Original Study

COMPARATIVE EFFECT OF TWIN-BLOCK APPLIANCE ON SKELETAL AND DENTAL INDICES IN PATIENTS WITH SKELETAL CLASS II MALOCCLUSION AND DIFFERENT VERTICAL GROWTH PATTERNS

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ABSTRACT

Aim: Malocclusion is a skeletal complication that requires orthodontic treatment, and class II malocclusion has been observed in many patients, for which twin-block appliance can be a treatment of choice. Due to scarcity of studies in this regard, the current study was carried out to evaluate the effect of this appliance on different vertical skeletal growth patterns as well as its prognosis.

Materials and Method: In this retrospective study, the medical files of 66 patients with class II malocclusion treated by twin-block appliance by a faculty member orthodontist at Isfahan University of Medical Sciences were obtained, from which 37 files were selected via simple random sampling based on the determined criteria.The patients' lateral cephalometric radiographs before and after treatment were traced manually and analyzed afterwards. Based on Mandibular Plane Angle (MPA) index, they were divided into two groups, including normal facial growth pattern and vertical facial growth pattern.

Result: In patients with normal facial growth pattern, only two cephalometric variables, overjet and ANB, showed statistically significant difference from among ten studied cephalometric variables . In patients with vertical facial growth pattern, SNB, overjet, N Perp/Pog, LAFH and ANB showed significant changes from among the ten cephalometric variables ($p<0.05$). However, taking the length of treatment into consideration, SNA and SNB cephalometric variables were reported to be significant.

Conclusion: Functional appliances are a good treatment of choice for patients with log faces and can be quite effective in controlling patients' MPA and vertical dimension, cause growth manifestation in anterior-posterior and vertical aspects of patients with vertical facial growth pattern and have equal or even more treatment effect on patients with vertical facial growth pattern than onthose with normal facial growth pattern.

Key words: Malocclusion class II, twin block appliance, functional therapy

Introduction

Among various types of malocclusion observed in human population, class II division 1 malocclusion is one of the most prevalent types. According to Dr. James McNamara's theory, backward mandible is a common characteristic of class II division 1 malocclusionin the growing children. Class II malocclusion rate is 15% in the world population.

Class II malocclusion gets complicated occasionally owing to discrepancies between maxilla and mandible. This malocclusion can be the result of backward mandible or forward maxilla or a combination of both. Treatment of class II malocclusion depends on such factors as patient's age, growth potential, malocclusion severity and patient's cooperation in treatment. In the growing patients, the growth improvement process during mixed dental period or early permanent dental period before the end of active growth can improve skeletal class II malocclusion.

This type of malocclusion is treated by fixed or removable myofunctional appliances. Functional appliances dictate a new pattern of function that leads to development of a new morphologic pattern (acceptable relationship between maxilla and mandible, changes in the value and growth direction of jaws, reinforced occlusion and proper dental order). Functional appliances correct the muscular equilibrium and regulate the performance of oral-nasal-pharyngeal complex.

These appliances treat class II malocclusion by increasing the functional displacement of mandibular condyles downward and forward and by limiting the mandibular forward movement. Also, articular reconstruction occurs at temporomandibular joint to strengthen the mandibular position in relation to maxilla. Functional appliances affect the growth of anterior and posterior teeth so that the mandibular posterior teeth move forward when the growth of maxillary anterior teeth is inhibited, resulting in occlusal plane rotation and correction of class II relations.

Fixed functional appliances such as Herbst, Forsus-FRD and Jusper Jumper are used in individuals who are at the end of developmental mutation, or those who do not cooperate. Twin block, Bionator, Activator and Frankel are removable myofunctional appliances that can improve class II malocclusion by bringing the mandible forward. However, the best treatment method for mature patients with severe discrepancies is a combination of orthodontic and surgical therapies.[1]

This study evaluated the effect of twin block appliance on the treatment of patients with class II malocclusion and different vertical skeletal growth patterns. The objective of treatment with this appliance is using a method for treatment of patients with class II malocclusion because this appliance id able to stimulate the mandibular growth in forward direction. This appliance is widely known owing to high acceptability by patients, high adaptability, high

compatibility, high efficiency, and gradual and constant mandibular forward movement without the need to change the appliance.[2]

Twin block appliance makes the patientsto close their teeth in a more forward position than before because this device has steep acrylic levels on occlusal bite block surfaces and changes the occlusal plane surfaces effectively. These surfaces act as a guide and make the mandible to move downward and forward. The patient should use this device 24 hours a day in order for the device to show its effects completely.[3] The other components of this appliance are labial part on the mandibular anterior teeth, Adams Clasp on the maxillary and mandibular first permanent molarsand a screw in the midline of maxilla, which correct the transversal relations. This device was designed by Dr. William J. Clark in Scotland more than twenty years ago.[4]

Various studies have reported the effects of twin block appliance, as follows:

The first effect showing rapidly is overjet reduction.[5] The mandibular working length is increased, 2/3 of which is related to ramus height increase and the remaining 1/3 is related to increase in mandibular trunk. Anterior and posterior lengths are increased, the length of anterior cranial base is increased, longitudinal slope of upper incisors is decreased and maxillary first molar moves distally. A series of headgear effects is also observed, including preventing the growth toward the anterior part of maxilla, reducing the longitudinal slope of upper incisors,[4] increasing the distance between condylion and gnathion and increasing SNB conspicuously. The other side effects of twin block functional appliance in patients are decreasing ANB, increasing vertical facial dimension, movement toward the posterior axis of maxillary teeth,[6] protrusion of mandibular anterior teeth,[7] increasing the facial convexity[8] and limiting the forward movement of maxillary molars.[9]

Based on Clark's theory in the book "Twin block functional therapy", orthodontic functional treatments affect vertical and anterior-posterior dimensions, and vertical dimension control in functional therapies is achieved by covering the dental surfaces in the opposite arch and controlling interdental spaces.[2]
In this book, it has been reported that selection of patients for treatment by twin block appliance should be done accurately. Patients with open bite and vertical facial growth pattern, due to muscular weakness, are not able to constantly maintain their mandible in anterior position, which is why they show a poor response to treatment in sagittal and vertical dimensions.[2] However, this response has not been reported in these patients and in comparison to other skeletal growth patterns. Moreover, the previous studies have mostly evaluated the effects of this appliance and compared it with other functional appliances.[6,8,9,10]

Furthermore, in a randomized control trial in 2009, the higher efficacy of functional appliances in patients with class II deep bite malocclusionand skeletal horizontal growth patternwas questioned.[3] Yet, a retrospective study by Mills & McCulloch in 1938 showed the favorable response of patients with open bite and deep bite malocclusion to twin block appliance.[4] \

Hence, the present study was conducted to quantitatively evaluate the efficacy of this appliance in patients with class II malocclusion and vertical and normal growth patterns.

Materials and Method

This retrospective study assessed the effectiveness of functional therapy by twin block appliance in patients with class II malocclusion and different vertical skeletal growth patterns. The patients were aged 10-14, including 18 males and 19 females.

First, 66 medical files of patients under the supervision of a faculty member endodontist at Isfahan University of Medical Sciences in Afzal clinic and Isfahan dental school and under treatment with twin block appliance were extracted. Several forms (Appendix 1) were prepared from the data obtained from the files, and the forms were numbered. The inclusion and exclusion criteria considered in this study were as follows:

Inclusion criteria:

1. Patients with ≥7 mm overjet.
2. Patients with skeletal class II division 1 malocclusion.
3. Patients without craniofacial syndrome.
4. Patients with CVS3-CVS4 skeletal growth stage.
5. Patients who had undergone treatment by twin block appliance.

Exclusion criteria:

1. Poor cooperation of patients based on the reports in their files.
2. Illegibility of necessary anatomic parameters for analysis in radiography.

Further, it had been mentioned in all patients' files that anterior opening rate in all patients was 3 mm, measured by three 1-mm-thickness tongue blades.

The numbered forms were selected and analyzed according to the inclusion criteria. The patients qualified for inclusion in the study were chosen, from whom 37 patients were finally selected. To calculate the sample size, ANOVA and follow-up tests like Tukey test were applied. With 14 samples and 80% probability, a difference equal to d=1.5 ° for SNA and SNB angles and d=2.5 mm for distances at α=0.05 will be significant.

The twin block device used by the researchers according to the clinicians' opinions and patients' needs comprised of the following components, a modified version of twin block appliance designed by Clark:

1. Nasolabial part on the mandibular anterior teeth.
2. Adam's Clasp on the maxillary and mandibular first permanent molars.
3. A screw in the maxillary midline, which corrects the transversal relations. The patient opens the screw twice

a week, depending on the need, to make a coordination between maxillary and mandibular arches. The patients were asked to use the device at least 16 hours a week and continue using the appliance as a retainer at night after their active treatment.[10,11]

Cephalometric radiographs before and after treatment (n=74) were extracted from the patients' files and traced by a dental student and an orthodontist. Meanwhile, the cephalometry of each patient was traced by one person manually, and in the case of difference in the size of each index, their meanwas calculated and selected. After connecting the drawing paper to cephalograms with tape, they were drawn by a 0.5 pencil, and the lines were drawn with different colorsto prevent confusion. A millimeter ruler was used to draw the millimeter lines and planes, and a protractor was used to measure the angles. After covering the negatoscope page with a dark board card, except in the location of cephalograms, cephalograms were drawn by an orthodontist in a relatively dark room. After cephalometric analysis by McNamara method, SNA, SNB, N Perp/Pog, N Perp/Point A, etc. were measured to correct the efficacy of the device in sagittal dimension.

Based on the book "Esthetic and biomechanics in orthodontics", among all indices, mandibular plane slope index is the key determinant of skeletal findings in high angle patients.[12] Further, according to McNamara analysis, the normal range of MPA is 22±4, >26 in long face patients and <18 in patients with short facial growth pattern. Also, a study by Field *et al* in 1984 showed when thepatientwas in natural head position, there were no differences between the patients in terms of cranial base rotation relative to horizontal dimension, but there were differences with regard to cranial base angle relative to SN-mandibular plane among the patients. In long face people, mandibular plane is steep and mandibular angle is increased relative to palatal plane; whereas, the reverse is true for short face people.[13]

Based on the results of studies, mandibular plane is classified into two groups according to slope index:

1. Vertical skeletal growth pattern (MPA>26)
2. Normal skeletal growth pattern (18≤MPA≤26)

In addition, it should be noted that while doing cephalometric analysis on the radiographs of the given patients, they were not aware of the facial growth pattern.

The obtained data were fed into SPSS (version 18) software and analyzed bydependent t-test, independent t-test and Kolmogorov-Smirnov (for analysis of normal distribution of data), paired t-test and one-way ANOVA (for between-group comparisons) as well as ANOVA and Tukey Analyzer. p<0.05 was considered significant.

Moreover, because the interval between radiographs before and after treatment might be different, to eliminate the effect of this factor on the results of treatment, the time between the primary and secondary radiographs was extracted from the files and the values obtained from analysis of radiographs after treatment in each group were divided by the length of treatment, and the results were compared in different skeletal groups.

Results

Table 1 presents the results of dependent t-test for patients with normal facial growth pattern. Among the changes of ten cephalometric variables, only two variables, including overjet and ANB showed a statistically significant difference in the normal facial growth pattern group. [Table. 1]

Variables	Statistical indices of variables in groups with vertical facial growth pattern treated by twin block functional therapy							
	Before Treatment		After Treatment		t	df	p-value	
	Mean	SD	Mean	SD				
SNA	79.81	3.78	78.97	3.55	1.56	15.00	0.14	NS
SNB	74.78	3.03	76.31	3.97	-1.49	15.00	0.16	NS
Overjet	7.00	1.78	3.91	1.81	5.56	15.00	0.00	S
N Perp/Point A	1.98	1.32	2.55	3.27	-0.67	15.00	0.51	NS
N Perp/Pog	-5.60	3.80	-3.31	5.27	-1.59	15.00	0.13	NS
MPA	22.84	2.38	22.22	2.99	0.73	15.00	0.48	NS
LAFH	60.89	7.23	62.31	6.81	-1.30	15.00	0.21	NS
Distance from the tip of maxillary anterior tooth to a line perpendicular to Frankfort plane from vertical trigoid	51.71	6.50	52.88	6.68	-0.71	15.00	0.49	NS
Distance from the most anterior dental point to the pog perpendicular to Frankfort plane	5.77	3.84	5.76	3.77	0.01	15.00	0.99	NS
ANB	5.47	2.24	3.97	1.74	2.54	15.00	0.02	S

Table 1: Statistical indices in the patients with normal facial growth pattern

Table 2 shows the results of dependent t-test for patients with vertical facial growth pattern, where SNS, SNB, overjet, N Prep/Pog, LAFH and ANB showed a significant difference among the ten cephalometric variables [Table. 2].

Table 3 illustrates the results of independent t-test for mean differences of variables in both groups, including normal and vertical facial growth patterns, without considering the length of treatment. The findings indicated a significant difference only for SNB variable.

Variables	Statistical indices of variables in groups with vertical facial growth pattern treated by twin block functional therapy							
	Before Treatment		After Treatment		t	df	p-value	
	Mean	SD	Mean	SD				
SNA	78.55	4.80	79.36	4.61	-1.49	20.00	0.15	NS
SNB	72.59	5.55	75.81	4.17	-4.95	20.00	0.00	S
Overjet	7.71	2.68	4.64	1.38	4.63	20.00	0.00	S
N Perp/Point A	2.55	2.44	2.32	2.41	0.50	20.00	0.62	NS
N Perp/Pog	-11.79	5.49	-8.29	7.37	-3.42	20.00	0.00	S
MPA	29.71	2.85	28.43	3.74	2.0.02	20.00	0.06	NS
LAFH	64.55	7.49	66.12	6.63	-2.14	20.00	0.04	S
Distance from the tip of maxillary anterior tooth to a line perpendicular to Frankfort plane from vertical trigoid	53.27	8.32	52.10	9.37	0.65	20.00	0.52	NS
Distance from the most anterior dental point to the pog perpendicular to Frankfort plane	8.73	2.90	8.73	3.37	-0.01	20.00	0.99	NS
ANB	5.55	2.17	3.98	2.28	3.20	20.00	0.00	S

Table 2: Statistical indices in the patients with vertical facial growth pattern

Variables	Mean difference of variables in groups with normal and vertical facial growth patterns							
	Normal		Vertical		t	df	p-value	
	Mean	SD	Mean	SD				
SNA	- 84	16.2	81	49.2	- 12.2	0.350	41	NS
SNB	84	53.1	03.3	68.2	- 92.2	0.350	01	S
Overjet	- 30.3	18.2	- 90.2	97.2	- 46	0.350	65	NS
N Perp/Point A	- 11	67.3	97	06.3	- 97	0.350	34	NS
N Perp/Pog	- 23.1	5.6	23.3	87.4	- 49.2	0.350	12	NS
MPA	- 62	42.3	- 28.1	91.2	63	0.350	53	NS
LAFH	16.1	35.4	57.1	36.3	- 32	0.350	75	NS
Distance from the tip of maxillary anterior toothto vertical trigoid perpendicular to Frankfort plan	24.1	70.6	40	24.3	50	0.350	62	NS
Distance from the most anterior dental point to the pog perpendicular to Frankfort plane	- 36	30.2	00.0	83.1	- 54	0.350	59	NS
ANB	- 75.1	17.2	- 45.1	45.2	- 38	0.350	70	NS

Table 3: Statistical indices for mean differences of variables in the patients with normal and vertical facial growth patterns

Moreover, table 4 presents the mean differences of variables in patients with normal and vertical facial growth patterns based on the length of treatment, where SNA and SNB variables were found to show a significant difference.

Variables	Mean difference of variables in groups with normal and vertical facial growth patterns							
	Normal		Vertical		t	df	P-value	
	Mean	SD	Mean	SD				
SNA	-098/0	264/0	064/0	185/0	-215/2	35	033/0	S
SNB	065/0	199/0	247/0	237/0	-465/2	35	019/0	S
Overjet	-352/0	184/0	-237/0	275/0	-441/1	35	158/0	NS
N Perp/Point A	072/0	465/0	110/0	258/0	-315/0	35	755/0	NS
N Perp/Pog	-064/0	672/0	316/0	489/0	-996/1	35	054/0	NS
MPA	-107/0	440/0	-117/0	376/0	086/0	35	932/0	NS
LAFH	1299/0	570/0	128/0	328/0	009/0	35	993/0	NS
Distance from the tip of maxillary anterior tooth to vertical trigoid perpendicular to Frankfort plan	181/0	677/0	064/0	293/0	711/0	35	482/0	NS
Distance from the most anterior mandibular dental point to the pog perpendicular to Frankfort plane	-051/0	264/0	-007/0	4898/0	-651/0	35	519/0	NS
ANB	-419/0	322/0	-115/0	167/0	-657/0	35	516/0	NS

Table 4: Statistical indices for mean differences of variables in the patients with normal and vertical facial growth patterns, according to the length of treatment

Discussion

Traditionally, many authors believe that functional therapies affect the vertical and anterior-posterior dimensions, and vertical dimension control is achieved by covering the dental surfaces in the opposing arch and controlling interdental spaces.[2] Strategies to control the vertical dimension in patients with long face and class II malocclusion are presented according to the rise in priorities, respectively: high-pull (HP) headgear connected to molars, HP headgear connected to maxillary splint, bite block on functional appliance and HP headgear connected to bite block functional appliance.[14]

The only instance that is prior to the bite block functional appliances is HP headgear connected to functional device, but bite block functional appliance is itself an option with high preference; being second in rank. However, this is a personal idea and there are various opinions about the impacts of functional treatments on vertical dimension, as presented by the following studies.

According to Clark in the book titled "Twin block functional therapy", orthodontic functional therapies affect the vertical and anterior-posterior dimensions, and vertical dimension control in functional treatments is achieved by covering the dental surfaces in the opposing arch and controlling interdental spaces.[3]

In recent study there is no statistically significant differences between the activator and Twin-block for the face.[15] However, Twin-block could be slightly more effective than the activator perhaps due to an better control in the upper jaw.[16] It is also reported that selecting patients for treatment by twin block appliance should be performed accurately. The patients with open bite and vertical facial growth pattern, due to muscular weakness, are not able to retain their mandible in anterior position constantly, thereby their response to treatment in sagittal and vertical dimensions is poor.[3] However, this response has not been reported in these patients and compared to other skeletal growth patterns. Moreover, the present studies have mostly investigated the effects of this appliance and compared it with other functional appliances.[6,8,9,10]

Also, a randomized control trial in 2009 questioned the higher efficacy of functional appliances in deep bite class II patients with horizontal skeletal growth.[3] Yet, a retrospective study by Mills & McCulloch in 1938 emphasized the favorable response of open bite and deep bite patients to twin block appliance.[4]

Based on the literature, no study was found to have compared the patients with class II malocclusion and long face growth pattern and individuals with normal facial growth pattern as well as their response to functional therapies. Response to treatment in a group of patients can be expressed by measurement of changes in cephalometric indices, including SNA, SNB, overjet, ANB, N Perp/Pog, N Perp/Point A, LAFH, etc.

One of the problems of retrospective studies is inability to equalize the treatment length in patients with different functional therapies. To eliminate this problem in patients in this retrospective study, response to treatment in each case was divided by the length of treatment (per month) to obtain the changes monthly. However, this method is not flawless per se because it is based on this principle that growth speed in all months of treatment is continuing in a similar manner, and this principle is possible not to occur in clinical situation, but it is the only method used for relative equalization in similar studies.

As for the mean differences of variables in the patients with normal and vertical facial growth patterns without considering the length of treatment, changes of cephalometric index SNB angle were statistically significant (p=0.01), indicating that this appliance increased SNB angle by 3.03 ° in the patients with vertical facial

growth pattern, while it increased SNB angle by 0.84° in the patients with normal facial growth pattern [Table 3].

After applying the effect of length of treatment on the data, the angle changes of SNA and SNB in both groups were found to be statistically significant. Further, SNA in the patients with normal facial growth pattern was reduced during the treatment, while in patients with vertical facial growth pattern, maxilla grew forward. SNB increase was significantly more in the patients withvertical facial growth pattern than those with normal facial growth pattern [Table 4].

Comparison of mean changes of other cephalometric indices measured (ANB,N Perp/Point A,N Perp/Pog, LAFH, etc.) in both groups showed the mean changes were statistically equal in both groups, and treatment by twin block functional appliance had similar effects in the patients with normal and vertical facial growth patterns. Yet, lack of significant differences might be due to small sample size in this study. These changes might be revealed more in future studies by using a larger sample size.

Considering the need for a large sample size for the differences to be significant between the two groups and impossibility of doing it clinically in the current study, there is the possibility of obtaining more information by comparing the data before and after treatment in each group of patients becauseit is also possible to obtain significant differences in a smaller number of patientsby controlling more factors. Hence, the data were compared before and after treatment in each group of patients.

In this comparison, SNB was increased in the patients with vertical facial growth pattern (+3.03) and changes of this index were significant [Table 3]. In this group of patients, other cephalometric indices related to forward growth of chin, including N Perp/Pog were effectively changed, indicating the forward growth of chin. Further, ANB index was significantly reduced in this group, which showed the improvement of class II skeletal relationship in patients. The patients' overjet was also reduced significantly during the treatment, possibly due to improved skeletal relation of the jaws because the changes of dental indices, including the distance from the tip of maxillary anterior tooth to a line perpendicular to Frankfort plane from vertical trigoids well as the distance from the most anterior point of mandibular anterior tooth to a line perpendicular to Frankfort plane from Pogwere not significant (p=0.52 and p=0.99, respectively) [Table 2].

The analysis of cephalometric indices like MPA and LAFH in the vertical facial growth pattern group showed although the 1/3 lower face height was significantly increased over time, MPA remained fixed and was reduced by 1/3 °, showing no statistically significant difference. It can be concluded that mandible rotated forward and upward, decreased ANB and increasedchin prominence in this group [Table 2]. In the patients with normal facial growth pattern, SNB and N Perp/Pog indices did not significantly change, although the changes were in line with increased chin prominence. Moreover, ANB was significantly reduced in this group, indicating that SNA and SNB changes had caused this change. On the other hand, controlling maxillary and mandibular forward and downward growth simultaneously decreased ANB effectively. In addition, MPA and LAFH in this group were not significantly changed, and dental changes were trivial because dental changes such as distance from thetip of maxillary anterior tooth to the line perpendicular to Frankfort plane from vertical trigoidas well as the distance from the most anterior point of mandibular anterior tooth to a line perpendicular to Frankfort plane from Pog were not statistically significant [Table 1].

MPA in the normal facial growth pattern group was relatively fixed and not statistically changed. This confirms that mandible had not rotated backward and downward, and mandible in the patients with normal facial growth pattern had grown forward in anterior-posterior direction and had been controlled in vertical direction [Table 1].

Changes of LAFH in both groups were positively increased, but they were significant in the patients with vertical facial growth pattern. However, increase in this cephalometric index was because of facial growth, changing the pattern in functional appliance so that MPA in both groups was not increased and only face height increase was observed as a result of a rise in ramus.

As indicated in the results of the present study, in patients with vertical facial growth pattern, there was no need to use specific twin block functional appliance like maxillomandibular vertical elastics to control vertical growth, and the same functional bite plane appliance alone was able to control the vertical facial growth well. This result contradicts the Clark's ides in the book "Twin block functional therapy" because he states that twin block functional appliance is not much effective in patients with vertical facial growth pattern due to the patients' muscular weakness and their inability to keep the mandible forward.[2] Furthermore, our results confirmed the findings of the randomized control trial in 2009 and retrospective study of Mills & McCulloch in 1938.[3,4]

However, it is noteworthy that the main objective of these studies is not analysis of the subject we intended to investigate in this study, and they have reported it as a subsidiary result. Moreover, as mentioned before, controlling the vertical growth in the book"Contemporary orthodontics" by covering the dental surfaces has been found to be more effective than HP headgear in molars or maxillary splints, confirming the results of the current study.

In the present research, twin block functional appliance was found to be effective in controlling the vertical dimension with the same principal components and without adding any new component to its structure. Additionally, to control the vertical dimension of long face patients, it is not necessary to use HP headgear with functional device because the functional appliance with posterior bite block, according to Dr. Profit, can be more effective than HP

headgear in common orthodontic mechanics, and efficacy of posterior bite block in controlling the vertical growth was shown completely in the current study.

Conclusion

Functional appliances are a good treatment of choice for long face patients, can effectively control the vertical dimension of patients and cause the manifestation of mandibular growth in anterior-posterior dimension in patients with vertical facial growth pattern. The treatment effect in this group of patients was also equal or even more than the patients with normal facial growth pattern.

References

1. Pachori Y, Navlani M, Gaur T, Bhatnagar S. Treatment of skeletal class II division I malocclusion with mandibular deficiency using myofunctional appliance in growing individuals. J Indian Soc Pedod Prev Dent 2012;30(1):56-65.
2. ClarckWT. Twin Block Functional Therapy: Applications in Dentofacial Orthopaedics. 2nd ed. Edinburg: Elsevier Sciences Ltd; 2002.
3. O'Brien K, Wright J, Conboy F, Sanjie Y, Mandall N, Chadwick S, *et al*. Effectiveness of treatment for class II malocclusion with the herbst or twin-block appliances: A randomized controlled trial. Am J Orthod Dentofacial Orthop 2003;124(2):128-37.
4. Mills CM, McCulloch KJ. Treatment effect of twin block appliance: A cephalometric study. Am J Orthodontic Dentofacial Orthop 1998;114(1):15-24.
5. O'Brien K, Wright J, Conboy F, Sanjie Y, Mandall N, Chadwick S, *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 Dentofacial Orthop 2003;124(3):234-43.
6. Toth LR, McNamara JA Jr. Treatment effect produced by the Twin-block appliance and the FR-2 appliance of Frankel compared with an untreated Class II sample. Am J Orthod Dentofacial Orthop 1999;116(6):597-609.
7. Baccetti T, Franchi L, Toth LR, McNamara JA Jr.Treatment timing for Twin block therapy. Am J Orthod Dentofacial Orthop 2000;118(2):159-170.
8. Baysal A, Uysal T. Soft tissue effects of Twin block and herbst appliance in patient with Class II division I mandibular retrognathy. Eur J Orthod 2013;35(1):71-81.
9. Jena AK, Duggal R. Treatment effect of Twin-block and mandibular protraction appliance- IV in the correction of Class II malocclusion. Angle Orthod 2010;80(3):485-91.
10. McNamara JA Jr, Howe RP, Dischinger TG. A comparison of the Herbst and Frankel appliances in the treatment of class II malocclusion. Am J Orthod Dentofacial Orthop 1990;98(2):134-44.
11. McNamara JA Jr, Bookstein FL, Shaughnessy TG. Skeletal and dental changes following functional regulator therapy on Class II patients. Am J Orthod 1985;88(2):91-110.
12. Ravinda N. Esthetics and biomechanics in orthodontics. 2nd ed. st.louis. missouri: Elsavier; 2015.
13. Field HW, Proffit WR, Nixon Wl, Phillips C, Stanek E. Facial pattern differences in long faced children and adults. Am J Orthod 1984;85(3):217-223.
14. Profit WR, Fields HW, Sarver DM. Contemporary Orthodontics. 5th ed. Mosby. Elsevier. 2013.
15. Tsiouli K, Topouzelis N, Papadopoulos MA, Gkantidis N. Perceived facial changes of Class II Division 1 patients with convex profiles after functional orthopedic treatment followed by fixed orthodontic appliances. Am J Orthod Dentofacial Orthop 2017;152(1):80-91.
16. Koretsi V, Zymperdikas VF, Papageorgiou SN, Papadopoulos MA. Treatment effects of removable functional appliances in patients with Class II malocclusion: a systematic review and meta-analysis. Eur J Orthod 2015;37(4):418-34.

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