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Cephalometric assessment of Twin Block appliance in treatment of Class II div 1 malocclusion

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Abstract
Purpose: The study was aimed at studying treatment effects of Twin Block on Class I div 1 malocclusion. The relevance of this study lies on the fact that Class II div 1 malocclusion is most frequently encountered malocclusion in our day to day clinical practice.
Materials and Methods: Pretreatment and post treatment cephalometric radiographs were assessed and treatment effects were observed by comparing pretreatment and post treatment values statistically using Students "t" test.
Results: All the variables except cranial base measurements were found to be significantly changed after Twin Block treatment.
Conclusion: Twin Block treatment does produce significant changes and can be used routinely to treat Class II div 1 malocclusion due to increased patient compliance.

Keywords: Twin Block, Class II div 1 malocclusion, Cephalometrics, Effective mandibular length, Mandibular reposturing

1. Introduction
In the past the area of dentofacial orthopaedics was predominant in Europe, whereas Americans were highly influenced by Angle's fixed appliance philosophy. Norman W. Kingsley introduced the concept of bite jumping in 1879 and he described it as, "The object was not to protrude the lower teeth, but to change or jump the bite in the case of an excessively retreating lower jaw" [1]. Wilhelm Roux was the first to investigate the effect of natural forces and functional stimulation on morphology [2]. This study became the basis of dentofacial orthopaedics. Many authors including Karl Haupl [3] explained the working of functional appliances based on functioning of orofacial musculature.
Role played by functional appliances has been a matter of controversy in terms of treatment effects whether being dental [4, 5] or skel *et al* [6, 7], timing of fuctional appliance therapy [8], stability of treatment results [9]. Class II div 1 malocclusion due to mandibular retrusion is a very common presentation in day to day orthodontic practice hence it becomes imperative to study practical relevance of various treatment modalities available. Apart from definitive surgical treatment which involves surgical lengthening of mandible in adults, fuctional appliance therapy offers an attractive alternative treatment modality in a younger age group. Results obtained by fuctional appliances have been variable, and variabiability of results can attributed to differences in sampling procedures, selection of comparison groups, choice of research design, consideration of confounding variables and statistical methods [10]. Also inconsistency in various cephalometric landmarks and reference planes may lead to controversial results [7]. The twin block appliance in not an exception regarding above mentioned fact.
Twin block appliance was developed by Dr. William J. Clark [11, 12, 13] in Scotland, gained a lot of popularity[13]. Twin Block appliance is based on principle of protrusive functional appliances used on monkeys by McNamara [14, 15, 16] and others [17, 18].
Keeping in view the above mentioned findings and also since limited number of studies are available on Indian samples it becomes necessary to study the effects of twin block in a local population sample and assess these results for future studies in similar populations.

2. Materials and methods

The study was carried out on the patients received in the Out-Patient Department of the department of Orthodontics & Dentofacial Orthopaedics, Government Dental College & Hospital, Srinagar. The sample for this study consisted of 15 subjects of which 9 were males and 6 were females. Mean age of sample was about 9years and 10 months with following criteria for inclusion: Dentally Class II div 1, Skeletal Class II with orthognathic maxilla and retrognathic mandible, ANB>4^0,overjet ≥ 5mm,average or horizontal growth pattern.

2.1 Pattern of treatment

Twin block appliance consisting of upper and lower acrylic plates having bite blocks inclined at an angle of about 60^0 and a midline screw in upper acrylic plate were given to all patients (figure 1)

Fig 1: Various intra oral views of twin block appliance.

Bite was advanced aiming at a molar relation which was Class I or super Class I. Expansion screw was activated by giving one turn per week. When the over jet was reduced by 3mm about 1-2mm of acrylic were added onto distal inclines of lower bite block and distobuccal aspect of maxillary bite block was trimmed gradually to allow for eruption of mandibular molar. Mean treatment time was about 12months. Lateral cephalograms were taken in centric occlusion under standard conditions at start and end of treatment. Lateral cephalogram were traced upon an A4 size acetate paper with a 2B or 3HB hard lead pencil over well-illuminated viewing screen by a single operator. The linear measurements were recorded with a measuring scale up to a precision of 0.5 mm. The angular measurements were analysed with a protractor up to a precision of 0.5°.Reference points and measurements used in study are given in figure 2.

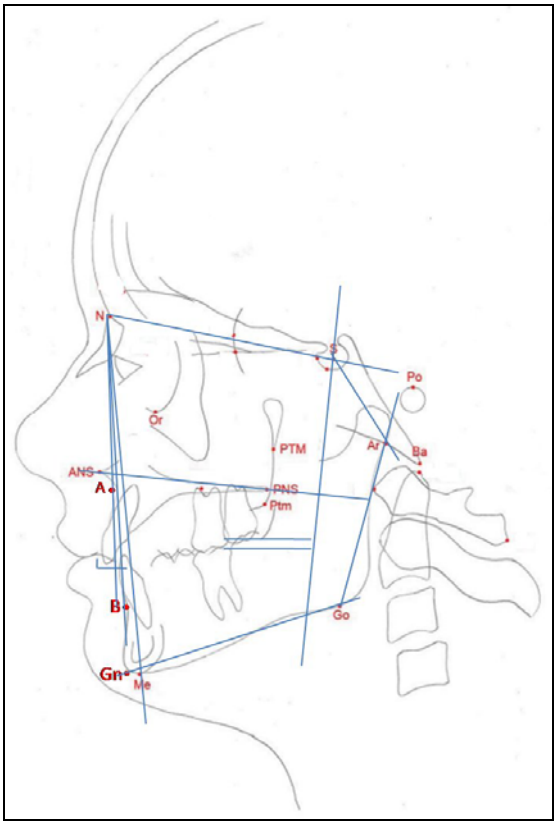

Fig 2: Cephalometric landmarks and measurements.

Following parameters were measured at start and end of treatment.

Skeletal parameters
1. SNA(^{0})
2. SNB(^{0})
3. ANB(^{0})
4. Effective mandibular length(Ar-Gn) (mm)
5. Ramus height (Ar-Go) (mm)
6. Saddle angle (N-S-Ar) (^{0})
7. Articular angle (S-Art-Go) (^{0})
8. Gonial angle (Ar-Go-Gn) (^{0})
9. Anterior facial height (N-Me)(mm)

Dental parameters
1. Overjet(mm)
2. Overbite (mm)
3. Maxillary incisor position(UI-SN)(^{0})
4. Mandibular incisor position(L1-GoGn)(^{0})
5. Upper molar position(U6-reference plane)(mm)
6. Lower molar position(L6-reference plane)(mm)

2.2 Statistical analysis: The statistical analysis of data was carried with the help of means, ranges and standard deviations. Pre and post mean values were subtracted to obtain the net change achieved. Student's t-test was used to test the difference between means of various variables. In the statistical evaluation, the following levels of significance were used:
P > 0.05 Non-significant
0.05 ≥ P > 0.01* Significant
0.01 ≥ P > 0.001** Highly significant
P ≤ 0.001*** Very highly significant

3. Results

Table 1: Pretreatment and post-treatment comparison.

S. No.	Parameter	Pretreatment	Post Treatment	Difference	P-value
1.	SNA(^{0})	81±2.5	80±2.43	1	***
2.	SNB(^{0})	74.5±2.66	76±3.01	-2	***
3.	ANB(^{0})	6.58±1.57	3.46±1.56	3.12	***
4.	Effective mandibular length(Ar-Gn) (mm)	100.60±6.99	106±6.91	-5.4	***
5.	Ramus height(Ar-Go) (mm)	40.01±2.99	42.00±1.77	-1.99	***
6.	Saddle angle (N-S-Ar) (^{0})	125±4.1	124.2±5.4	0.8	NS
7.	Articular angle (S-Art-Go) (^{0})	143.7±5	144.2±6.2	-0.5	NS
8.	Gonial angle (Ar-Go-Gn) (^{0})	126.8±6.3	127.29±4.3	0.49	NS
9.	Overjet(mm)	8.99±1.88	4.11±1.23	4.88	***
10.	Overbite (mm)	5.19±1.83	2.78±1.26	2.41	***
11.	Maxillary incisor position(UI-SN)(^{0})	107.7±5.9	105.0±5.3	2.7	***
12.	Mandibular incisor position(L1-GoGn)(^{0})	93.22±3.3	96.25±3.6	-3.03	***
13.	Upper molar position(U6-reference plane)(mm)	36.11±4.62	35.0±3.88	1.11	***
14.	Lower molar position(L6-reference plane)(mm)	30.44±1.22	34.52±1.36	-3.08	***
15	Anterior facial height (N-Me)(mm)	100.31±4.86	103.0±5.21	2.69	***

It is observed that mean value of SNA decreased by about one degree and mean value of SNB increasedby two degrees. Also mandibular molar has moved forward and maxillary molar backward significantly. Effective mandibular length increased significantly. All these movements lead to correction of Class II relation which occurs due to a combination of skeletal and dental effects.

Also ramus height increases along with increase in mandibular forward positioning. But this increase in ramal height does not compensate completely for mandibular forward positioning and this leads to increase in anterior facial height. In spite of increase in anterior facial height the increase in gonial angle was not significant.

Also the decrease in over jet and overbite can be attributed to changes in position of molars and incisors. Upper incisors tipped backwards and lower incisors forward significantly. Selective trimming of bite blocks allowed for eruption of lower molars which lead to decrease in overbite. Increase in erution of lower molars led to increase in anterior facial height.

4. Discussion

Main aim of twin block therapy or for that matter any functional appliance therapy is to achieve skeletal correction of Class II malocclusion by inducing lengthening of mandible using the method of continous forward posturing of mandible. This is based on number of studies where it is proved that continous forward posturing of mandible leads to stimulation of mesenchmal cells of condylar cartilage [19, 20, 21]. But these studies were conducted on animals and the factor of compliance is eliminated in these studies. Also growth rate of animals is different from that of humans but even with these limitations functional appliances are still being used.

Direction of manifestation of mandibular growth is of prime importance in deciding the outcome of functional appliance treatment. Futility of functional appliance treatment is pointed out in various studies [22, 23, 24] when growth of mandible is expressed only in a vertical direction. In this study a sihificant increase in mandibular length was observed, but the doubt that whether this was due to actual growth of mandible or forward reposturing of mandible remains in this study as well as other studies [25]. Increase in mandibular length has also been reported in other studies [26, 27, 28]. In this study a significant increase in anterior facial height is observed but also a significant increase in ramal height is also observed hence this leads to a decreased rotational component of growth in a vertical direction. This increase in anterior facial height after treatment can prove beneficial in horizontal growers but can prove detrimental to vertical growers. Effective mandibular length was measured from Articulare rather than from Condylion in this study as the error in locating the latter was greater than the former [29].

The present study demonstrated a significant decrease in overjet, which is due to a combination of forward movement of mandible and backward tiping of maxillary incisors. This is in agreement with other studies [25, 30]. But these studies have shown more lingual tipping of upper incisors than the present study. Forward tiping of lower incisors has also been

observed in this study but this tipping is less as compared to other studies [26, 31]. All these findings suggest that correction in overjet is more due to skeletal changes than dental changes as compared to other studies.

Overbite got reduced due to eruption of lower posterior teeth as is evident by increase in anterior facial height. Molar relation was corrected due to a combination of mandibular growth, distal movement of maxillaru molars and mesial movement of mandibular molars. The distal movement of maxillary molar was less as compared to mesial movement of mandibular molars. The saggital relation of jaw bases was improved with a significant reduction of ANB. This decrease in ANB was mainly due to increase in SNB. There was a reduction in SNA showing that twin block had a "head gear effect" but this restraining effect on maxilla was found to be comparatively less as is evident in other studies [32, 33].

Also studies comparing various functional appliances have slight edge to twin block by concluding that twin block produces more effective correction of Class II malocclusion [34].

Patient compliance is a major limiting factor concerning functional appliance treatment. Fixed functional appliances like Herbst gained widespread acceptance [6]. In this study all the patients were corrected from Class II molar to a Class I molar because twin block is highly acceptable to patients. This is due to small size of the appliance, and speech and other functions are disturbed to a lesser extent. Also the appliance is esthetic as compared to other appliances. Twin block is a versatile appliance and various components like expansion screws, torquing screws, facebows can be added for control of dental and skeletal segements.

5. Conclusion

Twin block appliance corrects Class II malocclusion due to a combination of skeletal and dental effects. This correction was more due to skeletal effect than dental in the present study as compared to other studies. Success of twin block can be attributed to increased patient compliance and thereby eliciting a favourable biological response.

6. Future directions

Studies regarding longterm stability of treatment results should be conducted.

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