COMPARATIVE EVALUATION OF SKELETAL AND DENTOALVEOLAR EFFECTS OF BONDED INCLINED BITE RAISER ELASTIC (BIBRE) AND MODIFIED FIXED TWIN BLOCK APPLIANCES IN SKELETAL CLASS II PATIENTS WITH RETROGNATHIC MANDIBLE

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Abstract

Background: Class II malocclusion is a dental problem where the upper and lower jaws don't align properly. This study compares two methods, the BIBRE technique and modified Twin Block appliances, to treat Class II patients with a backward-positioned lower jaw. The goal is to find out if there are any noticeable differences in the results of these treatments.
Aim: Comparative Evaluation of Skeletal and Dentoalveolar Effects of Bonded Inclined Bite Raiser Elastic (BIBRE) and Modified Fixed Twin Block Appliances in Skeletal Class II Patients with Retrognathic Mandibles
.**Material and methods:** The study examined individuals who opted for fixed orthodontic treatment involving mandibular advancement. The sample size of 20 (10 in each group) was determined based on a previous study, taking into account a standard deviation of ±2, a 95% confidence interval, and 80% study power. Cephalometric analysis evaluated maxillomandibular relations using 12 skeletal parameters, 5 dentoalveolar parameters, and 2 transverse parameters. The control group used the fixed twin block appliance, while the experimental group used the bonded inclined bite raiser elastic appliance..
Results: The Fixed Twin Block Appliance and BIBRE Appliance groups showed significant results. Skeletal parameters, including Beta angle, SNA, SNB, ANB, Effective mandibular length, Y-axis, Mandibular plane angle, Saddle angle, Gonial angle, Lower gonial angle, Articular angle, and Facial axis angle, had notable differences before and after treatment in both groups. Dento-alveolar parameters also exhibited significant changes. However, the differences in SNA and Gonial angle between pre and post-treatment were not statistically significant. When comparing the two groups, the control group (Fixed Twin Block) had higher values in Beta angle, SNA, Effective mandibular length, Gonial angle, Lower gonial angle, and Facial axis angle compared to the experimental group (BIBRE).
Conclusion The study evaluated the effectiveness of Fixed Twin Block appliance and BIBRE therapy for treating class II malocclusion. Both treatments restrained maxillary growth and increased mandibular length. The Fixed Twin Block appliance showed significant effects on upper incisors and inter-canine width.

Keywords: Fixed twin block , BIBRE- Bonded Inclined Bite Raisers Elastics, class II malocclusion ,retrognthic.

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1. Introduction

Dr. Edward H. Angle introduced the classification of malocclusion into three classes in 1890. Class II malocclusion can be attributed to factors like prognathism, retrognathism, excess maxilla, and mandibular insufficiency. Growth modification during the appropriate growth phase is a viable treatment approach for Class II malocclusion. In North India, the prevalence of Class II malocclusion in children aged 12 to 16 was found to be 18.9%. Early treatment during growth allows for skeletal correction and improved aesthetics.1

For patients with Class II malocclusion, various treatment options exist, including dental compensation and surgical therapy. However, growth modification using functional appliances is a conservative approach preferred for growing patients.2 Functional appliances like the Monoblock, Activator, Bionator, Bite Jumping Appliance, Functional Regulator, and Twin Block Appliance are commonly used to address Class II malocclusion caused by mandibular deficiency.3

The Twin Block Appliance, created by William Clark, is a renowned treatment for correcting Class II malocclusions.4 It consists of two plates that push the lower jaw forward, with sloping surfaces. The upper plate covers the upper molars and second premolars, while the lower plate has inclined planes near the first molars. Despite its effectiveness, fabricating the Twin Block appliance can be challenging and time-consuming.

Removable functional appliances rely on patient compliance, but their bulkiness can make it difficult. Fixed functional appliances have drawbacks like manufacturing issues, breakage, and tissue irritation. Slanted bite planes can address occlusal prematurities, preventing premature contact and functional shifts. The fixed Twin Block appliance improves patient comfort, cooperation, and aesthetics. The updated design includes only acrylic bite blocks, reducing its size and enhancing dental hygiene. It can be used alongside fixed appliances, reducing treatment duration while ensuring continuous wear. The Twin Block appliance works by displacing the lower jaw functionally to correct the maxillomandibular discrepancy.

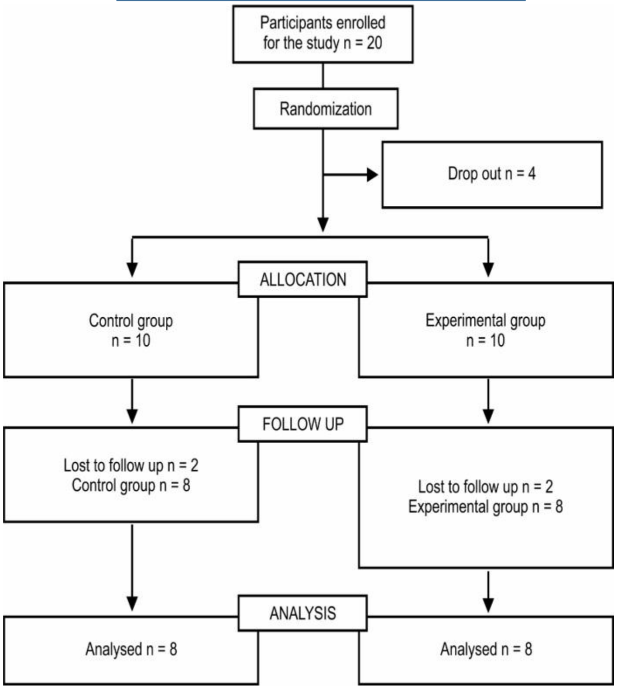
The BIBRE (Bonded Inclined Bite Raiser Elastic) is an affordable and easily adjustable fixed functional appliance.5 It is discreet, patient-friendly, and less bulky compared to other fixed appliances. The BIBRE promotes gradual mandibular advancement to avoid strain on the lateral pterygoid muscles. It can be used in combination with light levelling archwires at the start of fixed appliance treatment. However, there is a lack of comparative studies assessing the BIBRE against other fixed functional appliances.

This study aimed to compare the skeletal and dentoalveolar effects of the BIBRE with a modified fixed Twin Block appliance in patients with skeletal Class II malocclusion and retrognathic mandibles. The null hypothesis proposed no differences in skeletal and dentoalveolar changes between the BIBRE and the modified fixed Twin Block appliance.

2. Materials and Methods

The study was conducted at the Department of Orthodontics and Dentofacial Orthopaedics, KM Shah Dental College and Hospital, Sumandeep Vidyapeeth. The participants included in the study were individuals who willingly opted for fixed orthodontic treatment with mandibular advancement. They were selected from the same department at KM Shah Dental College and Hospital, Sumandeep Vidyapeeth.The sample size was determined based on previous research by Ahmad S. Burhan et al., following CONSORT guidelines. With a standard deviation of ±2 at a 95% confidence interval and a study power of 80%, the minimum required sample size was calculated to be 16. To account for potential dropouts, the sample size for our study was set at 20, with 10 participants in each group.

STUDY DESIGN



Selection Criteria:

Participants aged 14-16 years meeting specific criteria for malocclusion and dental condition were included in the study. Those with Dental Class II malocclusion, Class II/Div1 malocclusion with overjet greater than 4 mm, mild to moderate Class II skeletal pattern with a retrognathic mandible, positive Visual Treatment Objective, horizontal growth pattern, and complete dentition were included. Exclusion criteria consisted of not meeting the inclusion criteria or having unwillingness to participate, congenital syndromes, developmental anomalies, craniofacial abnormalities, obvious facial asymmetry, previous orthodontic treatment, extreme vertical disproportion, permanent tooth extractions, or significant medical history related to disorders or syndromes.

The participants were randomly assigned to two groups: Group 1 (control group) received the fixed twin block appliance, and Group 2 (experimental group) received the bonded inclined bite raiser elastic appliance. Random numbers were generated to allocate participants, and the type of appliance for each participant was determined using sealed envelopes. The randomization process was done equally using an online randomization tool at https://www.randomizer.org/ (Research Randomizer).

Materials / Equipment Required

Kodak 8000c OPG and Lateral Cephalometric Unit,Dolphin Imaging Software,Alginate impression material (Algitex),Orthodontic stone class-III (Orthokal),Modeling wax (DPI Modeling wax),Colored filled composite (3M),Curing Light (Wood Pecker),Bonding Agent (3M),Essix Sheet,0.022 MBT Brackets,Niti and SS wires,Vernier caliper,Dontrix gauge,DPI cold cure acrylic.

Study Procedure

The study received ethical approval from the Sumandeep Vidyapeeth Institutional Ethics Committee. Participants were selected based on specific inclusion criteria, and they received detailed information about the study through an informational document. Written informed consent was obtained from all participants. Pre-treatment records, including cephalograms and study models, were obtained before the bonding procedure.

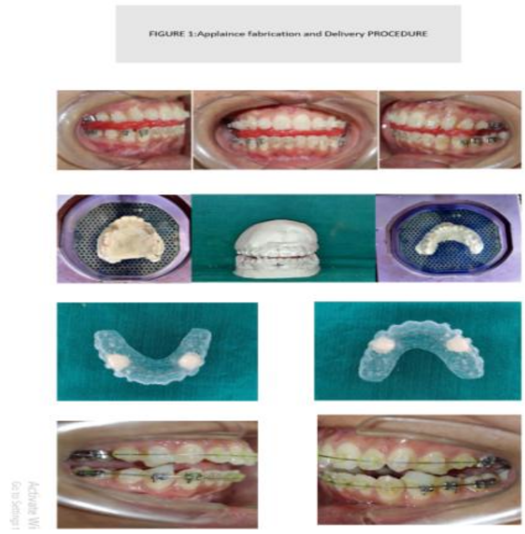
To identify participants with Class II malocclusion, 19 parameters were used to detect skeletal Class II and retrognathic mandible, as well as assess growth patterns. Participants were included in the study based on their eligibility determined by these parameters. Table 1 provides a summary of the parameters used for participant selection

TABLE NO. 1		
SKELETAL PARAMETERS		
PARAMETERS	**MEAN TABLE**	**INFERENCE**
Beta angle	27^{0}-35^{0}	**The angle denotes the retrognathic / prognathic mandible w.r.t A point**
SNA	82^{0}	**A Angle asses the antero-posterior position of maxilla relativd to upper cranial structure**
SNB	80^{0}	**Angle asses the antero-posterior position of mandible relative to upper cranial structure**
ANB	2^{0}	Measure the relative position of mandible to maxilla
Effective mandibular length (linear)	119mm	Assess the length of the mandible
Down's Y axis (Gonion - Menton to FH)	53^{0}-60^{0}	Measures the vertical growth of the mandible w.r.t FH plane
Mandibular plane angle (Steiner analysis)	21^{0}	Measures the vertical growth of the mandible
Saddle angle	130^{0}	Effectively measure the bend between anterior and posterior cranial base.
Gonial angle	128^{0}	Effectively measure the growth pattern of mandible
Lower gonial angle	55^{0}	Effectively measure the growth pattern of mandible.
Articulare angle	143^{0}	Assess the growth of mandible prognathic/retrognathic.
Facial axis angle	90^{0}	I Indicates growth pattern of mandible
DENTO –ALVEOLAR PARAMETERS		
PARAMETERS	**MEAN TABLE**	**INFERENCE**
UI LONG AXIS TO MAXILLARY PLANE	30mm	Denotes the extrusion or intrusion of the incisor from maxillary plane
LI LONG AXIS TO MANDIBULAR PLANE	45mm	Denotes the extrusion or intrusion of the incisor from Mandibular plane
OP-HP ANGLE	6.2mm	Indicates Vertical height of the maxilla w.r.t horizontal plane

UI-NF ANGLE	111^0	Determine the proclination/retroclination of the upper incisor
LI-MP ANGLE	95^0	Determine the proclination/retroclination of lower incisor w.r.t mandible.
TRANSVERSE PARAMETERS		
INTER-CANINE WIDTH	32mm	Determine the expansion of the arch in the canine region
INTER-MOLAR WIDTH	54mm	Determine the expansion of the arch in Molar region.

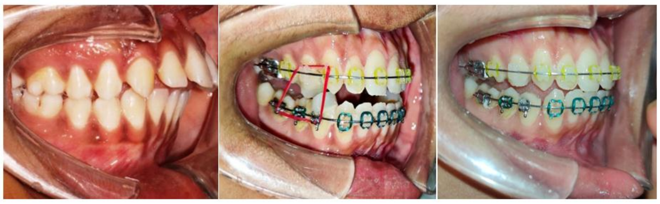
Construction of Applaince:
Bonded Inclined Bite Raiser Elastic (BIBRE) CONSTRUCTION (Experimental Group):

The construction process of the Bonded Inclined Bite Raiser Elastic (BIBRE) appliance for the experimental group followed the recommended configurations by El-Bokle D and Abbas NH[29]. It involved several steps:(Figure 1)



The construction process of the Bonded Inclined Bite Raiser Elastic (BIBRE) appliance for the experimental group followed recommended configurations. It involved creating a 2 mm symmetric advancement wax bite and taking impressions of the maxillary and mandibular arches. Complementary inclined bite raisers were constructed on occlusal surfaces using tooth-colored composite. Transfer trays were fabricated using soft Essix sheets. The bite raisers were bonded to the patient's teeth using the transfer trays and a flowable composite. Fixed orthodontic appliance therapy was initiated using prescribed archwires, and the BIBRE appliance was placed on the maxillary and mandibular premolars. Intermaxillary elastics (3/16-inch) with a force of 75 g were used between specific teeth to achieve proper alignment (figure 2). The elastics were changed daily. Once a Class I molar and canine relation was achieved, the BIBRE appliance was removed, and treatment with the fixed orthodontic appliance continued. Regular follow-up appointments were scheduled, and participants were educated about the BIBRE appliance. Post-treatment records, including cephalograms and study models, were obtained for evaluation.

FIGURE 2:pre and post appliance therapy



Fabrication of Fixed Twin Block (CONTROLGROUP)
For the control group, the fabrication of the Fixed Twin Block appliance followed the recommended configuration by Pattanaik S and NavyaPuvvula[18]. The process included the following steps(FIGURE 3)

FIGURE 3:Applaince fabrication and Delivery PROCEDURE

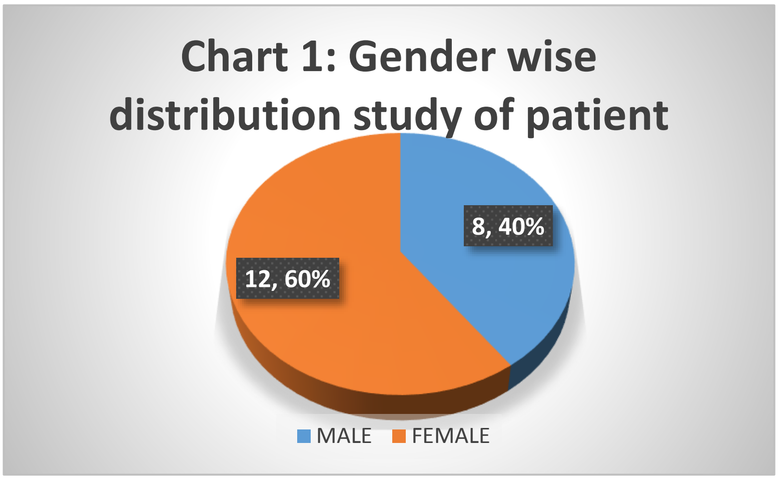
The twin block appliance consisted of two acrylic bite blocks inclined at an angle of 70° to each other. This design facilitated functional displacement of the mandible to correct the maxilla-mandibular discrepancy.
The appliance was modified from the original design by including only the occlusal bite blocks, which were supported by a stainless steel wire framework. The wire framework was created using a 0.9 mm stainless steel wire, which was soldered to the molar bands in both the upper and lower arches.(FIGURE 4)

FIGURE 4:Applaince fabrication and Delivery PROCEDURE

The bite planes were made on the wire framework using self-cure clear acrylic. The bite blocks were inclined at a 70° angle to each other.Appliance Insertion: The participants were informed about the construction of the Fixed Twin Block. Within two weeks of the patient's initial records, all appliances were delivered by the principal investigator. Regular follow-up was maintained until the end of the treatment period. Post-treatment cephalogram and upper and lower study models were obtained from the participants treated with the Fixed Twin Block, and the sagittal and vertical parameters were analyzed for pre-treatment, leveling and alignment, and post-treatment cephalometric parameters for both appliances.

3. Result

This study aimed to compare skeletal and dento-alveolar changes in Class II malocclusion patients with a retrognathic mandible using the BIBRE appliance and the Fixed Twin Block appliance. The study included 20 patients, with 10 in each group. The majority of the participants were female, accounting for 60% of the total sample. (Graph 1).



The male participants had an average age of 15.0476 ± 3.38 years, while the female participants had an average age of 15.9667 ± 2.41 years. An independent t-test showed no significant age difference between the two groups ($p = 0.479$, $t = 0.728$, mean difference = 0.375). In both the experimental and control groups, there were 4 males and 6 females. The chi-square test indicated no significant difference in gender distribution between the groups ($p = 0.302$). Independent t-tests were used to compare skeletal and dentoalveolar parameters between the two groups. (Table 2-4).

GRAPH 1:shows the demographic characteristic of study participants. A major portion of the study participants were female (60%).The mean age of the male and female participants was found to be 15.0476+3.38 and 15.9667+2.41 years respectively.

Table 2:- Evaluation of Fixed twin Block Appliance therapy.

Parameters	Mean	N	Std. Deviation	Std. Error Mean	Mean Difference	P Value
Skeletal Parameters						
PRE BETA ANGLE	23.750	10	1.773	.413	-3.74000	.000**
POST BETA ANGLE	27.250	10	1.599	.30		

PRE SNA	82.750	10	1.066	.300	.86500	.121
POST SNA	81.000	10	.582	.33		
PRE SNB	76.50	10	.402	.205	-3.3500	.000*
POST SNB	79.00	10	.291	.166		
PRE ANB	6	10	.593	.226	4.27000	.000*
POST ANB	1.70	10	.711	.25		
PRE Effective mandibular length (linear)	96.6	10	1.164	.665	-2.1500	.004*
POST Effective mandibular length (linear)	98.7	10	2.385	.839		
PRE Down's Y axis (Gonion - Menton to FH)	54.3	10	.841	.339	-4.3500	.000*
POST Down's Y axis (Gonion - Menton to FH)	58.7	10	.613	.90		
PRE Mandibular plane angle (Sn-GoGn)	23.6	10	3.530	1.079	-5.0000	.000*
POST Mandibular plane angle (Sn-GoGn)	28.5	10	3.188	1.066		
PRE Saddle angle	128	10	2.0	.7071	2.63500	.000*
POST Saddle angle	124.50	10	1.81	.655		
PRE Gonial angle	126	10	1.64	.665	.12700	.890
POST Gonial angle	124.60	10	1.74	.539		
PRE Lower gonial angle	64.70	10	1.89	.476	-7.00000	.000*
POST Lower gonial angle	70.30	10	1.73	.493		
PRE Articulare angle	138.30	10	1.41	.676	2.80000	.000*
POST Articulare angle	134.50	10	1.47	.449		
PRE FACIAL AXIS ANGLE	93.0	10	4.76	1.480	-4.7500	.000*
POST FACIAL AXIS ANGLE	96.50	10	3.28	1.347		
Dentoalveolar Parametes						
PRE UI- NF LINEAR	19.700	10	2.487	.886	-4.34000	.000*
POST UI- NF LINEAR	24.400	10	2.455	.832		
PRE LI- long axis to mandibular plane	96.50	10	3.894	1.50	-3.23600	.000*
POST LI- long axis to mandibular plane	97.40	10	3.676	1.101		
PRE OP-HP ANGLE	8.20	10	1.421	.5000	1.73400	.000*
POST OP-HP ANGLE	5.50	10	1.774	.539		
PRE AO-BO	4.20	10	1.510	.396	2.27000	.000*
POST AO-BO	2.5	10	.593	.226		
PRE UI – NA ANGLE	39.43	10	2.993	.875	5.338500	.000*
POST UI- NA ANGLE	34.450	10	2.775	.991		
PRE LI – NB ANGLE	24.3	10	.9582	.333	-4.67500	.000*
POST LI- NB ANGLE	29.30	10	1.247	.449		

Significant changes were observed in various skeletal parameters, including the Beta angle, SNA, SNB, effective mandibular length, y-axis, mandibular plane angle, saddle angle, lower gonial angle, articular angle, and facial axis angle, following the application of the Fixed Twin Block appliance. The paired t-test was used for intra-group comparisons, separately within the Fixed Twin Block group and the BIBRE group. In a study comparing pre- and post-treatment parameters in the control group, several parameters showed statistical significance, including UI-nf Linear, LI-long axis to mandibular plane, OP-HP ANGLE, AO-BO, UI-NA angle, and LI-NB angle. However, there were no statistically significant mean differences observed for SNA and gonial angle. In particular, the Beta angle values before and after treatment with the Fixed Twin Block appliance were 23.750 and 27.120, respectively, with a mean difference of 3.740 (p = 0.00)(Table -2).The SNA angle showed a mean decrease of 0.860, with pre-treatment and post-treatment values of 82.70 and 81.000, respectively (p = 0.12) (Table -2).In contrast, the SNB angle increased after appliance therapy, with mean values changing from 76.50 before treatment to 79.000 after treatment. The mean increase in SNB angle was 3.350 (p=0.00) (Table -2).The ANB angle changed from 6.000 pre-treatment to 1.700 post-treatment, resulting in a mean decrease of 4.270 (p=0.00) (Table -2).Effective mandibular length increased from 96.80 mm before treatment to 98.7 mm after treatment, with a statistically significant mean increase of 2.02 mm (p=0.004) (Table -2).The Y-axis increased after Twin Block therapy by 4.370, with pre-treatment and post-treatment values of 54.40 and 58.60, respectively (p=0.00) (Table -2).Mandibular plane angle showed a mean increase of 50 from pre-treatment (23.650) to post-treatment (28.50) (p=0.00) (Table -1).The saddle angle ranged between 128.000 pre-treatment and 124.500 post-treatment, showing a mean decrease of 2.6350 (p=0.00) (Table -1).The gonial angle decreased from 126.000 to 124.600 after treatment, with a mean reduction of 0.1270 (p=0.80) (Table -1).Lower gonial angle increased from 64.700 to 70.300 after treatment, with a mean increase of 7.000 (p=0.00) (Table -1).Articulare angle showed a mean decrease of 2.500, with pre-treatment and post-treatment values of 137.870 and 135.570, respectively (p=0.00) (Table-2).Facial axis angle increased from 93.0 to 96.500 after treatment, with a mean increase of 4.750 (p=0.00) (Table -2).Regarding dento-alveolar parameters, significant results were observed with the application of the Fixed Twin Block appliance. These parameters included UI-NF Linear, LI-long axis to mandibular plane, OP-HP ANGLE, AO-BO, UI-NA.

Table 3:- Evaluation of Bonded Inclined Bite Riaser Elastic Appliance therapy.

Parameters	Mean	N	Std. Deviation	Std. Error Mean	Mean Difference	P Value
SKELETAL PARAMETERS						
PRE BETA ANGLE	21.750	10	1.45774	.51539	-4.52500	.000*
POST BETA ANGLE	26.5600	10	1.51186	.53452		
PRE SNA	82.2150	10	.99103	.35038	1.86500	.000*
POST SNA	80.300	10	1.28174	.45316		
PRE SNB	76.250	10	1.12599	.39810	-3.20000	.001*
POST SNB	79.250	10	.83452	.29505		
PRE ANB	6.2000	10	1.06904	.37796	4.27500	.000*
POST ANB	1.5250	10	.91613	.32390		
PRE Effective mandibular length (linear)	92.3250	10	4.18970	1.48128	-2.47500	.000*
POST Effective mandibular length (linear)	94.6000	10	4.17475	1.47600		
PRE Down’s Y axis (Gonion - Menton to FH)	56.34000	10	2.50713	.88641	-1.97500	.006
POST Down’s Y axis (Gonion - Menton to FH)	58.2250	10	2.26385	.80039		
PRE Mandibular plane angle (Sn-GoGn)	26.3550	10	1.59799	.56497	-4.35000	.000*
POST Mandibular plane angle (Sn-GoGn)	30.6150	10	1.30247	.46049		
PRE Saddle angle	130.2250	10	1.64208	.58056	3.65000	.000*
POST Saddle angle	126.4550	10	1.76777	.62500		
PRE Gonial angle	122.6750	10	7.15017	2.52797	1.65000	.052
POST Gonial angle	120.8950	10	6.17454	2.18303		
PRE Lower gonial angle	67.2250	10	3.18198	1.12500	-2.40000	.000*
POST Lower gonial angle	69.2250	10	3.02076	1.06800		

PRE Articulare angle	141.7250	10	4.47014	1.58043	5.72500	.000*
POST Articulare angle	136.4400	10	4.10575	1.45160		
PRE FACIAL AXIS ANGLE	90.120	10	4.82368	1.70543	-3.34000	.000*
POST FACIAL AXIS ANGLE	93.120	10	4.38952	1.55193		
Dentoalveolar Parametes						
PRE UI- NF LINEAR	25.2250	10	3.35676	1.18679	-.24000	.351
POST UI- NF LINEAR	25.3750	10	3.06769	1.08459		
PRE LI- long axis to mandibular plane	92.3400	10	6.09449	2.15473	-1.97500	.000*
POST LI- long axis to mandibular plane	93.7950	10	5.81715	2.05667		
PRE OP-HP ANGLE	9.4750	10	1.40789	.49776	.86500	.041
POST OP-HP ANGLE	8.5300	10	1.60357	.56695		
PRE AO-BO	4.2650	10	.74402	.26305	2.73000	.000*
POST AO-BO	1.5350	10	.91613	.32390		
PRE UI – NA ANGLE	34.7950	10	6.42401	2.27123	2.47000	.000*
POST UI- NA ANGLE	32.4350	10	6.02228	2.12920		
PRE LI – NB ANGLE	24.2700	10	4.89168	1.72947	-2.35000	.000*
POST LI- NB ANGLE	26.5400	10	4.65986	1.64751		

The application of the BIBRE appliance resulted in significant changes in various skeletal parameters. The Beta angle, SNA, SNB, ANB, Effective mandibular plane angle, Articulare angle, and facial axis angle all showed significant results after the appliance was applied. When comparing all the parameters for statistical significance between pre-treatment and post-treatment within the control group, most of the parameters showed statistically significant differences. However, the mean differences in SNA and Gonial angle between pre and post-treatment were observed to be statistically non-significant.

Skeletal Parameters Findings

The study examined pre- and post-treatment skeletal angles. Results showed an increase in the ANB angle (21.750 to 26.560, p = 0.00) and a decrease in the SNA angle (82.150 to 80.300, p = 0.00). The SNB angle increased (76.250 to 79.250, p = 0.001), while the Bonded inclined bite raiser elastic appliance led to a decrease in the ANB angle (6.200 to 1.520, p = 0.00). Effective mandibular length increased by 2.47 mm (p = 0.00). The Y-axis increased (56.340 to 58.2250, p = 0.006), and the mandibular plane angle increased (26.350 to 30.6150, p = 0.00). The saddle angle decreased (130.2250 to 126.4550, p = 0.00). The gonial angle decreased by 1.75º (122.620 to 120.870, p = 0.052), while the lower gonial angle increased by 2.400 (67.2250 to 69.2250, p = 0.00). The Articulare angle decreased by 5.720 (141.720 to 136.440, p = 0.00), and the facial axis angle increased by 3.340 (90.120 to 93.120, p = 0.00). (Table -2)

Dento-alveolar parameters

The BIBRE appliance showed significant effects on dental parameters, including LI-long axis to mandibular plane, AO-BO, UI-NA angle, and LI-NB angle. However, there was no observed increase in the values after appliance therapy. The mean values of upper incisor to nasal floor before and after treatment were 25.22 mm and 25.37 mm, respectively, with a mean difference of 0.24 mm (p = 0.351). The angulations of lower incisor to mandibular plane increased from 92.340 to 93.790, with a mean difference of 1.970 (p = 0.00). The mean values of occlusal plane to horizontal plane before and after treatment were 9.470 and 8.530, with a mean difference of 0.860 (p = 0.041After the treatment, there was a significant decrease in the mean linear distance between point A to point B perpendicular on the occlusal plane, with values of 4.26 mm before and 1.53 mm after treatment, resulting in a mean decrease of 2.73 mm (p = 0.00). The inclination of the upper incisor to the NA line also showed a significant decrease, with values of 34.790 and 32.40 before and after treatment, respectively, resulting in a mean decrease of 2.470 (p = 0.00). On the other hand, the angulations of the lower incisor to the NB line exhibited a significant increase, with values of 24.270 and 26.540 before and after treatment, respectively, resulting in a mean increase of 2.250 (p = 0.00). Among all the parameters compared between pre and post treatment in the experimental group, the mean difference of the majority of parameters was statistically significant. However, the mean difference of the Gonial angle and UI to NF linear measurement was observed to be statistically non-significant.

Table no. 4: Comparison of treatment outcomes between Standard twin block appliance and Bonded inclined bite raiser elastic appliance post appliance therapy.

Parameter	Group	N	Mean (post treatment-pre treatment	Standard Deviation	Standard Error Mean	Mean Difference	p-value
Skeletal Parameters							
Beta Angle	Control	10	27.250	1.12599	.39810	.62500	.364
	Experimental	10	26.5300	1.51186	.53452		
SNA	Control	10	81.6500	.92582	.32733	1.25000	.042*
	Experimental	10	80.2500	1.28174	.45316		
SNB	Control	10	79.7300	.46291	.16366	.62500	.085
	Experimental	10	79.250	.83452	.29505		
ANB	Control	10	1.6500	.70711	.25000	.12500	.764
	Experimental	10	1.5250	.91613	.32390		
Effective mandibular length(linear)	Control	10	98.6350	2.26385	.80039	4.12500	.028
	Experimental	10	94.5300	4.17475	1.47600		
Down Y axis (Gonion - Menton to FH)	Control	10	58.6550	.91613	.32390	.25000	.776
	Experimental	10	58.2350	2.26385	.80039		
Mandibular plane angle	Control	10	28.700	3.01188	1.06486	-1.87500	.128
	Experimental	10	30.5250	1.30247	.46049		
Saddle angle	Control	10	124.3830	1.84681	.65295	-2.00000	.044
	Experimental	10	126.3760	1.76777	.62500		
Gonial angle	Control	10	124.4750	1.45774	.51539	4.00000	.096
	Experimental	10	120.7750	6.17454	2.18303		
Lower gonial angle	Control	10	70.5250	1.18773	.41993	1.00000	.398
	Experimental	10	69.7250	3.02076	1.06800		
Articulare angle	Control	10	135.2750	1.30247	.46049	-.62500	.688
	Experimental	10	136.5000	4.10575	1.45160		
Facial axis angle	Control	10	96.6250	3.77728	1.33547	3.50000	.109
	Experimental	10	93.1340	4.38952	1.55193		
Dentoalveolar Parameters							
U1 to NF linear	Control	10	23.3500	2.31455	.81832	-2.12500	.140
	Experimental	10	25.4650	3.06769	1.08459		
LI long axis to mandibular plane	Control	10	98.7750	3.13676	1.10901	5.00000	.050
	Experimental	10	93.6750	5.81715	2.05667		
OP-HP angle	Control	10	5.9750	1.45774	.51539	-2.62500	.004*
	Experimental	10	8.6000	1.60357	.56695		
AO – BO in mm	Control	10	2.4000	.75593	.26726	.37500	.387
	Experimental	10	1.5250	.91613	.32390		
U1 to NA angle	Control	10	34.2250	2.58775	.91491	1.75000	.463
	Experimental	10	32.6750	6.02228	2.12920		
LI to NB angle	Control	10	29.5750	1.30247	.46049	2.87500	.115
	Experimental	10	26.4000	4.65986	1.64751		

In the post-treatment evaluation, the control group exhibited higher values compared to the experimental group in several skeletal parameters. The control group showed higher values in the Beta angle (27.2º > 26.560), SNA angle (82.700 > 80.300), effective mandibular length (98.6 mm > 94.60 mm), gonial angle (124.600 > 120.890), lower gonial angle (70.300 > 69.220), and facial axis angle (96.000 > 93.120) (Table 4).Similarly, in the post-treatment assessment of dento-alveolar parameters, the control group had higher values compared to the experimental group in the LI long axis to mandibular plane angle (98.670 > 93.77º) and LI to NB angle (29.570 control, 26.600 experimental) (Table 4).However, parameters such as SNB angle (79.850, 79.220), ANB angle (1.650, 1.720), and Y-axis (58.220, 58.470) showed similar values in both the control and experimental groups (Table 4).The majority of the parameters compared between the control and experimental groups after the appliance therapy did not show statistically significant differences (Table 4).Among the skeletal parameters, the SNA angle (mean difference = 1.450, p = 0.046), saddle angle (mean difference = 2.000, p = 0.044), and effective mandibular length (linear) (mean difference = 4.22 mm, p = 0.029) exhibited statistically significant mean differences (Table 4).Regarding the dento-alveolar parameters, the LI long axis to mandibular plane angle (mean difference = 6.000, p = 0.050) and OP-HP angle (mean difference = 2.5220, p = 0.004) showed statistically significant differences (Table 4).Additionally, the transverse dimension was assessed by measuring intercanine and intermolar width.

Table no.5 :Comparison of ICW,IMW outcomes between Standard twin block appliance and Bonded inclined bite raiser elastic appliance post appliance therapy.

Type of Appliance	**Transverse parameter**	**N**	**Mean ± SD**	**Mean difference ± SD**	**t**	**P VALUE**
FIXED TWIN BLOCK(control group)	Pretreatment I.C.W	10	32.44±0.81	-0.37±0.49	-2.40	0.04
	Post treatment I.C.W	10	32.81±0.7			
	Pretreatment I.M.W	10	54.92±1.11	-0.02±0.04	-1.50	0.168
	Post treatment I.M.W	10	54.94±1.12			
BIBRE(experimental group)	Pretreatment I.C.W	10	33.85±0.46	-0.08±0.08	-3.21	0.011
	Post treatment I.C.W	10	33.93±0.43			
	Pretreatment I.M.W	10	54.92±1.11	-0.02±0.04	-1.50	0.168
	Post treatment I.M.W	10	54.94±1.12			

4. Discussion

In this research study, the aim was to assess the effects of two different treatment approaches on patients with skeletal class II malocclusion, specifically those with a high prevalence of Angles class II div 1 malocclusion in the age group of 14-16. The treatment methods evaluated were the bonded inclined bite raiser elastic (BIBRE) and the fixed twin block appliances, which were randomly assigned to the patients.

The twin block appliance is considered the standard treatment for correcting skeletal class II malocclusion in growing patients. Functional appliances, including the twin block, have been used for many years to address skeletal class II malocclusion in patients during their growth phase. This two-phase therapy involves modifying the patient's growth pattern first, followed by fixed orthodontic treatment. This approach has several advantages, such as improved aesthetics, the ability to influence growth, reduced need for extractions, shorter treatment duration, easier subsequent therapy, potential avoidance of future surgery, and minimized trauma to flared incisors. The twin block appliance, originally developed by Clark, has gained wide acceptance due to its ability to correct sagittal (front-to-back) discrepancies through skeletal changes and compensatory adjustments in the teeth and supporting bone structures. However, the configuration of the twin block appliance underwent modification in this study. One of the modifications applied was the Bowbeer Appliance, which was specifically designed to effectively address transverse (side-to-side) development. This modification combines elements of the Schwarz appliance and the twin block. Both the upper and lower twin blocks were equipped with screws to help develop the arch form during the mixed dentition phase, which is the period when both primary and permanent teeth coexist. Overall, this research aimed to evaluate the skeletal and dentoalveolar effects of using the BIBRE and modified twin block appliances in patients with skeletal class II malocclusion, taking into account the prevalence of Angles class II div 1 malocclusion in the 14-16 age group. The twin block appliance, known for its effectiveness in growth modification and compensatory adjustments, was further enhanced through modifications like the Bowbeer Appliance to address specific aspects of malocclusion correction, such as transverse development.

One variation of the twin block appliance is the sagittal twin block, which utilizes two screws aligned in the anteroposterior direction on the palate. This configuration is typically utilized when the upper and lower incisors are retroclined (tilted towards the back) with a deep overbite.

Another modification of the twin block appliance is the McNamara modification, where two screws are positioned in the mid-palatal region—one in the anterior region aligned with the premolars and another in the posterior region aligned with the molars. This modification allows for either anterior or posterior expansion as needed, providing flexibility in achieving the desired results.For patients requiring both sagittal and transverse arch development, a three-way screw can be incorporated in the anterior part of the palate within the twin block appliance.

The Crozat modification of the twin block appliance is suitable for adult treatment and features minimal palatal and lingual coverage. However, this type of appliance requires careful adjustments to maintain symmetry.

In the magnetic twin block appliance, magnets are added to increase occlusal contacts on the bite blocks, maximizing functional forces to correct the malocclusion.In cases where patients exhibit a tongue thrust habit, a spinner can be added to the twin block appliance to control the tongue thrusting behavior.

A fixed twin block appliance is utilized when patients lack motivation to wear the appliance consistently for 24 hours, making it suitable for non-cooperative patients. It consists of a Transpalatal Arch with occlusal inclined planes cemented on both sides. Wire tags, which are extensions of the transpalatal arch, hold the occlusal inclined planes in place. Additionally, a lingual arch extends over the occlusal surface of the molars and premolars, depending on the stage of dental development.Compliance is a major concern with removable appliances, particularly for patients during or nearing the end of their pubertal growth spurt. The fixed twin block appliance was designed to address these compliance limitations.

A relatively new device called BIBRE (bonded inclined bite raiser elastic) claims to offer better patient compliance and simpler manufacturing as it does not include wire components.

The advantages of the fixed functional appliance include its use in non-cooperative patients, faster treatment outcomes, and continuous appliance usage. Thus, both groups included in this study were treated using a fixed configuration.Upon reviewing the existing literature, no studies were found comparing the treatment effects of BIBRE and the Fixed Twin Block appliance. Therefore, in this study, BIBRE and the Fixed Twin Block appliance were selected to evaluate and compare their efficacy. The participants were randomly allocated to each treatment group as part of the study's randomized controlled design.

The evaluation of fixed twin block appliance therapy revealed that most of the variables demonstrated a statistically significant difference between the pre- and post-appliance therapy measurements. However, it was observed that the mean difference between pre- and post-treatment measurements of SNA (Sella-Nasion-A point angle) and Gonial angle did not reach statistical significance. Several authors, such as Sayeh Ehsani et al., Mark Cornelis van der Plas et al., and Kamal et al., have conducted studies on similar topics, including systematic reviews. These studies have explored various parameters, including SNA, SNB (Sella-Nasion-B point angle), effective mandibular length, Y-axis, saddle angle, articulare angle, facial axis angle, LI (lower incisor) long axis to mandibular plane angle, UI (upper incisor) to NA (nasion-point A) angle, and LINB (lower incisor to nasion-point B) angle. The findings of this present study were found to align with the conclusions drawn by the aforementioned authors' studies. In summary, the evaluation of fixed twin block appliance therapy demonstrated significant changes in most variables assessed. However, the lack of statistical significance in the mean difference of SNA and Gonial angle measurements before and after treatment suggests that these particular variables may not be greatly affected by the use of the fixed twin block appliance. The results of this study are consistent with previous research conducted by other authors in the field. The evaluation of BIBRE (Bonded Inclined Bite Raiser Elastic) appliance therapy revealed that the majority of parameters exhibited a statistically significant difference when comparing the pre- and post-treatment effects. However, the Gonial angle and the UI (Upper Incisor) to NF (Nasion-Point A to Frankfort plane) linear measurement did not show statistical significance.

It suggests that the results obtained from the application of the BIBRE appliance may not be significant due to the utilization of light force class II elastics and heavy wire in the treatment. The use of these specific components may have contributed to the lack of statistically significant changes in the Gonial angle and the UI to NF linear measurement.

Unfortunately, no existing research was found that specifically examined the therapeutic effects of the BIBRE appliance. Therefore, it was not possible to compare the observations from this study with the findings of other studies in the field.

The comparison of post-treatment effects between the Fixed Twin Block appliance and the BIBRE appliance demonstrated that the majority of parameters examined did not exhibit statistically significant differences between the control and experimental groups.

However, three skeletal characteristics showed statistically significant mean differences. These were the SNA angle, with a mean difference of 1.25° (p=0.042), the Saddle angle, with a mean difference of 2.00° (p=0.044), and the Effective mandibular length (linear), with a mean difference of 4.12mm (p=0.028). These findings indicated that there were notable changes in these specific skeletal characteristics as a result of both the BIBRE and Fixed Twin Block appliance therapies.

In terms of the comparison between the BIBRE and Fixed Twin Block appliances, a statistically significant difference was observed in the SNA angle. The average decrease in the SNA angle was 2° for the BIBRE appliance and 1° for the Fixed Twin Block appliance. However, it is important to note that although statistical significance was observed, the clinical relevance of this difference may be minimal.

Overall, while the majority of parameters did not demonstrate statistically significant differences between the two appliance therapies, the SNA angle exhibited a significant distinction. Nevertheless, the clinical significance of this observed difference in the SNA angle remains limited.

The observed differences in the study outcomes may be attributed to various factors, including disparities in the participant selection criteria, assessment criteria for evaluating the success of appliance therapy, and random patient assignment criteria.

While a 1° difference was noted in the mean reduction of the saddle angle following appliance therapy, this difference is considered clinically insignificant.

A statistically significant finding was observed for the dentoalveolar parameter LI (Lower Incisor) Long axis to mandibular plane, with a mean difference of 5.00 (p=0.050). This indicates that the fixed twin block appliance therapy resulted in more proclination (forward inclination) of the lower incisors. This observation may be attributed to the 700 angulation of the block, which generated higher forces. It is also possible that the tooth with weaker support in the dental arch exhibited quicker results in terms of lower incisor proclination.

Comparing the results of the UI (Upper Incisor) to NF (Nasion-Point A) linear measurement with BIBRE (pre-treatment: 25.12 mm, post-treatment: 25.37 mm) to those of the fixed twin block appliance therapy (pre-treatment: 19.25 mm, post-treatment: 23.25 mm), it is evident that the fixed twin block appliance had a clinically significant impact on the UI to NF linear measurement, despite not yielding a statistically significant result. This suggests that the upper incisors might retract (move backward) and extrude (move upward) more effectively with the fixed twin block appliance, which could be attributed to the higher reciprocal forces generated by this appliance compared to the BIBRE appliance. These effects may have influenced the occlusal plane angle. Furthermore, the analysis of the OP-HP (Occlusal Plane to Horizontal Plane) angle for post-treatment outcomes revealed a higher clinical significance with the fixed twin block appliance.

In summary, the observed differences in outcomes may be influenced by factors such as participant selection criteria, assessment criteria, and random patient assignment. The fixed twin block appliance demonstrated more significant effects on the lower incisors' inclination and the UI to NF linear measurement, indicating potential advantages over the BIBRE appliance in terms of occlusal plane angle and upper incisor positioning.

During fixed twin block therapy, it was observed that the maxilla tends to rotate in an anticlockwise direction. The mean decrease in the OP-HP (Occlusal Plane to Horizontal Plane) angle was found to be greater in the control group compared to the experimental group.

At the conclusion of the treatment, both the control and experimental groups exhibited proclination (forward inclination) of the lower incisors. The measurements were 98.87° ± 3.13° for the control group and 93.87° ± 5.81° for the experimental group. Notably, the proclination of the lower incisors was higher in the control group.

Parameters such as SNB (Sella-Nasion-B point angle), ANB (A point-Nasion-B point angle), and Y-axis angle showed similar values between the experimental and control groups. The values were approximately 79.750 and 79.120 for SNB, 1.75° and 1.62° for ANB, and 58.62° and 58.37° for the Y-axis, respectively.

When comparing the difference in intercanine width between the two groups, it was observed that the fixed twin block group (control group) had a higher difference in intercanine width. However, this difference was statistically non-significant, as indicated by a t-value of 1.856 and a p-value of 0.095. On the other hand, there was less expansion in the intercanine width observed in the BIBRE appliance group. This difference in intercanine width could potentially be attributed to the impact of the force exerted by class II elastics in the case of the BIBRE appliance and the higher reciprocal forces applied in the fixed twin block appliance.

Unfortunately, no research was found that specifically examined the therapeutic effects of the BIBRE appliance. Therefore, it was not possible to compare the observations from this study with the findings of other studies.Similarly, when comparing the difference in intermolar width between the two groups, it was found to be higher in the fixed twin block group (control group). However, this difference was statistically non-significant, with a t-value of 0 and a p-value of 1.

During the fabrication process of the Fixed twin block appliance, several challenges were encountered due to its intricate nature. The steps involving wire bending, soldering the wire to the molar band, and attaching the acrylic block required a high level of skill and precision. The custom-made nature of the appliance for each patient added to the complexity, as it demanded careful craftsmanship to ensure proper fit and functionality.

On the other hand, the fabrication of the BIBRE appliance presented fewer challenges in comparison. This was mainly due to its design that utilized ESSIX forming polycarbonate sheets and did not involve any wire components. The absence of wire components simplified the fabrication process, making it less time-consuming. The utilization of ESSIX forming polycarbonate sheets facilitated the creation of the BIBRE appliance in a more efficient manner, providing a viable alternative with reduced complexities during fabrication.

The delivery process of the Fixed twin block appliance posed challenges that required specific measures. To ensure a proper fit of the molar band onto the tooth surface, glass ionomer cement (G.I.C) was used. Additionally, there were instances where the blocks of the appliance had to be modified to accommodate individual patient needs. This added complexity to the delivery process of the Fixed twin block appliance.

In contrast, the delivery of the BIBRE appliance was relatively straightforward. The Essix sheets used in its fabrication allowed for a snug fit, simplifying the delivery process. The inherent flexibility and adaptability of the Essix sheets made it easier to ensure a proper fit for each patient, minimizing the challenges encountered during the delivery of the BIBRE appliance.

5. Conclusion

A study involving 20 participants was conducted to assess the treatment effects of the Fixed Twin Block appliance and BIBRE functional therapy for class II malocclusion. A comprehensive analysis was performed using 12 skeletal, 5 dentoalveolar, and 2 transverse parameters. The null hypothesis was rejected based on the findings. The study concluded that both the Fixed Twin Block appliance and BIBRE functional therapy were effective in treating class II malocclusion. Additionally, both appliances had a restraining effect on maxillary growth, resulting in improved skeletal relationships. Furthermore, both treatments contributed to an increase in mandibular length. Comparing the two appliances, the Fixed Twin Block appliance demonstrated a clinically significant extrusion and retraction of the upper incisors, whereas the BIBRE functional therapy exhibited a lesser effect. Both groups exhibited lower incisor proclination; however, the Fixed Twin Block appliance induced a greater degree of proclination compared to BIBRE. Additionally, the Fixed Twin Block appliance led to significant expansion in the intercanine width. In summary, the study highlights the efficacy of both the Fixed Twin Block appliance and BIBRE functional therapy in treating class II malocclusion, with each appliance exhibiting specific advantages and effects on dental and skeletal parameters.

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