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Evaluation of Cervical spine Posture following Twin Block Functional Appliance Therapy: A Longitudinal study

Swaroopa Rani Ponnada[*1,2], Snigdha Pattanaik[3], Smrithi Bhushan Nanda[4], G Chandrasekhar[2], Deepali Jain[5] & Tanmayi Akkina[6]

[1]Shiksha O Anusandhan University, Bhubaneswar, India
[2]Department of Orthodontics, Panineeya Mahavidyalaya Institute of Dental Sciences and Research centre, Hyderabad, Telangana, India
[3]Dept of Preventive and restorative Dentistry, College of Dental Medicine, University of Sharjah, Sharjah, UAE
[4]Institute of Dental Sciences, Bhubaneswar, India
[5]Private Practitioner, Jaipur, India
[6]Private Practitioner, Hyderabad, India

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***Corresponding author:**
Dr Swaroopa Rani Ponnada
Research scholar @ SOA, Bhubaneswar
Professor. Dept of Orthodontics
Panineeya Institute of Dental Sciences & Research centre

ABSTRACT

Objectives & Background: The authors compared postural changes produced by Twin block functional appliance therapy in 15 Asian children (10 males and 5 females) using cephalometrics by comparing pretreatment and post treatment values related to posture. ***Materials & methods:*** All 15 children were treated by same operator and mean average age of the sample was 10.8 years. Pre and post lateral cephalograms were taken using same specifications, 16 parameters were identified and evaluated by a single examiner. ***Results:*** The values were tabulated and subjected to SPSS software. The statistical tests performed were Shapiro-Wilk test and paired t test. The cervical parameters such as SN-OPT, PP-OPT, MP-OPT show a decrease in values which suggests cranio-cervical posture to be more upright after twin block therapy. ***Conclusions:*** Subjects with Class II malocclusion due to mandibular retrognathism with a reduced vertical dimension have a greater forward inclination of the cranio-cervical posture. The Twin Block therapy improves the sagittal relationships between the maxilla and mandible. The Twin Block therapy makes the cranio-cervical posture to be more upright.

Introduction

Functional appliance therapy aims to guide or stimulate mandibular growth in a positive direction, impacting various muscle groups that play a crucial role in the function and positioning of the mandible. Among the diverse range of functional appliances, the twin block (TB), introduced by Clark in 1977, has emerged as the most favored choice in orthodontic interventions. The growing popularity of this removable appliance can be attributed to its straightforward design and user-friendly features. An essential consideration in the stabilit-yof the stomatognathic system is cervical posture[1, 2].

Cervical posture, encompassing the alignment and positioning of the neck and head, holds significant importance in influencing the overall balance and functionality of the stomatognathic system. The intricate relationship between the cervical spine and the mandible suggests that any alterations in cervical posture may impact the harmony within oral and facial structures. Understanding the implications of functional appliance therapy on cervical posture becomes imperative for comprehending its comprehensive effects on the stomatognathic system[3].

The Twin block, with its simplicity and ease of use, has positioned itself as a cornerstone in orthodontic practices since its introduction in 1977. Its popularity has steadily risen, making it the preferred choice among functional appliances. The removable nature of the Twin block enhances its practicality, catering to the convenience of both practitioners and patients alike. As functional appliances continue to evolve, it becomes essential to explore their broader effects on the intricate dynamics of the stomatognathic system[4-6].

Sagittal skeletal improvement holds significance in its potential to enhance the alignment of skeletal structures along the anterior-posterior axis. This improvement may result in not only improved facial aesthetics but also enhanced functional outcomes. Vertical changes, on the other hand, relate to alterations in the height dimension, influencing occlusion and overall facial harmony. Examining changes in posture offers a holistic perspective, considering the overall balance and coordination within the stomatognathic system[7-9].

This study seeks to contribute to the existing body of knowledge by investigating the impact of functional appliance therapy, specifically utilizing the Twin block, on cervical spine posture. The primary objective is to compare cervical posture before and after the application of the Twin block, with a focus on evaluating sagittal skeletal improvement, vertical changes, and overall postural alterations. By delving into these aspects, the study aims to provide comprehensive insights into the therapeutic effects of the Twin block and its potential implications for the stability of the stomatognathic system. The study design includes a comparative analysis of cervical spine posture before and after functional appliance therapy, specifically employing the Twin block. This approach allows for a nuanced understanding of the appliance's impact on sagittal skeletal alignment, vertical changes, and overall postural adjustments. The findings from this study aim to contribute valuable insights to orthodontic practitioners, guiding them in understanding the potential benefits of the Twin block in functional appliance therapy.

Material and methods:

A prospective clinical study is conducted in patients treated with Twin Block functional appliance. The materials comprised of 15 subjects (10 males and 5 females) with skeletal class II retrognathic mandible proposed to be treated with Twin Block functional appliance reporting to Department of Orthodontics and Dentofacial Orthopaedics at Panineeya Mahavidyalaya Institute of Dental Sciences and Research. The skeletal growth status of the sample was evaluated using CVMI (Stage 3and 4). The chronological age of the sample ranged from 10-13years with mean age being 10.8 years (S.D+/- 1.4)

Inclusion Criteria:

1. Skeletal class II with retrusive mandible (ANB>=5).
2. SNB<78.
3. Class II molar and canine relation.
4. Circumpubertal age group. (Confirmed by CVMI)

Exclusion criteria:

1. History of trauma or surgery.
2. Cranio-facial syndromes.
3. No previous injury to spine or orthopaedic disorders.

All the subjects were instructed to wear the appliance for at least 16 to18 hours except during contact sports, brushing and eating. The mean duration for Twin block treatment was 8.2 +/- 0.9 months. Compliance of the wear was monitored by asking the parents to record the wear time every visit. The compliance was also checked clinically by observing the pterygoid reflex. If there was no substantial reduction in overjet or absence of pterygoid reflex or wear less than 16hrs per day for two consecutive months, the subject was removed from the sample.

All cephalograms were taken with rigid head fixation and a 165 cm film to tube distance (Dimax3Ceph). Cephalograms were traced manually with a 0.5-mm lead pencil on acetate sheets on an illuminator. Angular readings were measured with the help of a protractor.

Two lateral cephalograms of pre and post functional treatment were taken using a standardized technique. After removing 3 samples who were non- compliant, the final sample included 12 patients (both male and females). Three sagittal, 3 vertical and 9 cervical vertebral parameters were compared between the groups. The parameters considered in this study are tabulated (Table 1).

Table 1: The parameters considered in present study

Parameter	Definition	Mean value
SNA	Sella-Nasion-Point Angle	80°
SNB	Sella-Nasion_point B angle	82°
ANB	Angle between Nasion to point A andPoint A-Point B	2°
GoGN-SN(MPA)	Angle between Sella-Nasion plane andGoGN plane	32°
UAFH	Distance between Nasion- ANS	51.5-57.9
LAFH	Distance between ANS to Menton	64.8-72.4
SN-OPT	Angle between Sella-Nasion plane and Odontoid process tangent of second cervical vertebra	99-110
PP-OPT	Angle between Palatal plane and Odontoidprocess tangent of second cervical vertebra	94.7-102.2

OP-OPT	Angle between functional occlusal plane and Odontoid process of second cervical vertebra	62-93
MP-OPT	Angle between GoGN and Odontoid process tangent	70-80.2
SN-CVT	Angle between Sella-Nasion and cervical vertebral tangent of fourth cervical vertebra	100.7-113.5
PP-CVT	Angle between palatal plane and cervical vertebral tangent of fourth cervical vertebra	95-106.2
OP-CVT	Angle between occlusal plane and cervical vertebral tangent of fourth cervical vertebra	73-93
MP-CVT	Angle between GoGN and cervical vertebral tangent of fourth cervical vertebra	71.5-82.2

The odontoid process tangent (OPT) was drawn through the most posteroinferior point on the second cervical vertebra (C2). The anterior and inferior angles created with Sella-nasion (SN), palatal plane (PP), and mandibular plane (SN-GoGN) were measured to determine any change in the upper cervical posture.

The cervical vertebral tangent (CVT) was drawn through the most posteroinferior point on the fourth cervical vertebra (C4). The anterior and inferior angles created with the aforementioned planes and the angle between OPT and CVT were used to determine any change in the middle cervical posture.

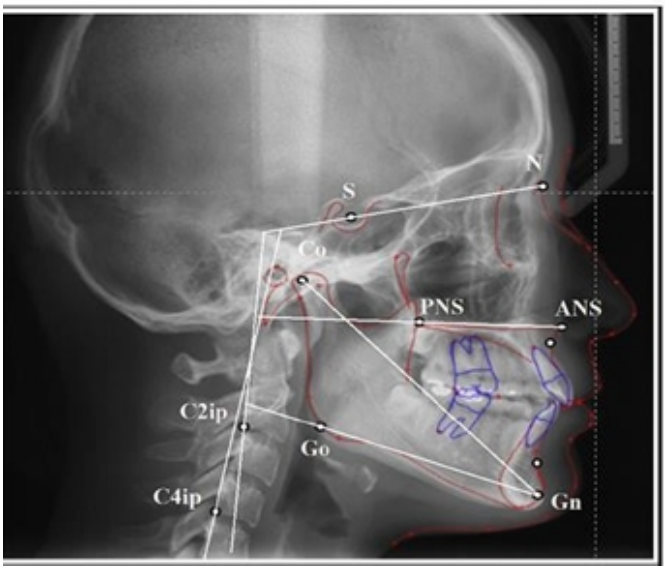

Figure 1: Cephalometric landmarks, planes and angles

Results:

Statistical test: The data collected was entered in the Microsoft Excel sheet by the examiner and analyzed using the Statistical Package for Social Sciences (SPSS)package version 22 (IBM Corp. in Armonk, New York, USA). The normality of the data was tested using the Shapiro-Wilk test, which was found to be normal distribution. The mean comparison of parameters with pre- and post- treatment values were tested using the paired t-test. $p \leq 0.05$ was considered to be statistically significant.

Table 2a: Mean comparison of parameters based on paired t-test revealed that there was a significant increase in the parameters of SNB, Beta angle, LAFH from pre-treatment (73.8±77.9, 21.8±24.8, 76.2±3.12 respectively) to post-treatment (77.9±2.34, 24.8±5.47, 79.6±4.02 respectively). While the ANB parameter decrease significantly post-treatment (6.8±1.89 Vs 3.06±0.96; p=0.000*). The parameters such as SNA, UAFH and GOGN-SN did not reveal any significant difference (p=0.334,0.301, 0.553 respectively).

Table 2b: Mean comparison of parameters based on paired t-test revealed that there was a decrease in the values of parameters like SN-OPT, PP-OPT, and OP- OPT from pre-treatment to post-treatment, significant difference was not observed (p=0.675, 0.552, 0.496 respectively). However, a significant decrease in the values of MP-OPT was observed (p=0.042).

Table 2c: Mean comparison of parameters based on paired t-test revealed that there was a decrease in the values of SN-CVT, PP-CVT, MP-CVT and OP-CVT when pre-treatment values (101.8±7.49, 95.4±7.89, 75,26±69.4, 88.66±85.2 respectively) are compared to post-treatment (97.4±9.39, 91.4±7.21, 69.4±5.44, 85.2±7.71 respectively). Nonetheless, significant decrease is noted only with the PP-CVT (p=0.016) and MP-CVT (p=0.004) parameters.

Table 2: Mean comparison of parameters before and after the treatment.

Parameters	n	Pre-treatment		Post-treatment		Mean difference	t value	P value
		Mean	SD	Mean	SD			
SNA	15	80.9333	1.79151	80.5333	2.19957	0.40000	1.000	0.334
SNB	15	73.8000	2.24245	77.9333	2.34419	-4.13333	-7.072	**0.000***
ANB	15	6.8000	1.89737	3.0667	0.96115	3.73333	6.424	**0.000***
SN-OPT	15	91.8000	6.43872	90.9333	7.68548	0.86667	0.429	0.675
MP-OPT	15	68.6667	4.53032	64.8667	7.14009	3.80000	2.236	**0.042***
PP-OPT	15	84.1333	7.08990	83.1333	7.43416	1.00000	0.610	0.552
SN-CVT	15	101.8000	7.49476	97.4000	9.39453	4.40000	2.091	0.055
PP-CVT	15	95.4000	7.89032	91.4000	7.21902	4.00000	2.726	**0.016***
MP-CVT	15	75.2667	9.74289	69.4667	5.44933	5.80000	3.413	**0.004***
Beta angle	15	21.8000	4.73890	24.8667	5.47549	-3.06667	-2.700	**0.017***
UAFH	15	56.6667	3.84831	56.9333	4.13118	-0.26667	-1.075	0.301
LAFH	15	76.2000	3.12136	79.6000	4.02611	-3.4000	-12.475	**0.000***
GoGN-SN	15	29.7333	2.93906	30.2000	3.23375	-0.46667	-0.608	0.553
OP-OPT	15	80.7333	8.37058	79.2667	8.78690	1.46667	0.699	0.496
OP-CVT	15	88.6667	8.76410	85.2667	7.71332	3.40000	1.555	0.142

Paired t-test; p≤0.05 considered statistically significant

The cervical parameters such as SN-OPT, PP-OPT, MP-OPT show a decrease in values which suggests cranio-cervical posture to be more upright after twin block therapy.

There is an increase in SNB angle which suggests improvement in mandibular position from an earlier retruded position. Also, the mandibular plane angle shows a decrease in value which suggests a shift in growth pattern from vertical to horizontal.

Discussion:

Orthodontic treatment is aimed at improving facial and dental appearances as well as enhancing the relationships of the teeth and skeletal bases to each other. With increasing awareness, parents are now seeking treatment for their children at an early age. So, the goal of the early treatment is to correct existing or developing skeletal, dentoalveolar and muscular imbalances[10-12].

There are a number of modalities available for managing Class II malocclusions with retrognathic mandible. One of the modalities includes growth modification using functional appliances in growing and cooperative patients. Functional appliances influence the mandibular growth, thereby also improving the facial profile of the patients with retrusive mandible. McNamara found an increase in mandibular growth over the controls of 1.2mm per year, Creekmore and Radney found an increase of 1.1mm per year[13-15].

There are ample options available for functional appliances to be chosen for the treatment. However, Twin Block is used more frequently for the treatment of Class II malocclusions with retrusive mandible. The advantages of Twin Block over other functional appliances are that it is more comfortable to wear, freedom in speech and other functions

Graphs:

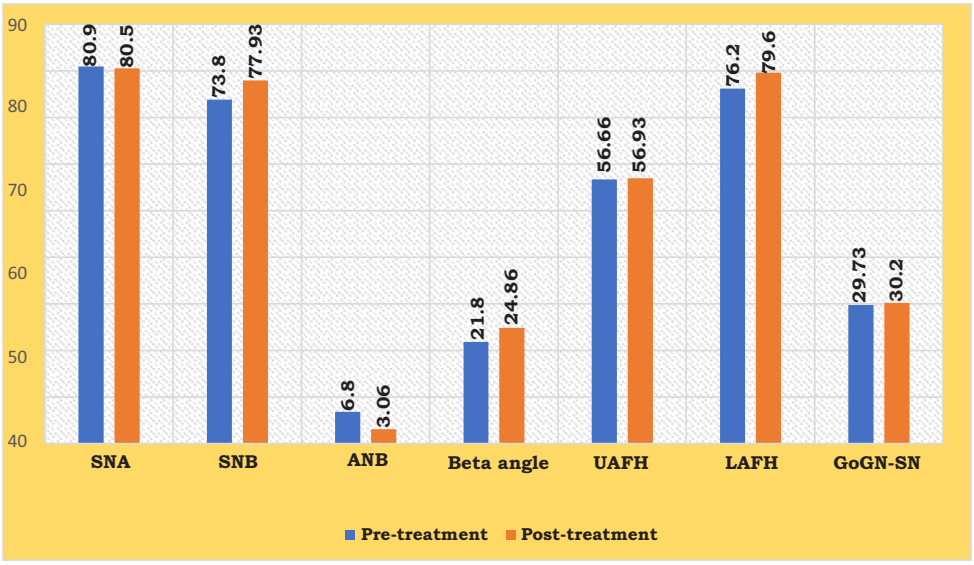

Figure 2: Mean comparison of parameters pre and post treatment

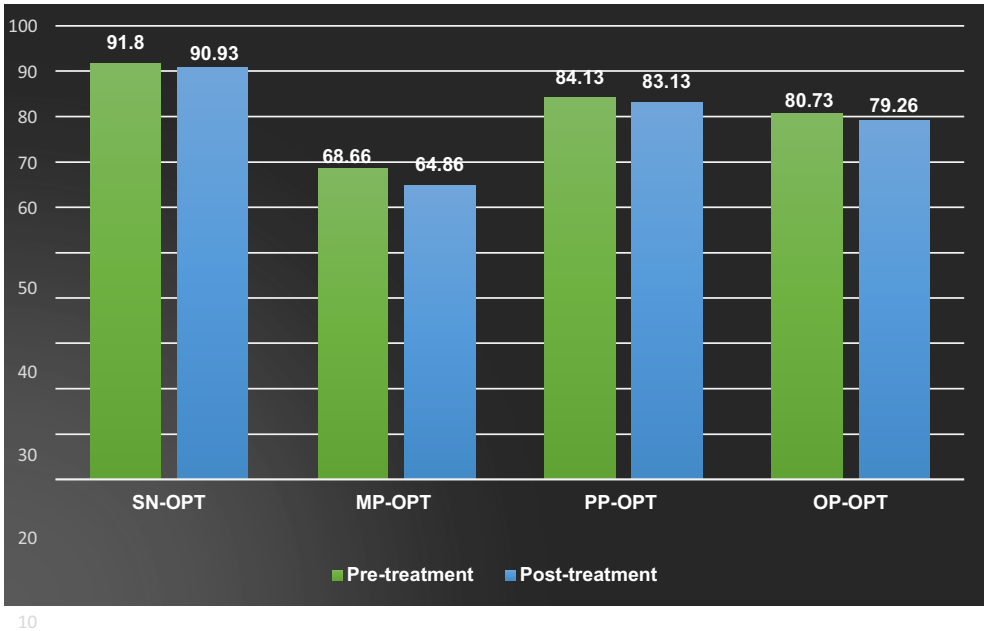

Figure 3: Mean comparison of parameters pre and post treatment (in relation to OPT)

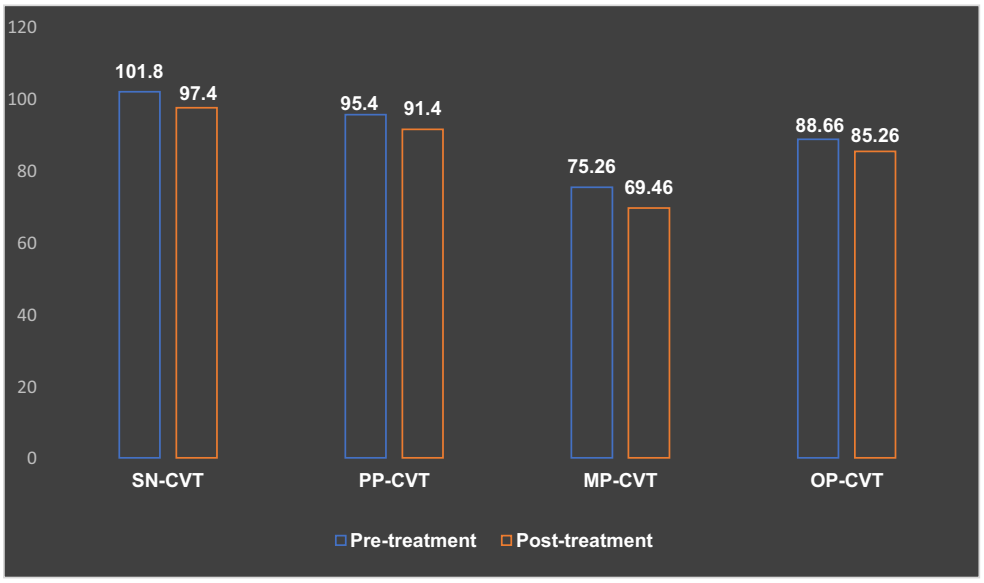

Figure 4: Mean comparison of parameters pre and post treatment (in relation to CVT)

because of the two pieces[16, 17].

Management of distal occlusion with functional appliances can lead to improvement in lip competency and orofacial function through muscle adaptation along with dental and skeletal changes. As a result, changes in the relationship between the jaws might induce body posture adaptations. The present study was conducted to determine the cervical spine posture in growing patients after Twin Block therapy[18-20].

Twin block treatment was done in 12 growing patients. Three sagittal, 3 vertical and 9 cervical vertebral parameters were compared between the groups. The results indicated an increase in SNB angle and an increase in cervical parameters like SN-OPT, SN-MPT angles in post-functional treatment cases. The comparison between the pre and post functional treatment with Twin Block therapy suggests an improvement in the cervical posture[21, 22].

However, the improvement in the cervical spine posture is because of the twin block therapy alone or the physiologic growth of the mandible remains the limitation of the study. Also, the study is based on 2-dimensional imaging technique and manual tracing of cephalometric landmarks and measurements are the limitations of the study[23].

Conclusion:

Individuals exhibiting Class II malocclusion attributed to mandibular retrognathism and a diminished vertical dimension demonstrate a heightened forward inclination of the cranio-cervical posture. The implementation of Twin Block therapy emerges as an effective intervention, fostering improvement in the sagittal relationships between the maxilla and mandible. Notably, the application of Twin Block therapy contributes to a more upright cranio-cervical posture, thereby underscoring its significance in positively influencing the overall orthodontic outcomes for individuals with such malocclusions.

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