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Functional Appliances Effectiveness and Stability of Treating Class II Skeletal Malocclusion: A Systematic Review

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ABSTRACT

Background: Skeletal malocclusion is a serious condition, which has many complications that affect oral health as causing dental trauma and mastication difficulties. There are many strategies for correction of class II malocclusion in growing age, including the use of functional appliance as a growing modification. The functional appliance aims to modify the position of mandible sagittal and vertically and to induce lengthening of the mandible by increasing the growth at condylar cartilage. Therefore, these appliances have the maximum effect when applies early, among the growing phase.

Aim: The current review aimed to systematically assess the literature on the effectiveness of fixed and removable functional appliances and determines its stability results among growing patients with skeletal class II malocclusion.

Material and methods: A systematic review was conducted where clinical trials were analyzed and published up to 2020, respecting years of seniority. The current systematic review of literature is carried out in view of the most essential points of the report for systematic reviews. The search question was developed following the PICO standards.

Results: The search identified a total of 5639 papers for screening after the removal of duplicate articles. Among the retrieved studies, 5376 papers did not meet the study inclusion criteria. Consequently, 263 full text articles were retrieved and reviewed. Finally, 10 papers that fulfilled all the inclusion criteria were selected and reviewed systematically. Quality assessment of the final articles was appraised for the risk of bias by one independent reviewer using a well formulated quality assessment tool.

Conclusion: Accordingly, it can be concluded that Fixed Appliances (FA) have a higher restriction on maxillary development, while Removable Appliances (RA) have a more significant effect on mandibular development. RA is more preferred for patients due to higher comfort levels; patients' speech is a reasonable and immediate improvement in patient appearance.

Keywords: Functional appliance, Class II, Malocclusion, Orthodontics, Skeletal

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INTRODUCTION

Face defects have many negative effects on the life of any person, however its very regular birth defects that occur in all socialites. One of these defects that found in all cultures is dental malocclusion. Dental malocclusion's prevalence not the same in all part of world as many factors as ethnic, environmental and genetic can affect and cause malocclusion. According to WHO, malocclusions are the third in the list of the highest conditions among oral pathologies after tooth decay and periodontal diseases and consider the third worldwide public health dental disease priorities.

Malocclusion is consisting of (mal) and (occlusion); occlusion is the relationship between maxillary and mandibular teeth when they are in functional contact. Consequently, malocclusion is the deviation from the normal occlusion movement. Angle's classification is the most popular method to classify malocclusion which divided according to this classification into three divisions; class I, II and II. Class II, which is the most, frequent condition presenting in orthodontic practice is a distal relationship of mandibular teeth compared with maxillary ones. However, the high prevalence of class 2 malocclusion, its cause for most cases is unknown. Although many factors may contribute with the condition as distortion of maxillary, mandibular development or both as it have a significant effect on positioning, alignment and health of normal teeth. Considering that, most cases of class 2 malocclusion were related to mandibular retrognathism rather than maxillary prognathism.

Depending on axial inclination of upper anterior, class 2 malocclusion is classified in two different types each called division and have number of 1 and 2. Division 1 is most frequent one, while division 2 is rare. The division one occurs when proclined upper central incisors is present with a significant increase in overjet. In division two, upper central incisors are retroclined and lateral one may be proclined or normally inclined with slightly or minimal overjet.

All children should be regularly checked for malocclusion, so if dentist see any problem in jaw or teeth alignment, he will suggest further visit to an orthodontist who in his turn will ask about child's past health, check the mouth and teeth and may also ask for taking X- rays and photos of face and teeth for more accurate diagnosis. For phoTting the teeth, dental casts, intra and extra oral photographs, radiographic images are used for this purpose. Nowadays, there are modern technologies used for imaging the face and teeth that replace the older ones as digitized dental models and three dimensional imaging.

Division 2 shows different triad feathers from division 1 which include; deep bite, retroclined maxillary incisors and posteriorly positioned mandibular dental arch. In addition, division 2 has different skeletal components as decreased lower face height, decreased gonial angle, hypo divergent pattern and low mandibular plane angle.

Skeletal malocclusion is a serious condition, which has many complications that affect oral health as causing dental trauma and mastication difficulties. In addition, untreated malocclusion is related to many other conditions as sleep related breathing disorders.

There many strategies for correction of class 2 malocclusion in growing age including the use of functional appliance with growing modification. Functional appliance aims to modify the position of mandible sagittally and vertically and to induce lengthening of mandible by increasing the growth at condylar cartilage. Therefore, these appliances have the maximum effect when applies early while jaw is still growing. Functional appliance may be removable appliance as activators, bionator, headgear and twin block appliances. In addition, fixed appliances as herbst, orthodontic camouflage and forsus appliance. Dissimilar to removable functional appliances, fixed functional devices have the benefit of not requiring patient compliance and they can be applied alongside with brackets. Each appliance has its advantages and disadvantages and many studies have been made to evaluate each appliance on the development of skeletal and dental correlation, however little studies have been done to compare between fixed and removable appliance in skeletal, dento alveolar and soft tissue correction, including clinical and lateral cephalometric measurements and the duration of treatment.

The current review aimed to systematically assess the literature on the effectiveness of fixed and removable functional appliances and determines its stability results among growing patients with skeletal class II malocclusion [1].

LITERATURE REVIEW

A systematic review was conducted where clinical trials were analyzed and published up to 2020, respecting years of seniority. Studies that have been evaluated are linked to functional appliances effectiveness and stability of treating class II skeletal malocclusion. The current systematic review of literature is carried out in view of the most important points of the report for systematic reviews [2]. To prepare and organize the systematic review, the search question was developed using the format: Comparison, OR: Result.

Search methods for identification of studies

Eligibility criteria and study selection: A comprehensive electronic search with time and language restrictions were is done. Several known databases were being included eg., “Google scholar, PubMed, the Cochrane library, web of science” from 2014 to 2020 following certain eligibility criteria (Table 1).

Table 1: Inclusion and exclusion criteria.

S. no	Inclusion criteria	Exclusion criteria
1	Participants: Children less than 16 years old with skeletal class II malocclusion and overjet greater than 5 mm	Trials involving patients with craniofacial syndromes and/or cleft lip or palate will be excluded
2	Interventions: Any type of fixed functional appliances (fixed and/or removable)	Other non-randomized studies including observational retrospective designs will be omitted
3	Outcome measures: The primary outcomes were measures of skeletal, dento alveolar and soft tissue correction, including clinical and lateral cephalometric measurements and the duration of treatment	Animal studies will be omitted as well
4	Randomized or non-randomized controlled clinical trials were to be included	Studies involved patients with class II malocclusion treated with extractions and/or orthognathic surgery
5	Published in a year between 2014 to 2020	Unsupported opinion of expert
6	Null	Replies to the author/editor
7	Null	Books’/conferences’ abstracts
8	Null	Published papers before 2014

Data analysis

In several known database were searched eg., Google scholar, PubMed, the Cochrane library, web of science. Combine the search terms and limited the study to the English language. Depending on PRISMA checklist duplicates were removed, articles were screened based on title, abstract and full text.

Quality synthesis: One particular reviewer assessed methodological quality of the studies after final assessment of the full text (n=10) independently. Accordingly, 10 final articles were individually applied for qualitative and quantitative assessments. Quality assessment of the 10 final articles was appraised for risk of bias using a well-formulated quality assessment tool. Sampling bias was appraised by assessing and evaluating the sample selection, performance, detection of outcome assessors, attrition and reporting. The overall assessment provided range from low to moderate risk of bias; the main methodological points of these studies are summarized in Table 2.

Table 2: Criteria for judging risk of bias in the 'risk of bias' assessment tool reproduced from the Cochrane tool.

Bias type	Overall assessment	Reporting	Attrition	Detection	Performance	Selection	
Bias		Selective reporting	Incomplete outcome data	Blinding outcome assessment	Blinding of participants and personnel	Allocation concealment	Random sequence generation
Javeria Asif, et al., 2019	Low	Low	Low	Unclear	Low	Unclear	Low
Konstantinos Papadopoulos, et al., 2015	Low	Low	Low	Unclear	Low	Unclear	Low
Luciano Zilio Saikoski, et al., 2012	Low	Low	Low	Unclear	Low	Unclear	Low
Veronica Giuntini, et al., 2015	Moderate	Low	Low	Unclear	Low	Unclear	Unclear
E. Erin Bilbo, et al., 2018	High	High	Low	Unclear	Low	Unclear	Unclear
Dirceu Barnabe Raveli, et al., 2016	Moderate	Low	Low	Low	Low	Unclear	High
Fatemeh, et al., 2017	Low	Low	Low	Low	Low	Unclear	Unclear
Antonio Carlos et al., 2019	Low	Low	Low	Unclear	Low	Unclear	Low
Gero Stefan, et al., 2018	Low	Low	Low	Unclear	Low	Unclear	Low
Arjun Atresh, et al., 2018	Low	Low	Low	Unclear	Low	Unclear	Low

Search methods for identification study the following search engine where are used:

- Medline (PubMed)
- Google scholar
- Cochrane database of systematic reviews
- Trip medical database
- Cambridge libguides
- NHS evidence
- Elsevier

In order to avoid omission of relevant studies, a broad search strategy was undertaken that covered the whole spectrum of treatment strategies of malocclusion and was then carefully restricted on functional appliances. The searched studies were concluded to orthodontic studies that deal with treatment of malocclusion type two of two divisions using functional appliances. The reference lists of the trials eligible for inclusion and systematic reviews concerning Class II malocclusion treatment were also checked [3].

Malocclusion types two, functional appliances, herbst, Forsus appliance, twin block, bionator, skeletal are the most keyword used. In addition, the reference lists of the included articles as well as of relative reviews were searched for the identification of possibly relevant studies. For studies published in more than one language, the English version is used. After choosing studies, each article was tested for reliability of authors, publisher and university where study conducted.

Criteria of judgment following low, high or unclear risk were judge based on the following:

Random sequence generation: Selection bias (biased allocation to interventions) due to inadequate generation of a randomized sequence.

Allocation concealment: Selection bias (biased allocation to interventions) due to inadequate concealment of allocations prior to assignment.

Blinding of participants and personnel: Performance bias due to knowledge of the allocated interventions by participants and personnel during the study.

Blinding of outcome assessment: Detection bias due to knowledge of the allocated interventions by outcome assessors.

Incomplete outcome data: Attrition bias due to amount, nature or handling of incomplete outcome data.

Selective reporting: Reporting bias due to selective outcome reporting.

DISCUSSION

Manual searches resulted in 9052 hits, which were reduced to 5639 after the removal of duplicates. Following the sequential elimination of 5376 studies on the basis of title and abstract, 263 full texts were considered eligible for further evaluation. From the latter, 253 were excluded for various reasons and finally 10 articles were included in the qualitative synthesis of the present review [4]. After removing the duplicated studies, each study was tested for inclusion and exclusion criteria. Only studies of randomized or non-randomized controlled clinical trials that included treatment of children less than 16 years old with skeletal class II malocclusion and overjet greater than 5 mm and treated with any type of fixed or removable functional appliances were included. The primary outcomes were measures of skeletal, dento alveolar and soft tissue correction, including clinical and lateral cephalometric measurements and the duration of treatment. Exclusion criteria included Trials involving patients with craniofacial syndromes and/or cleft lip or palate excluded, retrospective designs, animal studies, treatment with extractions and/or orthognathic surgery, unsupported opinion of expert, replies to the author/ editor and books'/conferences' abstracts. In the remaining articles, we examined it on the basis of title, abstract and full text [5].

General results

The general characteristics of the ten included articles are presented in brief in Tables 3 and 4. Four studies were retrospective study, three were prospective study, one was randomized clinical trial, one was case report and the last study was cross sectional study. The whole studies reporting 471 cases, 244 of them were male (51.8%) and 227 were female (48.2%). 224 patients were entering intervention group. Among the 10 studies reporting age, the average patient age was 12 (mean ages within each study ranging between 10 and 13.6 years). The majority of these studies took place in university settings in different countries (Bauru, Italy, Iran, Germany, Pakistan, USA, Brazil and Australia) whereas one of them were performed in private practices and had been published as journal papers and/or dissertations in English between 2014 and 2019 [6].

Most patients had malocclusion class two divisions one while 3 in three studies, patients had malocclusion class two of the two division. Four studies had control group of no treatment while 4 groups had another group that treated with another appliance and 2 cases without any comparable groups. Five studies studied the effect of removable appliance, three studied effect of fixed appliance and the two study try to compare between the two types of appliances [7].

Most of studies measure skeletal and dental change throughout the treatment program except in two studies which depend on measuring differences in soft tissue. A wide variety of removable or fixed functional appliances were used that include bionator, forsus nitinol flat spring, herbst, headgear and twin block. Regarding treatment modalities, twin block was the most appliance used in the studies (4 studies in that 3 studies deal with herbst appliance, two studies of head gear, three studies studied forsus appliance and two studies deal with bionator (Tables 3 and 4).

Table 3: General characteristics of the chosen studies including design, setting and number of participate.

No	Article	Type of malocclusion	Experimental group			Controlled sample		
			N (M/F)	Age in years	Used appliance	N (M/F)	Age in years	Used appliance
1	Javeria Asif, et.al., 2019	Class II , division 1, mandibular retrognathic malocclusion	70 (30/40)	Mean age=12.57 ± 0.71 years	Twin block appliance	Another group with another appliance		
						70 (30/40)	Mean age=12.57 ± 0.71 years.	Herbst appliance
2	Konstantinos Papadopoulos, et al., 2015	Class II division 1 malocclusion	1 (0/1)	10	Non extraction cervical headgear treatment	No control group, it was case report		
3	Luciano Zilio Saikoski, et al., 2012	Class II division 1 malocclusion	20 (11/9)	Mean age of 11.76 ± 1.64	Modified twin block functional orthopedic appliance	25 (14/11)	mean age of 11.39 ± 1.35	Untreated individuals

4	Veronica Giuntini, et al., 2015	Class II division 1 malocclusion	28 (9/19)	Mean age, 12.4	Twin block appliance Followed by fixed appliances	Another group with another appliance		
						36 (20/16)	mean age, 12.3 years	Forsus Fatigue Resistant Device (FRD) in combination with fixed appliances
5	E Erin Bilbo, et al., 2018	Class 2 malocclusion	21 (12/9)	10.7	High pull headgear	21 (10/11)	10.9	No treatment
6	Dirceu Barnabe Raveli, et al., 2016	skeletal class II division 1 malocclusion	20 (10/10)	9.1	Bionator	20 (9/11)	9	No treatment
7	Fatemeh, et al., 2017	II division I malocclusion	17 (11/6)	10.3	Twin block	Another group with another appliance		
						16 (9/7)	10.9	Bionator
8	Antonio Carlos, et al., 2019	Class II malocclusion, division 1	10 (7/3)	13.86	Forsus appliance	No control sample		
9	Gero Stefan, et al., 2018	class II malocclusion two type	21 (11/10)	Was mean 16 years and 2months for male patients and 15 years and 9 for female	Functional mandibular advancer	Another group with another appliance		
						21 (11/10)	Mean 12 years and 1 month for male patients and 13 years and 2 months for female patients.	Herbst appliance
10	Arjun Atresh, et al., 2018	Class 2; the two divisions	16 (5/11)	13.36	Herbst appliance	11	13.73	Untreated

Results of individual studies

Results of each study indicated simply in Table 4. Patients treated with Twin Block (TB) appliance showed significantly more protruded and buccally inclined mandibular incisors in comparison to the control group.

Table 4: The complete of general characteristics of the chosen studies including type of malocclusion, detailed information about participates and intervention used.

Article	Aim	Measurement	Results
Javeria Asif, et al., 2019	To evaluate the mean changes in soft tissue parameters in class II patient treated with two different appliances	Soft tissue linear measurements were traced on lateral cephalometric radiographs	Soft tissue profile is improved with use of both Twin block and herbst appliance but greater advancement of soft tissue pogonion and lower lip were observed in twin block group as compared to herbst group
Konstantinos Papadopoulo, et al., 2015	Class II division 1 malocclusion	The lateral head radiogram beside Cephalometric measurements	inhibition of maxillary growth and distal movement of the upper first molars were achieved by the combination of skeletal and dentoalveolar effects of the headgear appliance
Luciano Zilio Saikoski, et al., 2012	With the twin block appliance.	Lateral cephalograms	The Twin Block appliance has great effectiveness for correction of skeletal Class II malocclusion in individuals with growth potential. Most changes are of dentoalveolar nature with a large component of tooth inclination associated with a significant skeletal effect on the mandible
Veronica Giuntini, et al., 2015	To compare the dentoskeletal changes produced by the Twin Block appliance (TB) followed by fixed appliances *vs.* the forsus Fatigue Resistant Device (FRD) in combination with fixed appliances in growing patients having class II division 1 malocclusion	Cephalometric changes	The TB appliance produced greater skeletal effects in terms of mandibular advancement and growth stimulation while the forsus caused significant proclamation of the mandibular incisors
E. Erin Bilbo, et al., 2018	To evaluate the long term skeletal effects of treatment using high pull headgear followed	Lateral cephalometric outcomes	One phase treatment for class II malocclusion with high pull headgear followed by fixed orthodontic appliances resulted in correction to class I molar through restriction of horizontal maxillary growth with continued horizontal mandibular growth and vertical skeletal changes unaffected. The anteroposterior molar correction and skeletal effects of this treatment were stable long term.

Dirceu Barnabe Raveli, et al., 2016	To investigate the amount of skeletal and dentoalveolar changes after early treatment of class II, division 1 malocclusion with bionator appliance	Pretreatment and post treatment cephalometric records	Bionator appliance was effective in generating differential growth between the jaws. Cephalometric skeletal measurements ANB, WITS, Lafh, Co-A and dental L6-Mp, U1.Pp, IsIi, OB, OJ showed statistically significantly different from the control. Bionator induced more dentoalveolar changes than skeletal during treatment in prepubertal stage
Fatemeh, et al., 2017	To compare the treatment outcomes of twin block and bionator using cephalometric radiographs	Cephalometric radiographs	There were no statistically significant differences in dentoalveolar and mandibular position between twin block and bionator ($p>0.1$). Twin block was more efficient in inhibition of forward movement of maxilla ($p<0.1$).
Antonio Carlos, et al., 2019	To evaluate dentoalveolar skeletal changes promoted by the forsus appliance, associated to fixed orthodontic appliance, in the correction of class II, division 1 malocclusion	Computed Tomography (CT).	Forsus® presented similar results to other mandibular propulsion appliances, with dentoalveolar effects that favored class II correction, however, with very slight skeletal modifications
Gero Stefan, et al., 2018	To compare skeletal and dental changes in class II patients treated with Fixed Functional Appliances (FFA)	Lateral Cephalograms	FMA and Herbst appliance usage results in comparable skeletal and dental treatment effects despite different biomechanical approaches
Arjun Atresh et al., 2018	Evaluate the skeletal changes in class II subjects with different vertical facial patterns treated with the herbst appliance	3 dimensional superimposition techniques	Approximately 2 years after herbst treatment, the herbst subjects with different vertical facial patterns showed similar patterns of skeletal change compared with the class II controls treated with elastics

In addition, they presented significantly smaller molar relationship, greater increase in mandibular length Co-Gn and significantly greater increase in Sn-Ocl in comparison to the control group. Moreover, they presented greater and significant lingual inclination and retrusion of maxillary incisors and greater and significant buccal inclination and protrusion of mandibular incisors in comparison to the control group [8]. In addition to analysis of dental relationships, the TB group exhibited significantly greater reduction in overjet and molar relationship when compared to the control group 3. Patient with Twin block showed more significant decrease in H angle and significant increase in both (VRL-Si) and VRL-Pog than shown in patients treated with Herbst appliance as the difference 2.32 ± 1.69 mm in mean H angle for TB patients and difference 2.12 ± 1.88 mm in mean H angle for Herbst patients, difference of 6.60 ± 0.09 mm in VRL-Si in Twin block treated group and no significant reported difference for herbst treated group while difference of 6.04 ± 1.48 mm of VRL-Pog in Twin block treated group compared to no significant reported difference for herbst treated group 1. Further comparison of twin block appliance against forsus Fatigue Resistant Device (FRD) showed that both devices had the same rate of success. However, TB patients exhibited significantly greater mandibular than the (FRD) and control groups [9]. In addition, TB group showed significantly greater decreases in the ANB angle, greater increments in total mandibular length Co-Gn, greater decreases in overjet, greater increments of change in molar relationships, significantly greater amount of retroclination of the maxillary incisors and lower amount of mandibular incisor proclination when compared with (FRD) treated patients (20.8 mm, 2.0 mm, 23 mm, 1.5 mm, 26.5 u and 2.9 u respectively) and when compared with controlled group (20.2 u, 3.4 mm, 23.0 mm, 27.9 mm, 4.8 mm, 26.3 u and 5.6 u respectively. Moreover, when twin block appliance compared with another removable appliance as bionator, significant difference in the changes they made in ANB (A point Nasion B point) angle, NA-Pog (CONVEXITY angle), basal and gonial angles ($p< 0.1$). In addition, patients treated with bionator appliance showed increase in Lafh and (Co-Gn) compared with control group (0.96 mm and 1.15 mm respectively) and decreases in ANB and WITS by 0.89° and 2.06 mm in comparison to control group respectively. In addition, the OJ and OB decreased 3.12 mm and 1.22 mm in the treated group in comparison to controlled group, respectively. The IsIi and L6-Mp increased 4.33° and 0.76 mm in treated group in comparison to controlled group, respectively [10].

Head gear appliance is another removable appliance used to resolve malocclusion problem. The main result of usage of head gear in 10 years old child ended in facial aesthetic improvement with an obvious correction of the position and the relationship between the upper and lower lip with overjet reduction from 9 mm to 2 mm and normalization of overbite. In comparing with control group, patients with headgear appliance showed more negative changes (reduction) in the SNA angle. However, no significant difference in SNB changes, horizontal changes in B-point or Pogonion, nor were there significant changes in the angle FH-NPog between the study and control groups. In addition, there were no significant differences in vertical changes of ANS and PNS between study and controls [11].

Herbst appliance is one of the fixed appliances used in controlling malocclusion. It showed significant difference ($P=0.01$) in the change in vertical position of ANS

compared to control group. In addition, there was a significant difference (P=0.03) in the vertical position of B-point in the Herbst group compared with the Class II control group with increases in right and left mandibular lengths during phase 1. However, there was a statistically significant (P=0.02) closure of the right gonial angle in the herbst group (-1.59°) compared with the control group. In compare with Functional Mandibular Advancer (FMA), no significant difference had been established except for the distance between dorsal condyle margin and pterygoid vertical (Co(dorsal)-PTV) which decreased in FMA patients and increased in herbst appliance patients.

This systematic review summarizes evidence from clinical studies on the effect of functional appliance treatment on malocclusion class 2 and the difference between fixed and removable appliance. Even though functional appliances have been used for many decades to treat class II malocclusion, only 10 studies with 471 cases were identified and found eligible for inclusion in this review [12].

The key differences between fixed and removable devices relates to the ability of fixed types to secure compliance and produce significant bite advancement with limited vertical bite opening. However, these appliances may be associated with high rate of breakages and more emergency visits. Conversely, removable appliances may be associated with excessive vertical bite opening and interference with normal functions and mandibular movement, precluding their full time use.

Clinical and radiographic findings: Various cephalometric parameters were used in the included studies; the most common measures included the anterior posterior skeletal discrepancy, mandibular length, vertical face height and overjet. Overall there was inconsistency between authors in adopting these parameters and also in the method of intervention. The functional devices regardless of their type successfully reduced the overjet to within normal limits with similar proportional correction in terms of skeletal and dental effects in the sagittal plane [13].

Dento skeletal changes are concerned; some evidence indicated that patients treated with functional appliances differed from untreated patients. Meta-analysis of 5 studies indicated the positive and effective usage of generally functional appliance to treat patients with skeletal malocclusion.

Maxillary changes: Investigations into the actual dento skeletal changes obtained with the twin block appliance in the first treatment stage did not reveal any restriction of anterior maxillary displacement while the sagittal skeletal correction of class II relationships in the FRD group was due mainly to a significant restriction of maxillary growth. In addition, use of headgear restrained forward growth of the maxilla (decreases in SNA) when used in a phase of treatment prior to and separate from, edgewise therapy. Moreover, bionator appliance was effective in reducing sagittal inter maxillary relationship however, as twin block, both appliances do not actually restrict maxillary growth because maxillary length in both groups increased after treatment however this increase was less in twin block group. In forsus appliance, it seems that the device causes significant decrease in SNA indicating the appliance promoted limitation of the anterior displacement of the maxilla. In addition, as TB, in herbst and FML appliance, no growth inhibiting effect, nor a treatment related change in maxillary length happened.

Mandibular changes: In consider of mandibular growth, in twin block treatment, revealed a statistically significant increase of from 2.0 mm to 4.17 mm in the mandibular length (Co-Gn) which is greater than what happened in FRD treated patients. With headgear, the mandibular effects ranged from no significant difference in length or SNB angle change compared to controls to enhanced mandibular growth greater than controls and comparable to that of a bionator which showed small mean increase in SNB which is correlated with the minimal mandibular skeletal growth during prepubertal period. However, in most studies TB affect mandibular growth greater than bionator except in one study where mandibular length changes were greater in bionator group 7. In forsus treated patients, Co-Gn presented a statistically significant increase which cause increase in mandibular length soon after removal of the forsus appliance.

Maxillo mandibular relation changes: Evaluation of the maxilla mandibular relationship component in twin block treated patients revealed that mandibular growth and/or repositioning did not promote significant changes in ANB and wits variables with consequent reduction in skeletal discrepancy between jaws in individuals in the experimental group. However, the TB induced a more favorable correction in inter maxillary sagittal relationships than did the FRD or what occurred in the controls. In bionator patients, ANB angle was decreased after treatment but twin block resulted in more decrease and this was statistically significant. Forsus appliance result in significantly decreasing in ANB indicating a remarkable improvement in the maxilla mandibular relation [14].

Vertical changes: The height of lower facial third was increased in both TB and bionator treated patients. However, there was no statistically significant difference between two appliances, bionator resulted in more increase. In addition, TB induced a significant posterior rotation of the mandible with respect to the control sample while the FRD group did not show any significant difference in angular measurements compared with the control group. In addition, high pull headgear treatment followed by fixed edgewise appliances did not affect vertical development of the face. In Forsus appliance, there was a mandibular rotation counterclockwise, with decrease of SN.GoMe, of FMA and more increase in postero inferior facial height than in antero inferior facial height [15].

Soft tissue analysis: Unfortunately, only two studies deal with change in soft tissue changes due to usage of

functional appliance. Decrease in soft tissue convexity was reported after herbst and twin block therapies; however, this is greater in herbst. Soft tissue profile is improved with use of both Twin block and Herbst appliance but greater advancement of soft tissue pogonion and lower lip were observed in Twin Block (TB) groups as compared to herbst group (Table 5).

Table 5: Parameters and abbreviations.

Parameter	Abbreviation
Co-Gn	Mandible length: Linear distance between the most superior point of the mandibular condyle (Co(superior)) and most anterior, inferior point on the mandibular symphysis (Gnathion, (Gn))
Sn-Ocl	Angle formed by the line S-N (anterior carinal base)and occlusion plane
H angle	The angle formed between soft tissue nasion, soft tissue pogonion and labrale superioris
VRL-Si	Horizontal distance between vertical reference plane and sulcus inferioris
VRL-Pog	Horizontal distance between vertical reference plane and soft tissue pogonion
ANB	Anterior posterior relation of the maxilla and the mandible
NA-Pog	Angle of convexity: The angle is formed by the line NA and A-pog
Lafh	Anterior Lower Facial Height (ANS-Me)
WITS	Wits appraisal (Ao to Bo)
IsIi	Angle between upper and lower incisors
L6-Mp	Mesiobuccally cusp of Lower 6 to Mandibular Plane
SNA	Maxilla position in relation to cranial base
SNB	Mandible position in relation to cranial base
Pogonion	The most anterior point on the symphysis of the mandible on the mid sagittal plane
B-point	Most concave point on mandibular symphysis
FH-NPog	Angle formed at the intersection of FH plane and N-Pog line
ANS	Anterior nasal spine
PNS	Posterior nasal spine
FMA	Functional mandibular advancer
Co(dorsal)-PTV	Position of the dorsal condyle margin: Linear distance between the most posterior point of the mandibular condyle (Co(dorsal)) and Pterygoid Vertical (PTV)
SN, GoMe	Angle between lines SN and GoMe (used to represent the mandibular plane in the steiner analysis)

CONCLUSION

Functional appliances have a great positive effect in treatment of malocclusion class two whatever fixed or removable appliance. Fixed appliances have a greater restriction on Maxillary development while removable appliance has a greater effect on mandibular development. Both type of appliances have positive effect on reducing overjet without any preference. However, removable appliances are more preferred for patients due to higher comfort level, patients' speech is normal and immediately improvement in patient appearance.

REFERENCES

1. van Vlijmen OJ, Kuijpers MA, Berge SJ, et al. Evidence supporting the use of cone beam computed tomography in orthodontics. J Am Dent Assoc 2012; 143:241-252.
2. Bendgude V, Akkareddy B, Panse A, et al. Correlation between dental traumatic injuries and overjet among 11 to 17 years Indian girls with angle's class I molar relation. J Contemp Dent Pract 2012; 13:142-146.
3. Blair ES. A Cephalometric roentgenographic appraisal of the skeletal morphology of class I, class II, div. 1 and class II, div. 2 (angle) malocclusions. Angle Orthod 1954; 24:106-119.
4. Dodda KK, Prasad SE, Kanuru RK, et al. Diagnostic features of angle's class II div 2 malocclusion. Int Soc Prev Community Dent 2015; 5:513.
5. Frankel R. The treatment of class II, division 1 malocclusion with functional correctors. Am J Orthod 1969; 55:265-275.
6. Daskalogiannakis J. Glossary of Orthodontic Terms. 1st edition, Publisher: 4. Quintessence, London, 2000.

7. Johnson LE. Orthodontics: State of the art, essence of the science. St Louis: C V. Mosby, New York, 1986, pp. 88-99.
8. Joshi N, Hamdan AM, Fakhouri WD. Skeletal malocclusion: A developmental disorder with a lifelong morbidity. J Clin Med Res 2014; 6:399.
9. Masood Y, Masood M, Zainul NN, et al. Impact of malocclusion on oral health related quality of life in young people. Health Qual Life Outcomes 2013; 11:1-6.
10. McNamara Jr JA. Components of Class II malocclusion in children 8-10 years of age. Ang Orthodon 1981; 51:177-202.
11. Moss ML, Salentijn L. The primary role of functional matrices in facial growth. Am J Orthod 1969; 55:566-577.
12. O'Brien K, Wright J, Conboy F, et al. Effectiveness of early orthodontic treatment with the twin block appliance: A multicenter, randomized, controlled trial. Part 1: Dental and skeletal effects. Am J Orthod Dentofac Orthop 2003; 124:234-243.
13. Sauer C, Schluter B, Hinz R, et al. Childhood obstructive sleep apnea syndrome: An interdisciplinary approach. J Orofac Orthop 2012; 73.
14. Trenouth MJ. Proportional changes in cephalometric distances during twin block appliance therapy. Eur J Orthod 2002; 24:485-491.
15. Wieslander L, Lagerstrom L. The effect of activator treatment on class II malocclusions. Am J Orthod 1979; 75:20-26.