognathic or Retrognathic)	82°
2.	Maxillary Skeletal Linear	A-N $\perp$ FH (mm)	Linear distance measure between Point A to Nasion perpendicular on FH plane- Determines Anterior-Posterior orientation of the Maxilla to the Cranial Base	0 mm (Mixed Dentition) & 1mm (Adults)
3.	Maxillary Skeletal Linear	Co-Pt-A, (mm)	Linear distance between Condylion and Point A- Determines Total maxillary length.	86 mm

4.	Mandibular Skeletal Angular	Angle SNB	Angle between SN to point B- Specifies position of Mandible irt. Cranial Base (Orthognathic, Prognathic or Retrognathic)	80°
5.	Mandibular Skeletal Linear	Pog-N $\perp$ FH (mm)	Linear distance measure between Pogonion to Nasion perpendicular on FH plane- Determines relationship of the Mandible to the Cranial base	Male: (-2 to +2); Female: (-4 to 0)
6.	Mandibular Skeletal Linear	Co-Gn (mm)	Linear distance between Condylion and Gnathion- Determines total mandibular length.	106 mm
7.	Inter-maxillary Skeletal Angular	Angle ANB	Angle formed by intersection of lines joining Nasion to Point A and Nasion to Point B- Determines antero-posterior discrepancy between the maxillary to the mandibular apical bases	2°
8.	Inter-maxillary Skeletal Linear	Wits (mm)	Perpendicular are drawn to the occlusal plane from point A and point B- Determines antero-posterior discrepancy between maxilla and mandible	-1 mm (Male); 0 mm (Female)
9.	Vertical skeletal Angular	Angle FMA	Angle formed between the FH Plane and the Mandibular Plane- It indicates the growth pattern in vertical direction (Normodivergent, Hypodivergent or Hyperdivergent)	25°
Soft Tissue Parameters				
10.	Soft tissue Linear	E-Line	The line drawn from Tip of the Nose to Soft Tissue Pogonion- Indicates the soft tissue balance between the lips and the Profile	UL- 2-3 mm behind the E line & LL-1-2 mm behind the E line
11.	Soft tissue Linear	Subnasalae $\perp$ Chin	Linear distance between Sn perpendicular on FH Plane to Soft Tissue Pogonion- It describes the position of soft tissue Chin in relation to Maxilla	4-6mm
12.	Soft Tissue	Total Tissue	Angle formed between N'-tip of	133°(males)

	Angular	Profile Angle	the nose-pog'- it determines the Convexity or concavity of the profile	137° (females)
13.	Soft Tissue Angular	Soft Tissue Profile Angle	Angle formed between N'-sn-pog'- it determines the Convexity or concavity of the profile	161°
14.	Soft Tissue Angular	Nasolabial angle	Angle between the line form by the anterior columella to the subnasale and the line from subnasale to pogonion	90°-95° (males) 95° -115° (females)
15.	Soft Tissue Angular	Mentolabial Angle	Angle between the line formed by sublabaiale to labrale inferius and sublabiale to soft tissue pogonion	110°-130°
Dentoalveolar Parameters				
16.	Maxillary Dentoalveolar Angular and Linear	Upper Incisor to NA	Determines Angular and Linear location of Upper Incisor irt. NA line	Angular-22°& Linear-4mm
17.	Mandibular Dentoalveolar Angular and Linear	Lower Incisor-NB	Determines Angular and Linear location of Lower Incisor irt. NB line	Angular-25° & Linear-4mm
18.	Mandibular Dentoalveolar Angular	Angle IMPA	Angle formed by intersection of long axis of the Lower Incisor with the Mandibular Plane – Determines the inclination of the Lower Incisor	90°
19.	Maxillary Dentoalveolar Linear	U ₆ -PTM	Distance between Pterygoid Vertical to the Tangent parallel to Pterygoid Vertical on distal surface of the upper first molar	Difference in Measurement between T ₀ & T ₁ within the same Patient.
20.	Mandibular Dentoalveolar Linear	L ₆ -PTM	Distance between Pterygoid Vertical to the Tangent parallel to Pterygoid Vertical on distal surface of the Lower first molar	
21.	Maxillary Dentoalveolar Angular	U ₆ -NF	Angulation between Long axis of Upper First Molar and NF	
22.	Mandibular Dentoalveolar Angular	L ₆ - MP	Angulation between Long axis of Lower First Molar and MP	
23.	Inter-maxillary	Overjet	Extent of horizontal overlap of maxillary central incisors over the	2 mm

	Dental linear		mandibular central incisors	
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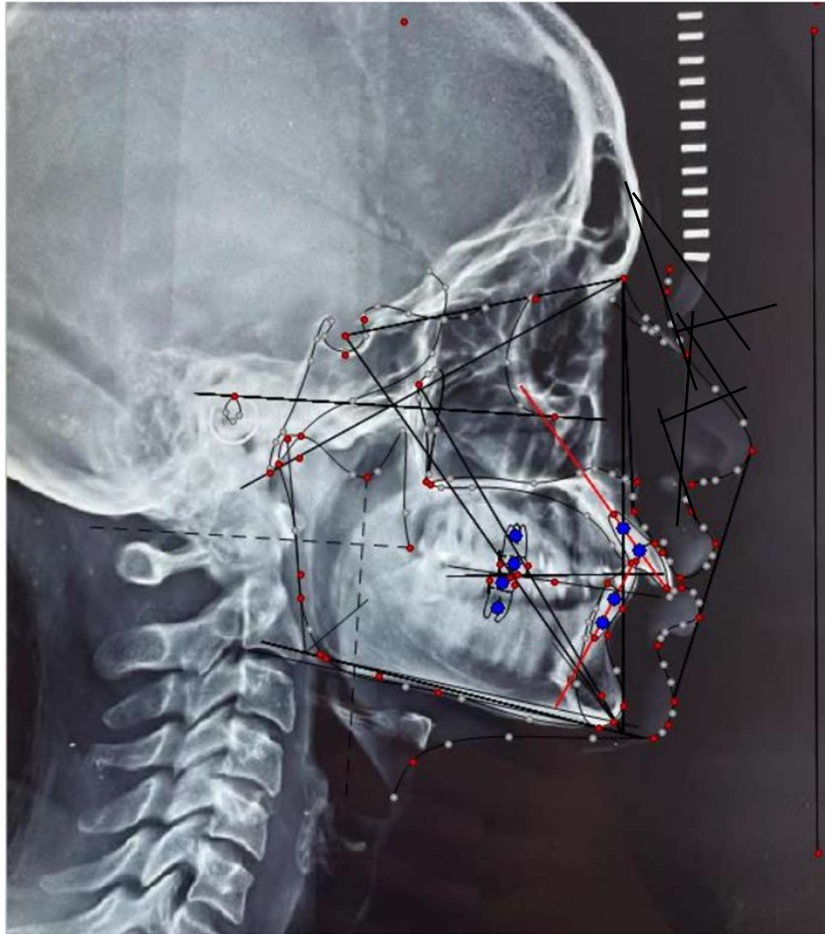


Fig.: 2 Cephalometric tracing of study parameters by Dolphin Cephalometric Software

Group-I: Forsus FRD Appliance:

After alignment and levelling, with tightly cinched 0.019*0.025 Stainless Steel Arch Wires in both upper and lower arches along with Trans-Palatal Arch in Maxilla for additional Anchorage, Forsus FRD Fixed Functional Appliance were inserted. The size of the appliance was selected with the measurement guide given in the appliance kit. The measurement was taken separately on right and left sides from the distal end of maxillary molar tube to the distal side of the mandibular canine Bracket, when patient bites in centric occlusion without advancing the mandible.

Patient were recalled monthly for routine check-up. Additional activation can be incorporate in the appliance with the crimps provided in kit. Maxillary incisor torque and mandibular incisor proclination were evaluated periodically. Once the targeted amount of correction was achieved with buccal segments in stable Angle's super-Class I molar relationship and Class I Canine Relationship, the appliance was removed. Photographic Records were taken after Levelling and Alignment and Before Inserting Forsus FRD appliance (Fig 3-7), With Forsus FRD appliance (Fig-8-10) and After completion of Advancement (Fig: 11-13). Skeletal, Dentoalveolar and Soft tissue parameters was evaluated at the time of T₁ (Before starting Fixed-Functional appliance therapy) and T₂ (After completion of Fixed-Functional appliance therapy).



Fig-3: Right Occlusion before



Fig-4: Left Occlusion before



Fig-5: Occlusion before Advancement



Fig-6: Mandibular Arch before



Fig-7: Maxillary Arch with TPA
before Advancement



Fig-8: Right Occlusion with Forsus
FRD Appliance



Fig-9: Left Occlusion with Forsus
FRD Appliance



Fig-10: Occlusion with Forsus FRD



Fig-11: Right Occlusion after Advancement



Fig-12: Left Occlusion after



Fig-13: Occlusion after Advancement

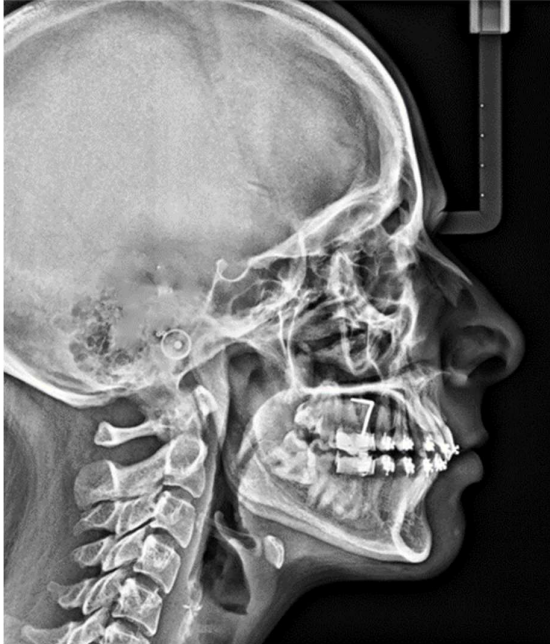


Fig-14: Lateral Cephalogram Before Fixed-Functional appliance therapy



Fig-15: Lateral Cephalogram after Fixed-Functional appliance therapy

Group -II: AdvanSync2 Appliance:

Pre-Adjusted Edgewise fixed Mechanotherapy with 0.022 MBT bracket system were bonded in both the upper and the lower arches. AdvanSync2 Appliance was installed simultaneously along with initiation of Aligning and levelling on the same appointment. AdvanSync2 appliance consist of right and left upper and lower first molar crowns with casing, Secure Screws and right and left Telescoping Rods with lumen. Lower Molar crown cementation was followed by upper molar crown cementation along with telescoping rod already attached to upper molar crown with secured screw through rod lumen. Additional screw retention can be achieved by dipping the screw in Ceka Bond. The Ceka Bond is an adhesive that prevents micro-unthreading of secure screw. Finally, to activate the appliance in desired edge to edge incisal relationship reactivation of 2-4 mm were performed. Photographic Records were taken Before Inserting AdvanSync2 appliance (Fig 16-18), With AdvanSync2 appliance (Fig-19-21) and After completion of Advancement (Fig: 22-24). Skeletal, Dentoalveolar and Soft tissue parameters was evaluated at the time of T₁ (Before starting Fixed-Functional appliance therapy) and T₂ (After completion of Fixed-Functional appliance therapy) (Fig: 25-26).



Fig-16: Right Occlusion before Advancement



Fig-17: Left Occlusion before Advancement



Fig-18: Occlusion Before Advancement



Fig-19: Right Occlusion with AdvabSync2 Appliance

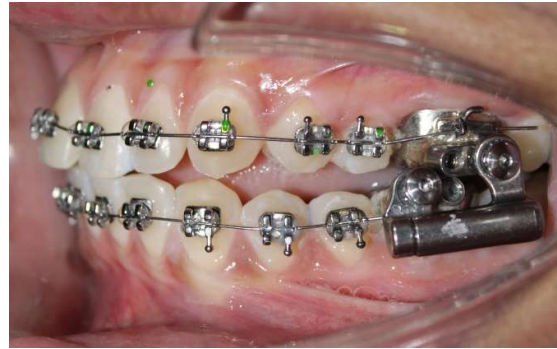


Fig-20: Left Occlusion with AdvabSync2 Appliance



Fig-21: Occlusion with AdvabSync2 Appliance

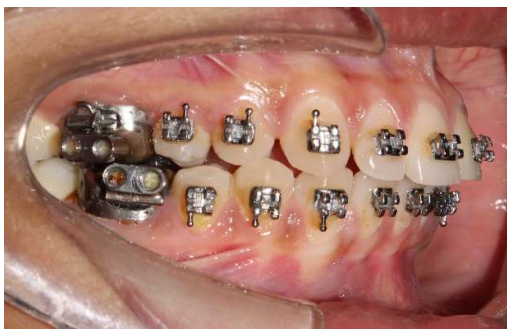


Fig-22: Right Occlusion after



Fig-23: Left Occlusion after



Fig-24: Occlusion after Advancement

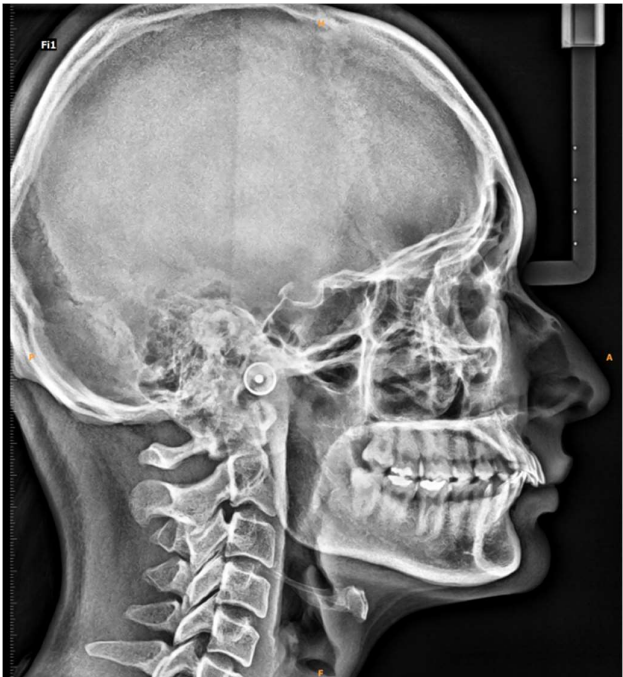


Fig-25: Lateral Cephalogram Before Fixed-Functional appliance therapy



Fig-26: Lateral Cephalogram after Fixed-Functional appliance therapy

RESULTS

Table 2: Demographic data

	Group	N	Mean	Std. Deviation	t	df	P VALUE
Age	Forsus FRD	10	20.900	1.370	0.172	18	0.866
	Advansync 2	10	20.800	1.229			

The data from Forsus FRD and AdvanSync2 groups were analysed under two main categories: Intergroup comparison and Intragroup comparison.

➤ **Intergroup Comparison:**

Independent t test was used to compare the two groups. Table 3 compares mean values of Skeletal Parameters between the two groups at Pretreatment and Post-treatment

The Angle SNA-T0 comparison between the two groups is statistically non-significant, and the Angle SNA-T1 comparison is also non-significant. When the Angle SNA-T1-T0 difference between the two groups is compared, it can be seen that the AdvanSync2 group has a higher Angle SNA-T1-T0 difference ($t = 11$), which is statistically significant ($p < 0.001$).

The Comparison in A-N Perpendicular to FH (mm)-T0 and A-N Perpendicular to FH (mm)-T1 between the two groups is statistically insignificant also A-N Perpendicular to FH (mm)-T1-T0 between the two groups is statistically non-significant

Comparison of the Co-Pt-A, (mm)-T0 and Co-Pt-A, (mm)-T1 between the two groups is statistically non-significant. Comparison of the Co-Pt-A, (mm)-T1-T0 difference between the two groups shows that Co-Pt-A, (mm)-T1-T0 difference is higher in Forsus FRD group and is statistically non-significant

Angle SNB-T0 between the two groups is statistically non-significant, while Angle SNB-T1 between the two groups is statistically non-significant with a p-value of 0.164. The comparison of the Angle SNB-T1-T0 difference between the two groups shows that the difference is greater in the FORSUS FRD group and is statistically non-significant with a p value of 1.

The comparison of the B-N Perpendicular to FH (mm)-T0 and B-N Perpendicular to FH (mm)-T1 between the two groups is statistically insignificant. A comparison of the B-N Perpendicular to FH (mm)-T1-T0 difference between the two groups indicates that the difference is greater in the FORSUS FRD group and is statistically non-significant with a p value of 0.038

The comparison of Co-Gn (mm)-T0 between the two groups reveals that it is statistically insignificant. The comparison of Co-Gn (mm)-T1 between the two groups is statistically non-significant, as is the comparison of Co-Gn (mm)-T1-T0 between the two groups.

The Angle ANB-T0 comparison between the two is not statistically significant. Angle ANB-T1 is higher in the FORSUS FRD group and is statistically non-significant. The FORSUS FRD group showed greater Angle ANB-T1-T0 difference compared to the AdvanSync2 group which was statistically non-significant.

The comparison of Wits (mm)-T0 between the two groups is statistically insignificant ($p = 0.054$). Comparison of the Wits (mm)-T1 between the two groups is statistically non-significant with a p value of 0.66. Comparison of the Wits (mm)-T1-T0 difference between the two groups shows that Wits (mm)-T1-T0 difference is also statistically non-significant

The Angle FMA-T0 comparison between the two groups is not statistically significant, with a p-value of 0.616. Angle FMA-T1 is significantly higher in the Advansync2 group ($t = -4.272$, $p < 0.001$) also the Advansync2 group has a significantly greater angle FMA-T1-T0 difference ($t = -4.497$, $p < 0.001$) compared to the other group.

The results suggest that the Forsus FRD group and AdvanSync2 Group showed similar pre and post treatment Skeletal Effects except AdvanSync2 group showed significantly higher Angle SNA-T1-T0 difference which suggest that AdvanSync2 group showed headgear effect on maxillary arch and also the Advansync2 group has a significantly greater angle FMA-T1 and FMA-T1-T0 difference compared to the Forsus FRD group which suggest that there is increase in divergence in AdvanSync2 group.

Table 3: Pretreatment and Post-treatment Skeletal Parameters comparison between Forsus and AdvanSync2 groups

Parameters	Group	N	Mean	Std. Deviation	t	df	P VALUE
Angle SNA-T0	FORSUS FRD	10	82.224	1.371	-2.512	18	0.17
	Advansync 2	10	83.659	2.467			
Angle SNA-T1	FORSUS FRD	10	81.000	1.155	-0.408	18	0.688
	Advansync 2	10	81.200	1.033			
Angle SNA-T1-T0 difference	FORSUS FRD	10	-1.024	0.316	11	9	<0.001
	Advansync 2	10	-2.659	0.312			
A-N Perpendicular to FH (mm)-T0	FORSUS FRD	10	2.000	0.000	-1.964	9	0.081
	Advansync 2	10	2.300	0.483			
A-N Perpendicular to FH (mm)-T1	FORSUS FRD	10	2.000	0.000	-1.964	9	0.081
	Advansync 2	10	2.300	0.483			
A-N Perpendicular to FH (mm)-T1-T0 difference	FORSUS FRD	10	0.000	0.000			
	Advansync 2	10	0.000	0.000			
Co-Pt-A, (mm)-T0	FORSUS FRD	10	83.700	5.519	0	18	1
	Advansync 2	10	83.700	6.482			
Co-Pt-A, (mm)-T1	FORSUS FRD	10	83.900	4.771	0.079	18	0.938
	Advansync 2	10	83.700	6.482			
Co-Pt-A, (mm)-T1-T0 difference	FORSUS FRD	10	0.200	1.398	0.452	18	0.656
	Advansync 2	10	0.000	0.000			
Angle SNB-T0	FORSUS FRD	10	76.100	1.101	-1.138	18	0.27
	Advansync 2	10	76.700	1.252			
Angle SNB-T1	FORSUS FRD	10	78.900	1.197	-1.45	18	0.164
	Advansync 2	10	79.500	0.527			
Angle SNB-T1-T0 difference	FORSUS FRD	10	2.800	0.422	0	12.629	1
	Advansync 2	10	2.800	0.919			
B-N Perpendicular to FH (mm)-T0	FORSUS FRD	10	6.100	1.370	1.741	11.203	0.109
	Advansync 2	10	5.300	0.483			
B-N Perpendicular to FH (mm)-T1	FORSUS FRD	10	3.100	0.568	7.005	18	0.120
	Advansync 2	10	1.400	0.516			
B-N Perpendicular to FH (mm)-T1-T0 difference	FORSUS FRD	10	-3.000	1.155	2.377	10.342	0.038
	Advansync 2	10	-3.900	0.316			
Co-Gn (mm)-T0	FORSUS FRD	10	107.300	7.364	1.248	18	0.228
	Advansync 2	10	103.800	4.940			

Co-Gn (mm)-T1	FORSUS FRD	10	107.30 0	7.364	1.248	18	0.228
	Advansync 2	10	103.80 0	4.940			
Co-Gn (mm)-T1-T0 difference	FORSUS FRD	10	0.000	0.000			
	Advansync 2	10	0.000	0.000			
Angle ANB-T0	FORSUS FRD	10	4.900	0.316	-3.656	14. 91 8	0.224
	Advansync 2	10	5.600	0.516			
Angle ANB-T1	FORSUS FRD	10	2.200	0.422	2.846	18	0.232
	Advansync 2	10	1.600	0.516			
Angle ANB-T1-T0 difference	FORSUS FRD	10	-2.700	0.483	4.333	18	0.264
	Advansync 2	10	-4.000	0.816			
Wits (mm)-T0	FORSUS FRD	10	3.600	1.075	-2.121	12. 94 4	0.054
	Advansync 2	10	4.400	0.516			
Wits (mm)-T1	FORSUS FRD	10	1.400	0.516	0.447	18	0.66
	Advansync 2	10	1.300	0.483			
Wits (mm)-T1-T0 difference	FORSUS FRD	10	-2.200	0.789	3.349	11. 82	0.042
	Advansync 2	10	-3.100	0.316			
Angle FMA-T0	FORSUS FRD	10	23.100	1.853	-0.51	18	0.616
	Advansync 2	10	23.500	1.650			
Angle FMA-T1	FORSUS FRD	10	24.000	1.414	-4.272	18	<0.001
	Advansync 2	10	26.400	1.075			
Angle FMA-T1-T0 difference	FORSUS FRD	10	0.900	1.197	-4.497	14. 97 5	<0.001
	Advansync 2	10	2.900	0.738			

Table 4 compares mean values of Dento-alveolar Parameters between the two groups at Pretreatment and Post-treatment.

The comparison of U1 to NA Angular-T0 between the two groups is not statistically significant. The U1 to NA Angular-T1 between the two groups is statistically non-significant ($p = 0.545$), as is the U1 to NA Angular-T1-T0 difference ($p = 0.935$).

Comparison of the U1 to NA Linear-T0 and U1 to NA Linear-T1 between the two groups is statistically non-significant with and Comparison of the U1 to NA Linear-T1-T0 difference between the two groups is also statistically non-significant.

The L1-NB Angular-T0 comparison between the two groups is not statistically significant ($p = 0.132$). The L1-NB Angular-T1 difference between the two groups is statistically non-significant with a p value of 0.104, as is the L1-NB Angular-T1-T0 difference with a p value of 0.785.

Comparison of the L1-NB Linear-T0 and L1-NB Linear-T1 between the two groups is statistically non-significant and Comparison of the L1-NB Linear-T1-T0 difference between the two groups is statistically non-significant with a p value of 0.773

The Angle IMPA-T0 comparison between the two groups is not statistically significant (p -value = 0.772). The Angle IMPA-T1 comparison between the two groups is not statistically significant ($p = 0.09$). The Angle IMPA-T1-T0 difference between the two groups is statistically non-significant ($p = 0.303$).

Comparison of the U6-PTM Linear-T0 and U6-PTM Linear-T1 between the two groups is statistically non-significant. and Comparison of the U6-PTM Linear-T1-T0 difference between the two groups is also statistically non-significant.

The L6-PTM Linear-T0 comparison between the two groups is statistically insignificant ($p = 0.21$). The L6-PTM Linear-T1 comparison between the two groups is statistically non-significant with a p value of 0.604, and the L6-PTM Linear-T1-T0 difference between the two groups is also statistically non-significant with a p value of 0.12.

Comparison of the U6-NF Angular-T0 between the two Groups is statistically non-significant. Comparison of the U6-NF Angular-T1 between the two groups shows that U6-NF Angular-T1 is higher in FORSUS FRD group with a t value of 2.744 and is statistically significant with a p value of 0.013 and Comparison of the U6-NF Angular-T1-T0 difference between the two groups shows that U6-NF Angular-T1-T0 difference is higher in Forsus FRD group with a t -value of -11.156 and is statistically significant with a p value of <0.001 .

Comparison of the L6- MP Angular-T0 between the two groups is statistically NON-significant and Comparison of the L6- MP Angular-T1 between the two groups shows that L6- MP Angular-T1 is higher in Advansync2 group with a t value of -0.285 and is statistically significant with a p value of <0.001 and Comparison of the L6- MP Angular-T1-T0 difference between the two groups shows that L6- MP Angular-T1-T0 difference is higher AdvanSync2 group with a t value of 14.807 and is statistically significant with a p value of <0.001

Comparison of the Overjet-T0 and Overjet-T1 between the two groups is statistically non-significant with a p value of 0.532 and 0.673 respectively. Comparison of the Overjet-T1-T0 difference between the two groups is statistically non-significant with a p value of 0.302

The results suggest that the Forsus FRD group and AdvanSync2 Group showed similar pre and post treatment Dentoalveolar Effects except U6-NF Angular-T1 and U6-NF Angular-T1-T0 difference is significantly higher in Forsus FRD group indication distal root tipping of maxillary first molars and that L6- MP Angular-T1 and L6- MP Angular-T1-T0 difference is higher AdvanSync2 group indicating mesial crown tipping of mandibular first molars

Table 4: Pretreatment and Post-treatment Dento-alveolar Parameters comparison between Forsus and AdvanSync2 groups

Parameters	Group	N	Mean	Std. Deviation	t	df	P VALUE
U1 to NA Angular-T0	FORSUS FRD	10	30.100	7.738	-0.421	18	0.679
	Advansync 2	10	31.600	8.195			
U1 to NA Angular-T1	FORSUS FRD	10	25.300	5.272	-0.618	18	0.545
	Advansync 2	10	27.000	6.928			
U1 to NA Angular-T1-T0 difference	FORSUS FRD	10	-4.800	7.021	-0.082	18	0.935
	Advansync 2	10	-4.600	3.169			
U1 to NA Linear-T0	FORSUS FRD	10	6.500	2.068	-0.139	18	0.891
	Advansync 2	10	6.600	0.966			
U1 to NA Linear-T1	FORSUS FRD	10	4.800	1.033	6.934	12.758	0.896
	Advansync 2	10	2.300	0.483			

U1 to NA Linear-T1-T0 difference	FORSUS FRD	10	-1.700	1.337	5.014	18	0.812
	Advansync 2	10	-4.300	0.949			
L1-NB Angular- T0	FORSUS FRD	10	29.700	3.529	- 1.576	18	0.132
	Advansync 2	10	32.700	4.877			
L1-NB Angular- T1	FORSUS FRD	10	35.400	3.688	- 1.712	18	0.104
	Advansync 2	10	38.700	4.855			
L1-NB Angular- T1-T0 difference	FORSUS FRD	10	5.700	2.406	- 0.276	18	0.785
	Advansync 2	10	6.000	2.449			
L1-NB Linear- T0	FORSUS FRD	10	5.600	0.516	4.366	18	0.213
	Advansync 2	10	4.400	0.699			
L1-NB Linear- T1	FORSUS FRD	10	7.700	0.483	2.952	12.492	0.212
	Advansync 2	10	6.600	1.075			
L1-NB Linear- T1-T0 difference	FORSUS FRD	10	2.100	0.738	- 0.293	18	0.773
	Advansync 2	10	2.200	0.789			
Angle IMPA-T0	FORSUS FRD	10	100.700	5.813	- 0.294	18	0.772
	Advansync 2	10	101.400	4.766			
Angle IMPA-T1	FORSUS FRD	10	104.900	3.510	- 1.793	18	0.09
	Advansync 2	10	108.600	5.502			
Angle IMPA-T1- T0 difference	FORSUS FRD	10	4.200	7.983	-1.06	18	0.303
	Advansync 2	10	7.200	4.050			
U6-PTM Linear- T0	FORSUS FRD	10	17.800	2.573	2.775	18	0.212
	Advansync 2	10	15.000	1.886			
U6-PTM Linear- T1	FORSUS FRD	10	17.800	2.573	2.775	18	0.312
	Advansync 2	10	15.000	1.886			
U6-PTM Linear- T1-T0 difference	FORSUS FRD	10	0.000	0.000			
	Advansync 2	10	0.000	0.000			
L6-PTM Linear- T0	FORSUS FRD	10	15.400	2.675	1.3	18	0.21
	Advansync 2	10	14.000	2.108			
L6-PTM Linear- T1	FORSUS FRD	10	18.400	3.239	0.528	18	0.604
	Advansync 2	10	17.800	1.549			
L6-PTM Linear- T1-T0 difference	FORSUS FRD	10	3.000	1.155	- 1.633	18	0.12
	Advansync 2	10	3.800	1.033			

U6-NF Angular-T0	FORSUS FRD	10	101.800	4.492	5.002	18	0.213
	Advansync 2	10	91.900	4.358			
U6-NF Angular-T1	FORSUS FRD	10	97.200	4.566	2.744	18	0.013
	Advansync 2	10	91.700	4.398			
U6-NF Angular-T1-T0 difference	FORSUS FRD	10	-4.600	1.075	-11.16	18	<0.001
	Advansync 2	10	-0.200	0.632			
L6- MP Angular-T0	FORSUS FRD	10	91.700	1.494	-3.466	18	0.152
	Advansync 2	10	96.200	3.824			
L6- MP Angular-T1	FORSUS FRD	10	91.700	1.494	-0.285	18	<0.001
	Advansync 2	10	92.100	4.175			
L6- MP Angular-T1-T0 difference	FORSUS FRD	10	0.000	0.000	14.81	9	<0.001
	Advansync 2	10	-4.100	0.876			
Overjet-T0	FORSUS FRD	10	6.300	1.767	0.641	13.169	0.532
	Advansync 2	10	5.900	0.876			
Overjet-T1	FORSUS FRD	10	1.400	0.516	-0.429	18	0.673
	Advansync2	10	1.500	0.527			
Overjet-T1-T0 difference	FORSUS FRD	10	-4.900	1.370	-1.08	11.506	0.302
	AdvanSync2	10	-4.400	0.516			

Table 5 shows the mean values of Soft Tissue Parameters between Forsus FRD groups and AdvanSync2 groups at T1, T2 and T1-T2 and suggests that there was no significant difference in the Upper Lip to E-line, Lower Lip to E-line, Sn Perpendicular to Chin Linear, Soft Tissue Profile Angle, Total Tissue Profile Angle, Nasolabial angle, and Mentolabial angle at the end of fixed functional appliance therapy. According to the findings, the Forsus FRD and the AdvanSync2 showed similar soft tissue effects.

Table 5: Pretreatment and Post-treatment Soft Tissue Parameters comparison between Forsus FRD and AdvanSync2 groups

Parameters	Group	N	Mean	Std. Deviation	t	df	P VALUE
UL to E-Line-T0	FORSUS FRD	10	1.600	0.966	0	18	1
	Advansync 2	10	1.600	1.506			
UL to E-Line-T1	FORSUS FRD	10	1.500	0.850	-0.183	14.207	0.857
	Advansync 2	10	1.600	1.506			
UL to E-Line-T1-T0 difference	FORSUS FRD	10	-0.100	0.316	-1	9	0.343
	Advansync 2	10	0.000	0.000			
LL to E-Line-T0	FORSUS FRD	10	1.300	1.160	0.187	18	0.854
	Advansync 2	10	1.200	1.229			

LL to E-Line-T1	FORSUS FRD	10	1.200	1.033	0	18	1
	Advansync 2	10	1.200	1.229			
LL to E-Line-T1-T0 difference	FORSUS FRD	10	-0.100	0.316	-1	9	0.343
	Advansync 2	10	0.000	0.000			
Sn Perpendicular to Chin Linear-T0	FORSUS FRD	10	10.800	2.486	1.124	18	0.276
	Advansync 2	10	9.800	1.317			
Sn Perpendicular to Chin Linear-T1	FORSUS FRD	10	6.500	2.068	1.124	18	0.276
	Advansync 2	10	4.000	0.471			
Sn Perpendicular to Chin Linear-T1-T0 difference	FORSUS FRD	10	-4.300	1.160	3.727	9.9 33	0.124
	Advansync 2	10	-5.800	1.476			
Soft Tissue Profile Angle-T0	FORSUS FRD	10	149.50 0	2.506	2.426	18	0.221
	Advansync 2	10	148.20 0	5.138			
Soft Tissue Profile Angle-T1	FORSUS FRD	10	158.30 0	1.494	0.719	18	0.481
	Advansync 2	10	154.90 0	4.067			
Soft Tissue Profile Angle-T1-T0 difference	FORSUS FRD	10	8.800	1.619	2.481	18	0.122
	Advansync 2	10	6.700	5.794			
Total Tissue Profile Angle -T0	FORSUS FRD	10	124.40 0	4.088	1.104	18	0.284
	Advansync 2	10	123.50 0	4.696			
Total Tissue Profile Angle -T1	FORSUS FRD	10	131.80 0	3.048	0.457	18	0.653
	Advansync 2	10	130.90 0	4.408			
Total Tissue Profile Angle -T1-T0 difference	FORSUS FRD	10	7.400	3.658	0.531	18	0.602
	Advansync 2	10	7.400	2.271			
Nasolabial Angle-T0	FORSUS FRD	10	99.300	1.947	0	18	1
	Advansync 2	10	99.000	3.916			
Nasolabial Angle-T1	FORSUS FRD	10	99.200	1.932	0.217	18	0.831
	Advansync 2	10	98.600	3.565			
Nasolabial Angle-T1-T0 difference	FORSUS FRD	10	-0.100	0.316	0.468	18	0.645
	Advansync 2	10	-0.400	1.075			
Mentolabial Angle-T0	FORSUS FRD	10	81.200	12.390	0.847	18	0.408
	Advansync 2	10	84.400	10.458			
Mentolabial Angle-T1	FORSUS FRD	10	91.000	10.306	-0.624	18	0.54
	Advansync 2	10	94.600	12.686			
Mentolabial Angle-T1-T0 difference	FORSUS FRD	10	9.800	3.155	-0.696	18	0.495
	Advansync 2	10	10.78	3.38			

➤ **Intragroup Comparison:**

Paired t test was used to compare pre- and post-treatment Skeletal, Dentoalveolar and Soft tissue effects in each group separately.

• **Intragroup Pre- and Post-Treatment Comparison in Forsus FRD Group**

Table 6 represents the pre- and post-treatment comparison of skeletal parameters in Forsus FRD Group. On comparison of the mean values of the pre- and post-treatment SNA angles were similar (81 ± 1.16) with no statistical significance. The mean values of the pre- and post-treatment values of A-N Perpendicular to FH (mm) was also similar (2 ± 0) with no statistical significance. the pre- and post-treatment mean values of Co-Pt-A, (mm) was 83.7 ± 5.52 and 83.9 ± 4.77 , respectively which was not statistically significant (0.662). the mean values of SNB increased from 76.1 ± 1.1 and 78.9 ± 1.2 degrees, which was statistically significant with a p value of <0.001 . The pre- and post-treatment mean values of B-N Perpendicular to FH reduced from 6.1 ± 1.37 to 3.1 ± 0.57 , respectively which was statistically significant with a p value of <0.001 . the pre- and post-treatment mean values of Co-Gn (mm) were similar (107.3 ± 7.36) with no statistical significance. The pre- and post-treatment mean values ANB Angle reduced from 4.9 ± 0.32 to 2.2 ± 0.42 , respectively which was statistically significant with a p value of <0.001 . also, the mean values of Wits (mm) reduced from 3.6 ± 1.08 to 1.4 ± 0.52 which was statistically significant. the pre- and post-treatment mean values of Angle FMA increased from 23.1 ± 1.85 to 24 ± 1.41 , respectively which was statistically significant. The results indicate that there was significant improvement in the skeletal parameters- SNB angle, B-N Perpendicular to FH, ANB angle, Wits (mm) and Angle FMA in the Forsus FRD group.

Table 6: pre- and post-treatment comparison of skeletal parameters in Forsus FRD Group

Parameters	Time	N	Mean $\pm$ SD	Mean difference $\pm$ SD	t	P VALUE
Angle SNA	T0	10	81 ± 1.16			
	T1	10	81 ± 1.16			
A-N Perpendicular to FH (mm)	T0	10	2 ± 0			
	T1	10	2 ± 0			
Co-Pt-A, (mm)	T0	10	83.7 ± 5.52	-0.2 ± 1.4	-0.45	0.662
	T1	10	83.9 ± 4.77			
Angle SNB	T0	10	76.1 ± 1.1	-2.8 ± 0.42	-21.00	<0.001
	T1	10	78.9 ± 1.2			
B-N Perpendicular to FH (mm)	T0	10	6.1 ± 1.37	3 ± 1.16	8.22	<0.001
	T1	10	3.1 ± 0.57			
Co-Gn (mm)	T0	10	107.3 ± 7.36			
	T1	10	107.3 ± 7.36			
Angle ANB	T0	10	4.9 ± 0.32	2.7 ± 0.48	17.68	<0.001
	T1	10	2.2 ± 0.42			
Wits (mm)	T0	10	3.6 ± 1.08	2.2 ± 0.79	8.82	<0.001
	T1	10	1.4 ± 0.52			
Angle FMA	T0	10	23.1 ± 1.85	-0.9 ± 1.2	-2.38	0.041
	T1	10	24 ± 1.41			

Table 7 represents the pre- and post-treatment comparison of Dentoalveolar parameters in Forsus FRD Group. The pre- and post-treatment mean values of U1 to NA Angular reduced from 30.1 ± 7.74 to 25.3 ± 5.27 , respectively which was non-significant. mean values of U1 to NA liner reduced from 6.5 ± 2.07 to 4.8 ± 1.03 which was non-significant. The pre- and post-treatment mean values of L1 to NB Angular increased from 29.7 ± 3.53 to 35.4 ± 3.69 , respectively which was statically significant and mean values of L1 to NB liner increased from 5.6 ± 0.52 to 7.7 ± 0.48 which was statically significant. The pre- and post-treatment mean values of IMPA Angle increased from 100.7 ± 5.81 to 104.9 ± 3.51 , respectively which was statically significant. The pre- and post-treatment mean values of U6 to PTM liner was similar (17.8 ± 2.57) and statically non-significant whereas the mean values of L6 to PTM liner increased from 15.4 ± 2.68 to 18.4 ± 3.24 which was statically significant. The pre- and post-treatment mean values of U6 to NF Angular reduced from 101.8 ± 4.49 to 97.2 ± 4.57 , respectively and was statically significant whereas the mean values of L6 to MP liner was similar (91.7 ± 1.49) and statically non-significant. The pre- and post-treatment mean values of Overjet reduced from 6.3 ± 1.77 to 1.4 ± 0.52 , respectively which was statically significant. The results indicate that there was significant improvement in the Dentoalveolar parameters- L1-NB Angular, L1- NB Linear, Angle IMPA, L6 PTM Linear, U6-NF Angular and Overjet in the Forsus FRD group.

Table 7: Pre- and Post-treatment comparison of Dentoalveolar parameters in Forsus FRD Group

Parameters	Time	N	Mean $\pm$ SD	Mean difference $\pm$ SD	t	P VALUE
U1 to NA Angular	T0	10	30.1 ± 7.74	4.8 ± 7.02	2.16	0.059
	T1	10	25.3 ± 5.27			
U1 to NA Linear	T0	10	6.5 ± 2.07	1.7 ± 1.34	4.02	0.039
	T1	10	4.8 ± 1.03			
L1-NB Angular	T0	10	29.7 ± 3.53	-5.7 ± 2.41	-7.49	<0.001
	T1	10	35.4 ± 3.69			
L1-NB Linear	T0	10	5.6 ± 0.52	-2.1 ± 0.74	-9.00	<0.001
	T1	10	7.7 ± 0.48			
Angle IMPA	T0	10	100.7 ± 5.81	-4.2 ± 7.98	-1.66	0.131
	T1	10	104.9 ± 3.51			
U6-PTM Linear	T0	10	17.8 ± 2.57			
	T1	10	17.8 ± 2.57			
L6-PTM Linear	T0	10	15.4 ± 2.68	-3 ± 1.16	-8.22	<0.001
	T1	10	18.4 ± 3.24			
U6-NF Angular	T0	10	101.8 ± 4.49	4.6 ± 1.08	13.53	<0.001
	T1	10	97.2 ± 4.57			
L6- MP Angular	T0	10	91.7 ± 1.49			
	T1	10	91.7 ± 1.49			
Overjet	T0	10	6.3 ± 1.77	4.9 ± 1.37	11.31	<0.001
	T1	10	1.4 ± 0.52			

Table 8 represents the pre- and post-treatment comparison of Soft Tissue parameters in Group 1 i.e. Forsus FRD Group. The pre- and post-treatment mean values of UL To E-Line reduced from 1.6 ± 0.97 to 1.5 ± 0.85 , respectively which was non-significant whereas mean values of LL

To E-Line reduced from 1.3 ± 1.16 to 1.2 ± 1.03 , which was also non-significant. The pre- and post-treatment mean values of Sn Perpendicular to Chin Linear reduced from 10.8 ± 2.49 to 6.5 ± 2.07 , respectively which was statically significant. The mean values of soft tissue profile angle increased from 149.5 ± 2.51 to 158.3 ± 1.49 which was statically significant and the mean values of Total Tissue Profile Angle increased from 124.4 ± 4.09 to 131.8 ± 3.05 which was also statically significant. The mean values of Nasolabial Angle reduced from 99.3 ± 1.95 to 99.2 ± 1.93 which was not significant whereas the Mentolabial Angle increased from 81.2 ± 12.39 to 91 ± 10.31 Which was statically significant. The results indicate that there was significant improvement in the soft tissue parameters- Sn Perpendicular to Chin Linear, Soft Tissue Profile Angle, Total Tissue Profile Angle and Mentolabial Angle in the Forsus FRD group.

Table 8: Pre- and post-treatment comparison of Soft Tissue parameters in Forsus FRD Group

Parameter	Time	N	Mean $\pm$ SD	Mean difference $\pm$ SD	t	P VALUE
UL to E-Line	T0	10	1.6 ± 0.97	0.1 ± 0.32	1.00	0.343
	T1	10	1.5 ± 0.85			
LL to E-Line	T0	10	1.3 ± 1.16	0.1 ± 0.32	1.00	0.343
	T1	10	1.2 ± 1.03			
Sn Perpendicular to Chin Linear	T0	10	10.8 ± 2.49	4.3 ± 1.16	11.73	<0.001
	T1	10	6.5 ± 2.07			
Soft Tissue Profile Angle	T0	10	149.5 ± 2.51	-8.8 ± 1.62	-17.19	<0.001
	T1	10	158.3 ± 1.49			
Total Tissue Profile Angle	T0	10	124.4 ± 4.09	-7.4 ± 3.66	-6.40	<0.001
	T1	10	131.8 ± 3.05			
Nasolabial Angle	T0	10	99.3 ± 1.95	0.1 ± 0.32	1.00	0.343
	T1	10	99.2 ± 1.93			
Mentolabial Angle	T0	10	81.2 ± 12.39	-9.8 ± 3.16	-9.82	<0.001
	T1	10	91 ± 10.31			

- Intragroup pre- and post-treatment comparison in AdvanSync2 group**

Table 9 represents the pre- and post-treatment comparison of skeletal parameters in AdvanSync2 Group. On comparison of the mean values of the pre- and post-treatment SNA angle reduced from 82.3 ± 1.16 to 81.2 ± 1.03 which was statistically significant. The of the mean values of the pre- and post-treatment values of A-N Perpendicular to FH (mm) was also similar (2.3 ± 0.48) with no statistical significance. the pre- and post-treatment mean values of Co-Pt-A, (mm) was (83.7 ± 6.48) similar with no statistical significance. the mean values of SNB increased from 76.7 ± 1.25 and 79.5 ± 0.53 degrees, which was statistically significant with a p value of <0.001. The pre- and post-treatment mean values of B-N Perpendicular to FH reduced from 5.3 ± 0.48 to 1.4 ± 0.52 , respectively which was statistically significant with a p value of <0.001. the pre- and post-treatment mean values of Co-Gn (mm) were similar (103.8 ± 4.94) with no statistical significance. The pre- and post-treatment mean values ANB Angle reduced from 5.6 ± 0.52 to 1.6 ± 0.52 , respectively which was statistically significant with a p value of <0.001. also, the mean values of Wits (mm) reduced from 4.4 ± 0.52 to 1.3 ± 0.48 which was statistically significant with a p value of <0.001. the pre- and post-treatment mean values of Angle FMA increased from 23.5 ± 1.65 to 26.4 ± 1.08 , respectively which was statistically significant with a p value of <0.001. The results indicate that there was significant improvement

in the skeletal parameters- SNA angle, SNB angle, B-N Perpendicular to FH, ANB angle, Wits (mm) and Angle FMA in the AdvanSync2 group.

Table 9: pre- and post-treatment comparison of Skeletal parameters in AdvanSync2 Group

Parameters	Time	N	Mean $\pm$ SD	Mean difference $\pm$ SD	t	P VALUE
Angle SNA	T0	10	82.3 $\pm$ 1.16	1.1 $\pm$ 0.13		<0.001
	T1	10	81.2 $\pm$ 1.03			
A-N Perpendicular to FH (mm)	T0	10	2.3 $\pm$ 0.48			
	T1	10	2.3 $\pm$ 0.48			
Co-Pt-A, (mm)	T0	10	83.7 $\pm$ 6.48			
	T1	10	83.7 $\pm$ 6.48			
Angle SNB	T0	10	76.7 $\pm$ 1.25	-2.8 $\pm$ 0.92	-9.64	<0.001
	T1	10	79.5 $\pm$ 0.53			
B-N Perpendicular to FH (mm)	T0	10	5.3 $\pm$ 0.48	3.9 $\pm$ 0.32	39.00	<0.001
	T1	10	1.4 $\pm$ 0.52			
Co-Gn (mm)	T0	10	103.8 $\pm$ 4.94			
	T1	10	103.8 $\pm$ 4.94			
Angle ANB	T0	10	5.6 $\pm$ 0.52	4 $\pm$ 0.82	15.49	<0.001
	T1	10	1.6 $\pm$ 0.52			
Wits (mm)	T0	10	4.4 $\pm$ 0.52	3.1 $\pm$ 0.32	31.00	<0.001
	T1	10	1.3 $\pm$ 0.48			
Angle FMA	T0	10	23.5 $\pm$ 1.65	-2.9 $\pm$ 0.74	-12.43	<0.001
	T1	10	26.4 $\pm$ 1.08			

Table 10 represents the pre- and post-treatment comparison of Dentoalveolar parameters in AdvanSync2 Group. The pre- and post-treatment mean values of U1 to NA Angular reduced from 31.6 $\pm$ 8.2 to 27 $\pm$ 6.93, respectively which was statically significant. The mean values of U1 to NA liner reduced from 6.6 $\pm$ 0.97 to 2.3 $\pm$ 0.48, respectively which was statically significant. The pre- and post-treatment mean values of L1 to NB Angular increased from 32.7 $\pm$ 4.88 to 38.7 $\pm$ 4.86, respectively which was statically significant and mean values of L1 to NB liner increased from 4.4 $\pm$ 0.7 to 6.6 $\pm$ 1.08 which was statically significant. The pre- and post-treatment mean values of IMPA Angle increased from 101.4 $\pm$ 4.77 to 108.6 $\pm$ 5.5, respectively which was statically significant. The pre- and post-treatment mean values of U6 to PTM liner was similar (15 $\pm$ 1.89) and statically non-significant whereas the mean values of L6 to PTM liner increased from 14 $\pm$ 2.11 to 17.8 $\pm$ 1.55 which was statically significant. The pre- and post-treatment mean values of U6 to NF Angular increased from 91.9 $\pm$ 4.36 to 91.7 $\pm$ 4.4, respectively and was statically non-significant whereas the mean values of L6 to MP liner reduced from 96.2 $\pm$ 3.82 to 92.1 $\pm$ 4.18 and was statically significant. The pre- and post-treatment mean values of Overjet reduced from 5.9 $\pm$ 0.88 to 1.5 $\pm$ 0.53, respectively which was statically significant. The results indicate that there was significant improvement in the Dentoalveolar parameters- U1 to NA Angular, U1 to NA Linear, L1- NB Angular, L1- NB Linear, Angle IMPA, L6 PTM Linear, L6-MP Angular and Overjet in the AdvanSync2 Group.

Table 10: pre- and post-treatment comparison of Dentoalveolar parameters in AdvanSync2 Group

Parameters	Time	N	Mean $\pm$ SD	Mean difference $\pm$ SD	t	P VALUE
U1 to NA Angular	T0	10	31.6 $\pm$ 8.2	4.6 $\pm$ 3.17	4.59	0.001
	T1	10	27 $\pm$ 6.93			
U1 to NA Linear	T0	10	6.6 $\pm$ 0.97	4.3 $\pm$ 0.95	14.33	<0.001
	T1	10	2.3 $\pm$ 0.48			
L1–NB Angular	T0	10	32.7 $\pm$ 4.88	-6 $\pm$ 2.45	-7.75	<0.001
	T1	10	38.7 $\pm$ 4.86			
L1–NB Linear	T0	10	4.4 $\pm$ 0.7	-2.2 $\pm$ 0.79	-8.82	<0.001
	T1	10	6.6 $\pm$ 1.08			
Angle IMPA	T0	10	101.4 $\pm$ 4.77	-7.2 $\pm$ 4.05	-5.62	<0.001
	T1	10	108.6 $\pm$ 5.5			
U6-PTM Linear	T0	10	15 $\pm$ 1.89			
	T1	10	15 $\pm$ 1.89			
L6-PTM Linear	T0	10	14 $\pm$ 2.11	-3.8 $\pm$ 1.03	-11.64	<0.001
	T1	10	17.8 $\pm$ 1.55			
U6-NF Angular	T0	10	91.9 $\pm$ 4.36	0.2 $\pm$ 0.63	1.00	0.343
	T1	10	91.7 $\pm$ 4.4			
L6- MP Angular	T0	10	96.2 $\pm$ 3.82	4.1 $\pm$ 0.36	13.53	<0.001
	T1	10	92.1 $\pm$ 4.18			
Overjet	T0	10	5.9 $\pm$ 0.88	4.4 $\pm$ 0.52	26.94	<0.001
	T1	10	1.5 $\pm$ 0.53			

Table 11 represents the pre- and post-treatment comparison of Soft Tissue parameters in AdvanSync2 Group. The pre- and post-treatment mean values of UL To E-Line is the same (1.6 $\pm$ 1.51) which was Statistically non-significant and the pre- and post-treatment mean values of LL To E-Line is also the same (1.2 $\pm$ 1.23), which was also Statistically non-significant. The pre- and post-treatment mean values of Sn Perpendicular to Chin Linear reduced from 9.8 $\pm$ 1.32 to 4 $\pm$ 0.47, respectively which was statically significant. The mean values of soft tissue profile angle increased from 148.2 $\pm$ 5.14 to 154.9 $\pm$ 4.07 which was statically significant and the mean values of Total Tissue Profile Angle increased from 123.5 $\pm$ 4.7 to 130.9 $\pm$ 4.41 which was also statically significant. The pre- and post-treatment mean values of Nasolabial Angle reduced from 99 $\pm$ 3.92 to 98.6 $\pm$ 3.57 which was statically not significant whereas the Mentolabial Angle increased from 84.4 $\pm$ 10.46 to 94.6 $\pm$ 12.69 Which was statically significant. The results indicate that there was significant improvement in the soft tissue parameters- Sn Perpendicular to Chin Linear, Soft Tissue Profile Angle, Total Tissue Profile Angle and Mentolabial Angle in the AdvanSync2 Group.

Table 11: pre- and post-treatment comparison of Soft Tissue parameters in AdvanSync2 Group

Parameters	Time	N	Mean $\pm$ SD	Mean difference $\pm$ SD	t	P VALUE
UL to E-Line	T0	10	1.6 $\pm$ 1.51			
	T1	10	1.6 $\pm$ 1.51			
LL to E-Line	T0	10	1.2 $\pm$ 1.23			

	T1	10	1.2±1.23			
Sn Perpendicular to Chin Linear	T0	10	9.8±1.32	5.8±1.48	12.43	<0.001
	T1	10	4±0.47			
Soft Tissue Profile Angle	T0	10	148.2±5.14	-6.7±5.79	-3.66	0.005
	T1	10	154.9±4.07			
Total Tissue Profile Angle	T0	10	123.5±4.7	-7.4±2.27	-	<0.001
	T1	10	130.9±4.41			
Nasolabial Angle	T0	10	99±3.92	0.4±1.08	1.18	0.269
	T1	10	98.6±3.57			
Mentolabial Angle	T0	10	84.4±10.46	-	-8.78	<0.001
	T1	10	94.6±12.69			

DISCUSSION

Angle's Class II Division I Malocclusions are a major concern in Orthodontics, affecting majority of patients who require orthodontic treatment. Skeletal class II division 1 malocclusion in growing patients can be treated with headgear if the maxilla is prognathic, myofunctional treatment can correct mandibular retrognathism, or both can be treated concurrently. In non-growing patients, a Fixed Functional Appliance or Orthodontic Camouflage can address mild to moderate class II malocclusion and resolve severe class II malocclusions. Orthognathic surgeries are done. Functional appliances can drive mandibular growth by forward posture, addressing class II skeletal and occlusal discrepancy in post-pubertal patients. Although FFAs are frequently utilized to address skeletal discrepancies during growth, their effectiveness in improving mandibular growth has been challenged in growing patients.

The Forsus FRD's telescoping spring and push rod provide equal and opposing forces on the maxillary and mandibular dentitions, promoting correction of class II malocclusion. Patients generally accept the appliance, although there may be some initial discomfort and functional limitations that improve with time. The AdvanSync2 was designed to be used in conjunction with Fixed Mechanotherapy. The telescoping mechanism constantly position the jaw forward in order to correct Class II malocclusions. It is significantly more appealing for patients because it causes less discomfort and is aesthetically acceptable because it is not noticeable.

The aim of this study was to evaluate and Compare Skeletal, Dentoalveolar and Soft tissue effects of the Forsus FRD and AdvanSync2 Fixed Functional Appliances for correction of Angle's Class II Division 1 Malocclusion in post-pubertal patients. In the present study, we found out that Forsus FRD and AdvanSync2 Fixed Functional Appliance showed similar skeletal effects except Advansync2 showed more of a headgear effect on maxillary arch and increase in divergence was also seen compared to Forsus FRD Appliance. Both the appliance showed similar Dentoalveolar Effects except Forsus FRD appliance showed distal root tipping of maxillary first molars and AdvanSync2 Appliance showed mesial crown tipping of mandibular first molars also the Soft Tissue Effects of the Forsus FRD and the AdvanSync2 Fixed Functional Appliance were similar. Both Forsus Frd and Advansync2 Fixed Functional Appliance aid in the treatment of Class II malocclusion in post-pubertal patients, mostly through dentoalveolar alterations.

Ann Sara George et al.⁽²⁰⁾ undertook a study to assess the skeletal and dental outcomes of sagittal Class II correction using the Forsus FRD Fixed Functional Appliance. The study found that the Forsus FRD Fixed Functional Appliance was successful in treating Class II malocclusion, particularly at the dentoalveolar level. The net skeletal and dentoalveolar contributions to overjet and molar correction were 13 and 87%, respectively. The improvement in soft tissue profile and chin-throat structure was not statistically significant. The current study

found similar effects of those produced Forsus FRD Fixed Functional Appliance, as well as significant soft tissue effects were seen in Sn Perpendicular to Chin Linear, Soft Tissue Profile Angle, Total Tissue Profile Angle, and Mentolabial Angle.

Lorenzo Franch et al. ⁽²¹⁾ undertook a study to assess the dental, skeletal, and soft tissue effects of comprehensive fixed appliance therapy combined with the Forsus Fatigue Resistant Device (FRD) in Class II patients. The study concluded that the Forsus Fatigue Resistant Device (FRD) successfully corrected Class II malocclusions in 87.5% of patients. The appliance had a higher skeletal influence on the maxillary structures by restricting the maxilla's sagittal advancement. The effects on the mandible were primarily at the dentoalveolar level, with significant mesial movement of the lower incisors and first molars. The present study found similar effects except there was no skeletal effect on the maxillary structures by restricting the maxilla's sagittal advancement.

A study conducted by **Pradeep Raghav et al** ⁽²²⁾ to Cephalometrically compare the skeletal and dentoalveolar effects of AdvanSync2 in the correction of Class II malocclusions in circumpubertal and post-pubertal patients. The study concluded that both circumpubertal and post-pubertal groups experienced considerable increases in mandibular length. The circumpubertal group had more mandibular advancement (SNB) than the post-pubertal group. The post-pubertal group (Group B) showed a significant decrease in SNA angle, although both groups experienced a maxillary restrictive effect. Both circumpubertal and post-pubertal groups had mandibular dentoalveolar effects, with proclination of lower incisors. However, the post-pubertal group had a higher mean increase in IMPA compared to the circumpubertal group. The distalizing effect on upper molars and retroclination of upper incisors was significantly greater in the post-pubertal group compared to the circumpubertal group. The present study showed similar effects in post-pubertal patients except there was no increases in mandibular length and there was no significant distalizing effect on upper molars.

Shikha Rani et al ⁽²³⁾ conducted a study to evaluate skeletal, dento-alveolar and soft tissue profile changes, active-treatment effects of the AdvanSync™2 during comprehensive correction of Class II malocclusion and time duration of active treatment produced by AdvanSync2 fixed functional appliance. The study concluded that the time required for completing the treatment is significantly less than that of any other fixed appliance. SNA has decreased from pre-treatment, while an increase in SNB indicates that the mandible has advanced forward. When compared to pretreatment, upper incisor proclination has decreased while lower incisor proclination has increased. This had an overall effect on the upper lip, reducing lip Strain, and causing the lower lips to slide forward. Mandibular advancement has improved the lower airway. The present study did not evaluate the time required for completing the treatment and improvement in lower airway. The SAN and SNB effects were similar to present study

Hemanth M et al. ⁽²⁴⁾ undertook a study to determine whether AdvanSync2 provides superior skeletal, dental, and soft tissue outcomes than the Forsus FRD fixed functional appliance in patients with post-pubertal skeletal Class II malocclusion. Forsus and Advansync appliances are advantageous in treating skeletal Class II malocclusion in post-pubertal patients. There was no significant difference between Forsus and AdvanSync groups. the effects were majorly dentoalveolar minimal - skeletal and soft tissue effects. Present study showed similar results

CONCLUSION

- Forsus FRD and AdvanSync2 Fixed Functional Appliance showed similar skeletal effects except Advansync2 showed more of a headgear effect on maxillary arch and increase in divergence was also seen compared to Forsus FRD Appliance.

- Both the appliance showed similar Dentoalveolar Effects except Forsus FRD appliance showed distal root tipping of maxillary first molars and AdvanSync2 Appliance showed mesial crown tipping of mandibular first molars
- Soft Tissue Effects of the Forsus FRD and the AdvanSync2 Fixed Functional Appliance were similar.
- Both Forsus FRD and Advansync2 Fixed Functional Appliance aid in the treatment of Class II malocclusion in post-pubertal patients with maximum Dentoalveolar alterations, minimum skeletal alterations and mild Soft tissue alteration.

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