

## Comparison Of Mandibular Changes After Fixed Functional Appliance And Twin Block Appliance In The Treatment Of Class Ii Malocclusion: A Systematic Review

Research Article

Suvetha Siva<sup>1</sup>, Aravind Kumar Subramanian<sup>2\*</sup>, Nivethigaa B<sup>3</sup>

<sup>1</sup> Post Graduate Student, Department of Orthodontics and Dentofacial Orthopaedics, Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences, Chennai, Tamilnadu, India.

<sup>2</sup> Professor and Head Of the Department, Department of Orthodontics and Dentofacial Orthopaedics, Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences, Chennai, Tamilnadu, India.

<sup>3</sup> Senior Lecturer, Department of Orthodontics and Dentofacial Orthopaedics, Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences, Chennai, Tamilnadu, India.

### Abstract

**Background:** Skeletal class II malocclusion presenting with retruded lower jaw is one of the predominant malocclusions occurring in about one third of the total population. In growing individuals, treatment is usually done as an attempt to correct such developing malocclusion, either with the use of removable or fixed appliances which would redirect growth in the desired direction. But the outcome of these treatments is often debatable, since it is dependent on a variety of factors in patients treated at various ages.

**Aim:** This systematic review aimed at assessing the scientific evidence on the comparison of efficiency of using conventional Twin Block and fixed functional appliance (FFA) in bringing about the mandibular changes based on the correction of developing class II in patients with retrognathic mandible.

**Methodology:** A search of database was performed in the Medline database, Cochrane Clinical Trials Register, PubMed and Google Scholar till August 2020 using the MeSH terms. Search criteria included only the Randomized clinical trials (RCTs) and controlled clinical trials (CCTs).

**Results:** Using the search strategies in various databases 127 articles were obtained. After extraction using the inclusion and exclusion criteria, further sorting was done based on the relevance of title and the abstract. Out of these 127 articles, only 6 (2 RCT and 4 CCT) articles met with all the requirements of the study and were included in the systematic review. Quality analysis of these articles revealed a patient range from low (1) to medium (4) and high (1).

**Conclusion:** Nearly half of the patients who underwent treatment with Twin Block appliance showed significant changes in the total mandibular length whereas with FFA only one third of the samples showed significant changes. The co-efficient of efficiency was 0.73mm per month in Twin Block samples and 0.45mm per month in FFA samples. Adolescents showed a better response to treatment compared to other age groups.

**Clinical significance:** No clear evidence exists to exactly judge the amount of changes which occur due to a particular appliance, but the present systematic review had shown evidence in favour of Twin Block which provided more mandibular elongation in comparison to the fixed functional appliances.

**Keywords:** Skeletal Class II; Twin Block; Fixed Functional Appliance; Mandibular Elongation; and Mandibular Growth.

### Introduction

Skeletal class II malocclusion presenting with retruded lower jaw is one of the predominant malocclusions occurring in about one third of the total population [1-3]. Correction of the skeletal rela-

tionship by increasing the length of the base of the mandible can lead to improvement in profile in those cases [4, 5]. Retrusion, which is mostly the result of disturbances in the muscle activity can be corrected using different functional appliances. These appliances stimulate mandibular growth by forward posturing of

#### \*Corresponding Author:

Dr. Aravind Kumar Subramanian,  
Professor and Head Department of Orthodontics and Dentofacial Orthopedics, Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences, SIMATS, Chennai, India.  
Tel: 9841299939  
E-mail: aravindkumar@saveetha.com

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the mandible [5]. But the actual changes that occur within the jaw bases in such cases due to the altered growth with functional appliances has been a matter of debate in orthodontic literature for decades [6-10]. Whether or not these changes are permanent without any relapse is another subject of interest.

Functional appliances can exist in different forms either as fixed or removable of which Twin Block (TB) is a well-known removable appliance that is commonly used for the correction of mandibular retrusion in class II individuals. Considering the patient compliance to be the most critical factor which decides the treatment success [10-12] appliance fixed to the teeth and jaws are said better efficiency than the removable appliances. "Fixed Functional Appliances" (FFA) can be rigid (eg Herbst), flexible (eg Jasper Jumper) or a hybrid appliance [13, 14]. Hybrid appliances include "Forsus Fatigue Resistant Device" (FFRD) and "Twin Force Bite Corrector" (TFBC) [14]. These appliances provide constant horizontal forces in both open and closed mouth situations with additionally offering a headgear like distalising effect to the maxillary dentition [15]. FFA requires only less chairside time and laboratory work, but is more prone to catastrophic breakages [16]. These appliances were hence refined with more flexible variants which thereby would aid mandible in mandibular lateral and forward movement with an ease, thus enhancing patient comfort [17].

Randomised Controlled Trials (RCTs) provide a standard format of comparison between different modalities like diagnostics and treatment options. But the number of RCTs related to the treatment outcomes of Twin Block and Fixed Functional Appliances are found to be scarce in orthodontic literature. This can be attributed to the difficulty in selection of cases as well as their management over a very long period of time unlike any other dental facility [18, 19]. Even blinding the operator and observer becomes difficult when treating orthodontic patients. Hence in such cases rational systematic review can either be a prospective or retrospective controlled clinical trial (CCTs) to obtain a broad knowledge on the effects of various functional appliance therapy [20-23]. The inclusion of studies with untreated Class II samples as control group leads to better understanding of the results. The aim of this systematic review was to assess the scientific evidence on the comparison of mandibular changes after fixed functional appliance and twin block appliance in the treatment of class II malocclusion.

## Methodology

**Pico Question:** Is fixed functional appliance therapy as effective as treatment with Twin block appliance in bringing about changes in the mandible in class II subjects with mandibular retrognathism?

**Population-** Class II malocclusion attributable to retrognathic mandible.

**Intervention-** Fixed functional appliances

**Comparison-** Twin block

**Outcome-** Changes in the length of the mandible (Co-Gn (Post-Pre)), relationship of mandible to the cranial base (SNB) and inclination of the lower incisor to the mandibular base.

## Search Strategies

An extensive search was performed in the online database sources including the Medline database, Cochrane Clinical Trials Register, PubMed and google scholar till August 2020. Search criteria included only the Randomized clinical trials (RCTs) and controlled clinical trials (CCTs).

## Selection criteria

RCTs and prospective and retrospective CCTs that evaluated the effects of functional appliance therapy on the mandible (total mandibular length [Condylion(Co)- Gnathion(Gn)], SNB angle and IMPA angle) in comparison to untreated class II samples using cephalometric analysis were included. All articles from January 1966 to August 2020 written in English were included in the systematic review. Abstracts, in-vitro studies, case reports and case series, and review articles were excluded from the study.

## Data collection and quality analysis

The collected material for the systematic review included Publication year, design of the study, material and methodology (Experimental and control samples, type of functional or fixed functional appliance used), age of the patient when the treatment was started, methods used to assess the changes, type and duration of appliance wear, treatment duration, rate of success, post follow up, and conclusions provided by the author.

The quality check of methodology was done for each RCT based on the description by Jadad et al., [19] and also the quality check of the CCTs was done [20]. Risk of bias was estimated in the studies and it ranged from low to high. Extraction of data from each article was done, and any difference of opinion was resolved by the discussion on each article.

## Analysis of reported outcome

For quantitative assessment of improvement in mandibular dimension and sagittal position of mandible Twin Block or fixed functional appliance samples when compared with untreated Class II samples, data collected were Changes in the length of the mandible (Co-Gn (Post-Pre)), relationship of mandible to the cranial base (SNB) and inclination of the lower incisor to the mandibular base.

When the treatment duration using the appliance exceeded 12 months or one year, annualization of the data was done. If the treatment duration was less than one year, annualization was not done. The actual increase in mandibular length at the end of active treatment using Twin Block or Fixed Functional appliance was also analysed.

Since different appliances require different amount of time for the correction of Class II malocclusion both the efficiency and effectiveness of Twin Block and Fixed Functional Appliances was done in this review. Effectiveness was calculated as the amount of clinically significant changes produced by the appliance in treated versus untreated controls [24]. Efficiency evaluated the effective treatment time needed to achieve the treatment result. which was obtained by ratio of sagittal increase in mandible during the treatment to the duration (in months) of active treatment.

## Results

Using the search strategies in various database 127 articles were obtained. After extraction using the inclusion and exclusion criteria, further sorting was done based on the relevance of title and the abstract. Out of these 127 articles, only 6 (2 RCT and 4 CCT) articles met with all the requirements of the study and were included in the systematic review. The design and the results of the study were summarized in Table II, III and IV.

Based on quality analysis, the quality of research and methodology was low for one study, medium for four studies and high for one study (Table IV). Among these studies, no withdrawals (dropouts) were reported [25-30]. Two studies [26, 29] did not include a analysis for method error, and only one study [30] used blinding of measurements. Only two studies used proper statistical methods [29, 30]. In four studies [25-28] the normality distribution of data was not present and parametric tests were used for evaluation.

Based on average power of the studies if it was statistically significant with a value of 2.0mm or greater, then it was considered to be clinically significant. The statistically significant increase in mandibular base length was achieved in 3 out of 6 twin block samples and 3 out of 7 fixed functional appliance samples. All samples of Twin Block and two third of the FFA samples described clinically significant increase in total mandibular length.

One third of the twin block samples showed clinically significant changes in position of the mandible with respect to the cranial base (SNB angle) [29, 30], wherein the fixed functional appliance

samples showed no such clinically significant improvement. Proclination, the major disadvantage with the functional appliance therapy was noted in about two third of the samples in fixed functional appliances group and half the samples in Twin Block group (Table V).

The efficiency when noted to be 0.73mm per month for Twin Block appliance samples and 0.45mm per month for Fixed functional Appliance samples (Table V).

## Discussion

### Quality of the studies

Due to the minimal number of Randomized Controlled Trials in orthodontics, only two RCTs were included in this systematic review. Based on the quality analysis, out of the six articles reviewed, quality was noted to be medium in four (Table IV). This was mainly due to the limitations in methodology, statistics or blinding. However, one CCT30 was of high quality because there was a proper blinding in methodology applied to assess the changes. Since the methodology and the blinding were not clearly mentioned, one article was graded to be of low quality.

### Effectiveness of Twin Block and Fixed Functional appliances

This systematic review included two RCTs and four CCTs which evaluated amount of mandibular changes with either Twin Block or Fixed Functional appliances when compared with untreated controls. Two studies led to an idea that changes in the position of mandible with respect to the cranial base was clinically sig-

**Table 1. Inclusion and exclusion criteria for retrieved studies.**

INCLUSION CRITERIA	EXCLUSION CRITERIA
RCTs, prospective and retrospective CCTs	Case reports, case series and descriptive studies, review articles, opinion articles, abstracts
Articles in English	Laboratory studies
Articles published from January 1966 to July 2020	Studies of adults
Studies on growing patients	Studies performed on magnetic resonance imaging
Studies comparing Twin Block and fixed functional appliances	Measurements of total mandibular length using Point articulare.
Studies conducted on lateral cephalograms including measurements of total mandibular length (using point Condylion), SNB and IMPA angle.	Surgical treatments

**Table 2. Articles included in review.**

ARTICLES	STUDY DESIGN
Schaefer et al [25]	P, L, CCT
Kurt et al [26]	R, L, CCT
Siara-Olds et al [27]	RCT, L
Singh and Shetye [28]	RCT, L
Mahamed et al [29]	R,L,CCT
Giuntini et al [30]	R,L, CCT

RCT- Randomized clinical trial; L- longitudinal study; P- prospective study; CCT- controlled clinical trial; R- retrospective study.

Table 3. Summarized data of 6 studies.

Article Material	Controls	Age(y)	Methods/ Measurements	Appliance wear (h/day)	Treatment observation duration (mo)	Success rate	Post treatment observation	Author's conclusion
Schaefer et al [25] SS Crown Herbst-28 Twin block-28	University of Michigan	11.7yrs 12.4yrs	Lateral Cephalogram	Full time wear	13 13	Not declared	Post treatment including fixed appliance phase	Both the appliances were effective in correcting the class II malocclusion
Kurt et al [26] Herbst- 10 Twin block-10	Patients in waiting list in the University of Erciyes	14.56yrs 12.91yrs	Lateral Cephalogram	Full time wear	6 6	Not declared	No	More dental effects in Herbst. No significant differences when compared with the control group
Siara-Olds et al [27] Bionator- 20 Herbst- 20 Twin Block- 20 MARA- 20	University of Michigan and Denver growth study	10.58yrs 12.16yrs 10.91yrs 11.08yrs	Lateral Cephalogram	Full time wear	18.7 18.7 18.7 18.7	Not declared	Post treatment including fixed appliance phase	Herbst and MARA had significant restriction on maxillary growth. Twin Block controlled the mandibular plane angle and labial version of mandibular incisors.
Singh and Shetye [28] Twin Block- 15 Jasper Jumper- 10	Patients who didnt receive treatment in Himachal dental college	10.5yrs 10.5yrs	Lateral Cephalogram, OPG and Hand Wrist Radiograph	Full time wear	10 10	Not declared	No	Twin Block produced more skeletal effects. Jasper Jumper produced more dentoalveolar effects.
Mahamed et al [29] Forsus- 25 Twin Block- 25	Patients who did not receive any treatment in Yenepoya university	10.5yrs 12.9yrs	Lateral Cephalogram	Full time wear	15 12	Not declared	No	Twin Block induced both skeletal and dentoalveolar effects. Forsus induced more dentoalveolar effects
Giuntini et al [30] Twin Block- 28 Forsus- 36	University of Michigan and Denver growth study	12.4yrs 12.3yrs	Lateral Cephalogram	Full time wear	13 6	80%	Post treatment including fixed appliance phase	Twin Block induced more skeletal effects. Forsus induced more dentoalveolar effects

MARA- Mandibular Anterior Repositioning Device

Table 4. Quality evaluation of Studies.

Article sample size	Previous estimate of sample size	Withdrawal	Method error analysis	Blinding in measurements	Adequate statistics provided	Judged quality standard
Schaefer et al [25] SS Crown Herbst- 28 Twin block-28	No/ Unknown	None	Yes	No	No*	Medium
Kurt et al [26] Herbst- 10 Twin block-10	No/ Unknown	None	No	No	No*	Low
Siara-Olds et al [27] Bionator- 20 Herbst- 20 Twin Block- 20 MARA- 20	No/ Unknown	None	Yes	No	No*	Medium
Singh and Shetye[28] Twin Block- 15 Jasper Jumper- 10	No/ Unknown	None	Yes	No	No*	Medium
Mahamed et al [29] Forsus- 25 Twin Block- 25	No/ Unknown	None	No	No	Yes	Medium
Giuntini et al [30] Twin Block- 28 Forsus- 36	Yes	None	Yes	Yes	Yes	High

MARA- Mandibular Anterior Repositioning Device ; \*Use of parametric tests in samples that were not tested for normality.

Table 5. Descriptive analysis of reported outcomes.

Articles	Appliance	Active treatment duration (mo)	Annualized changes			Actual change	
			SNB	Co-Gn	IMPA	Co-Gn	Coefficient of efficiency (mm/mo)
			(°/degree)	(mm)	(°/degree)	(mm)	
Schaefer et al [25]	SS Crown Herbst	13	0.18 (S)	5.630(NS)	3.5(NS)	6.1	0.479
	Twin Block	13	1.38 (S)	6.461(NS)	4.15(NS)	7	0.538
Kurt et al [26]	Herbst	6*	1.5(S)	3.1(NS)	5.65(S)	3.1	0.516
	Twin Block	6*	1.5(S)	4.5(S)	1.4(NS)	4.5	0.75
Siara-Olds et al [27]	Bionator	18	0.43(NS)	3.8(NS)	0.53(NS)	5.7	0.316
	Herbst	18	0.56(NS)	4.40(NS)	0.32(NS)	6.6	0.366
	Twin Block	18	0.83(S)	4.78(NS)	0.71(NS)	7.17	0.398
	MARA	18	0.43(NS)	4.25(NS)	2.46(S)	6.37	0.354
Singh and Shetye [28]	Twin Block	10	3.27(NS)	6.324(NS)	4.476(S)	5.27	0.527
	Jasper Jumper	10	0.6(S)	2.04(S)	6.96(S)	1.7	0.17
Mahamed et al [29]	Forsus	15	0.72(NS)	1.6(S)	4.38(S)	1.6	0.1
	Twin Block	12	2.3(S)	6.02(S)	2.16(S)	6.02	0.5
Giuntini et al [30]	Twin Block	13	2.6(S)	8.67(S)	3.04(S)	9.4	0.72
	Forsus	6*	0.5(S)	7.4(S)	12.4(S)	7.4	1.23

MARA- Mandibular Anterior Repositioning Device; S-, statistically Significant; NS- Not Significant as reported by authors. Statistically and clinically significant differences (at least 2 mm) shown in bold and italics. \*Outcomes were not annualized.

nificant in Twin Block but not in the FFA. Since increase in the mandibular length was counteracted with vertical opening of the bite, the SNB angle cannot be considered as an actual indicator of the effectiveness of functional appliances.

In terms of lower Incisor position, clinically significant results were present in two third of samples in fixed functional appliances and one-half samples in Twin Block. This proclination of lower incisors can also be the contributing factor in mandibular growth and advancement in smaller amounts. This is in accordance with the previous studies which have reported similar amount of mandibular incisor proclination [31, 32].

One of the two RCTs reported a clinically significant increase in mandibular length when treated using fixed functional appliances [28]. Even though it's a known fact that the treatment response to functional appliances in cases of mandibular deficiencies depend on the biological response at the condyle [33-35] only two [27, 30] of the six studies reported information about an individual's skeletal maturity. Among the studies treatment was received during different time periods like the pre-pubertal growth peak [27] and pubertal growth spurt [30]. The amount of mandibular growth was clinically significant (i.e., 2mm) in cases treated during the peak pubertal growth spurt when compared to the cases treated during pre- pubertal growth phase which is the major key factor for the achievement of these changes. These findings were in support of previous research which enhances the role of treatment timing in functional therapy for ideal outcomes [33-35].

With regard to treatment timing, one of them did not include adequate details of skeletal maturity [28], whereas the other described at pre peak stages [27]. There was no clinically significant mandibular changes in these sample because of the prepubertal treatment timing.

The amount of time required for different functional appliances to achieve the necessary changes in Class II malocclusion was different. The co-efficient of efficiency for FFA was 0.45mm per month, whereas for Twin Block it was 0.73mm per month. The duration of active treatment for fixed functional appliances was 12.28 months and for the Twin Block appliances was 12 months.

### Conclusion

It can be concluded that:

1. Half of the Twin Block samples in the 6 studies reported clinically significant mandibular length whereas in Fixed functional appliances samples only one-third reported clinical significance.
2. There is a significant increase in the amount of mandibular length when the treatment is performed during the peak pubertal growth spurt phase.
3. The Twin Block appliance showed the highest coefficient of efficiency (0.73 mm per month) whereas the coefficient of efficiency for fixed functional appliances was less (0.45 mm per month).

**Clinical significance:** No clear evidence exists to exactly judge the amount of changes with occur due to a particular appliance, but the present systematic review had shown evidence in favour of twin block which provided more mandibular elongation in comparison to the fixed functional appliance.

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