A CLINICAL, CEPHALOMETRIC, ELECTROMYOGRAPHIC & ULTRASONOGRAPHIC EVALUATION OF TWIN BLOCK APPLIANCE

Authors:
Dr. Shubhangi Amit, MDS
Reader, Department of Orthodontics
Rural Dental College of
Pravara Institute of Medical Science (DU)
Loni, Maharashtra, India
Email: shubhangimani@yahoo.co.in
Tel.No.: 09822772099

Dr. N G Toshniwal, MDS
Prof & Head, Department of Orthodontics
Rural Dental College of
Pravara Institute of Medical Science (DU)
Loni, Maharashtra, India

Abstract: The study has evaluated the treatment response to Twin Block in 20 growing subjects with Skeletal Class II malocclusion with mandibular retrognathism in the age group of 10 to 13 yrs (mean age 11.8 S.D 1.6) for a period of 6 months. Response to Twin Block appliance has been studied clinically, cephalometrically, electromyographically and ultrasonographically. Twin Block repositions the mandible which transforms the Class-II molar and canine into Class-I molar and canine relationship. Cephalometric changes has revealed significant increase in mandibular length. Electromyographically, during maximal voluntary clenching the children with Class-II malocclusion, exhibited less EMG activity in masseter and temporalis than the children with normal occlusion. The mean masseter & temporalis muscle activity during maximal voluntary clenching showed a most significant change from the start to the end of 6 months indicating neuromuscular adaptation. So, with skeletal and dentoalveolar adaptations, neuromuscular adaptation was also observed with Twin Block appliance. Morphologic alteration in the masseter muscle length was observed ultrasonographically. The increase in length of masseter muscle indicating structural adaptation to the newly repositioned lower jaw. The findings of the study demonstrates that the Twin Block Appliance is a very effective and efficient tool with which severity of the overjet can be reduced.

KEYWORDS Twin Block appliance, Class II division 1 malocclusion, Mandibular length, EMG activity.

INTRODUCTION
Understanding the mechanism of action of functional orthopaedic appliances is critical for orthodontists who hope to treat and retain the achieved corrections in patients with skeletal Class-II malocclusion with mandibular retrognathism.

The awareness, popularity and usage of functional appliances is always on increase, although the controversies regarding their potential and the mode of action still linger around unsettled.

Functional appliances used in the correction of Class II malocclusions are shown to modify the neuromuscular environment of the dentition and associated bones. The first attempt - study muscular activity was reported by Moyers'1. Inherent imbalance of the temporomandibular musculature, particularly the
temporalis muscle was an etiologic factor of "True Class II cases". The clinical use of electromyography for orthodontic diagnosis and for monitoring treatment effects was soon introduced. Ahlgren utilized the technique to investigate the mechanism of mastication and Moller reported its correlation with facial morphology. The surface EMG has been utilized to aid in the detection, diagnosis and treatment of muscle hyperactivity and hypoactivity.2,3 The surface EMG has been utilized to aid in the detection, diagnosis and treatment of muscle hyperactivity and hypoactivity. Previously, concepts of Herren (increased muscle tones) Schwarz (long lasting isometric biting) Ahlgren (passive elastic muscle tension) and Andreson - Haupl (myotactic reflexes with isometric contractions) were tested for muscle activity. Applications meant for intermittent wear i.e. only during the nighttime (Activator and its modifications) acted as a splint rather than a device for mandibular hyperpropulsion. Functional appliances that are worn on full time basis like Herbst, Jasper Jumper and Twin Block elicit a greater and more rapid neuromuscular response than those worn only on part time basis.

A number of studies have investigated the treatment effects and results of the full time wear of functional appliances like Twin Block appliance. But none of study in the literature has discussed the treatment effects of Twin Block Appliance clinically, cephalometrically, electromyographically, and ultrasonographically as a whole. Along with the EMG studies, very few workers have tried to study the morphological alteration in muscle size, shape, and thickness before and after treatment with functional jaw orthopedics. Other means to calculate muscle cross sectional area and structure alteration are Computed Tomography and Magnetic Resonance Imaging. It has limited usefulness, due to radiation exposure and economical factors. Hence an attempt has been made in this study to analyse the muscle morphology before and after the treatment by Ultrasonography.

Thus the aims and objectives of the present study were planned as follows:

1. To evaluate the efficacy of the "Twin Block appliance" clinically by studying the amount of overjet and overbite reduction, the correction of molar and canine relationship. To evaluate the validity of the "Predictive Equation" given by Susi Caldwell and Paul Cook for the expected percentage of overjet reduction.

2. To evaluate cephalometrically, the treatment effects of the Twin Block appliance and to assess the extent to which the Twin Block appliance stimulates the mandibular growth.

3. To analyze and to compare electromyographically the synergistic behaviour of the masseter and anterior temporalis muscle in Normal occlusion and Angle's Class-II Division 1 malocclusion.

4. To investigate the muscle response of anterior temporalis and masseter to the Twin Block appliance and to analyze quantitatively, the various changes with the treatment.

5. To assess the morphological changes of masseter muscle particularly in length by using ultrasonographic quantitative assessment.

**MATERIAL AND METHODS**

**Material**

The total sample in this study consisted of 40 subjects with the mean age of 11.8 yrs (S.D 1.6 yrs) of both sexes of which 22 were males and 18 were females. The total sample was further divided into two groups of 20 subjects each, 1. Control Group. 2. Experimental group.

**Control group**

Was taken to evaluate and to compare the EMG activity of muscles in normal occlusion category with that of Angle's CI-II Division 1 malocclusion category.

Criteria for selection - Clinically optimal occlusion for that particular age. Extraorally, pleasing profiles, competent lips and well-balanced dentofacial proportions.

**Experimental group**

Experimental group was taken to evaluate a Twin Block response Clinically, Cephalometrically, Electromyographically and Ultrasonographically.

Criteria for selection - Clinically, full unit Angle's Class-II molar relationship bilaterally with a convex facial profile and increased overjet and overbite. Clinical VTO was positive. A pretreatment cephalometric analysis revealed increased < ANB (6-8°) and favorable functional analysis with favorable growth pattern. None of the subject had undergone any orthodontic treatment. All criteria favoured the use and selection of myofunctional appliance therapy.

**Method:**

The wax construction bite was registered. Models were mounted on an articulator with wax construction bite in place. Twin block was fabricated & delivered to the patients. During the whole observation period, the patients were instructed to wear the TB appliance on
full time basis. Assessment of models were done to see the change in molar and canine relationship bilaterally, also the overjet and overbite were recorded.

Method used to predict the overjet reduction:
The overjet (mm), overbite (mm) and molar relationship were recorded on the day of Twin Block appliance insertion. The angle $\angle$SNB was determined by cephalometric analysis. The predictive equation$^5$, which is used to assess the percentage of overjet reduction is as follows: Percentage of overjet reduction in 6 months$= \frac{132+4.9X_1-1.4X_2}{X_2}$ where $X_1$ = overbite, and $X_2$ = $\angle$SNB.

The amount of overjet reduction achieved in 6 mths of Twin Block wear was recorded and that were compared with the predicted amount of overjet reduction with equation and the validity of the same were tested statistically.

Cephalometric analysis$^6$:
A cephalometric head film was taken for each subject before and after 6 months of treatment. Angular and linear measurements were calculated. Method used for cephalometric analysis was same as used by Mills & McCulloch$^7$ in 2000 for evaluating the posttreatment changes with Twin Block Appliance. Same method was followed after 6 months and post treatment records were taken. The differences in angular and linear measurement revealed results of the Twin Block functional appliance

Electromyographic examination

1. Control group (Normal occlusion) - EMG activity of right & left masseter and temporalis was recorded & mean values measured.
2. Experimental group - A quantitative analysis of EMG activity from the temporal and masseter muscles was made on RMS Recorders and Medicare systems, with RMS EMG EP MARK-II software available in the College of Physiotherapy of Pravara Medical Trust, Loni. Patient underwent 4 EMG registration sessions both with and without the TB appliance at an interval of 0, 1, 3 and 6 months. The myoelectric signal was recorded from right and left masseter & temporalis muscles. The recording parameters were as follows: Frequency range: 20Hz – 2Khz , Sensitivity:100 $\mu$V, Sweep speed: 10 ms/div. Dual channel circular silver-silver chloride disk electrodes, (10.5mm in diameter) were coated with electrode paste & placed with an adhesive tape. Patient was sitted in a NHP. Ground electrode was placed on Chin. Active electrode was placed on Masseter & temporalis, and Reference electrode was placed on Zygomatic Bone. A point 2.5cm above and infront of the angle of mandible was selected for masseter muscle. For temporalis muscle, a point 2.5cm posterior to the lateral margin of orbit and above the upper border of zygomatic arch was selected$^8$. In all the cases, electrodes were placed parallel to the muscle fibre & were half way between origin & insertion of the muscles.

Temporal processing
Temporal processing of raw EMG was done using a linear detector. Root mean square voltage (RMS) was calculated from 2 seconds (2s window). Total recording period was 10 seconds. Initial and last 2 seconds were not taken in record system as the motor unit-firing rate has peak duration of approximately 2sec and it also eliminates the procedural error. The patient was asked to clench and hold for 10 seconds.

Ultrasoundographical (USG) Evaluation
All subjects had undergone real time USG imaging for the evaluation of morphology of masseter muscle before and after 6 months of treatment. Length was measured by Ultrasound on an Ultrasound Unit (GE LOGIQ 400, Pro series) using an 9 Mhz linear phased array transducer (PLF 805 ST, Toshiba) at Dept. of Radiology, Rural Medical College and Hospital, Loni Maharashtra. USG was done with subject in sitting position with their head turned side ways to provide a good access for the probe. The elevator muscles were relaxed in position and teeth were in maximum intercuspal position. The positioning of probe was standardized for each patient by making a reference line (i.e. thin strip of sticking plaster on the posterior border of ramus). Transducer was placed in contact with skin after applying ultrasound gel. Image confirmed on visual display and maximum length was measured. The orientation of probe was maintained manually until half of the image scanned and then other half was scanned. Both of these images were approximated by intra and inter muscular fat planes and these fat planes are seen as hyperchoeic lines between hypochoeic muscles$^9$. Three such readings were taken. Once electronic linear caliper lines with dots appear on the image of the scan, the length of the muscle was recorded. Values appear at the bottom of the screen. The same procedure is adopted for the other side. The same operator evaluated the same patient again after 6 months.
RESULTS

Good compliance was obtained within a week. Subjects were comfortable while speaking and eating within 8 to 15 days with Twin Block Appliance. Clinically, marked improvement in facial profile. An analysis of progress models revealed marked reduction in overjet and overbite and also change in molar and canine relationship from Class II to Class I malocclusion. The mean reduction in overjet was 5.2mm.

Cephalometrically, there is reduction in the anteroposterior apical base discrepancy via a decrease in <ANB (from 6 ± 1.48° to 2.175 ± 1.51°) (Table no. I). The correction of skeletal base relationship was mainly due to increase in angle SNB (from 74.95° ± 2.578° to 77.725° ± 2.46°) with a small reduction in angle SNA. Thus, so-called headgear effect was minimal. Also the effective mandibular length demonstrated a significant increase in post treatment group (CoGn - from 107.35 ± 4.10 to 112.5 ± 4.01 mm, GoGn - 107.35 ± 4.10 to 112.5 ± 4.01 mm, ArGo - 43.5 ± 2.73 to 47.3 ± 3 mm). A mean forward growth of the mandible was 2.70 mm measured from Go-Gn. The mean overjet reduction of 5.2 mm, a net 5.3° retraction of upper incisors and 2.45° proclination of lower incisors (Table no I).

Electromyographically, during maximal voluntary clenched the children with Class-II malocclusion exhibited less EMG activity (Table no II) in the masseter and anterior temporalis muscles than children with normal occlusion. In experimental group, both the muscles were stimulated, however the masseter showed a more definite pattern of change (Table No III). Temporalis did show a trend toward the increase in activity (Table No IV). During the 6 months period, the values at each recording were higher with the appliance than without (Table No III, IV) the appliance. The mean masseter activity with Twin Block increased gradually progressing through 4 recording sessions with appliance (236.52 ± 77.61 at 0 mth), 368.06 ± 90.29 (at 1 mth), 390.16 ± 87.45 (at 3 mths), 456.98 ± 114.79 (at 6 mths) μV). Our study showed that, the EMG activity from the anterior temporal muscle (244.73 ± 36.43) was much lower than that from the masseter muscle (456.98 ± 114.79) during whole observation period.

Results of USG evaluation have confirmed lengthening of masseter muscle fibre by a mean of (55.18 ± 4.56 mm) (Table no V) in a posttreatment group than in the pretreatment group (51.38 ± 3.35 mm) during 6 months.

DISCUSSION

Discrepancies between the jaws in the development of Stomatognatic system play an important role in the etiology of Angle's Class II Division I, malocclusions. Several studies revealed that the majority has a component of mandibular deficiency. Changing the function of the mandible by forcing the patient to function with the lower jaw forward could stimulate mandibular growth, thereby correcting a Class II problem. The mode of action of functional appliance therapy has been linked to neuromuscular and skeletal adaptations to altered function in the orofacial region. McNamara211 and Carlson's investigations indicated that modifications of functional position of the mandible results in an immediate alteration of the neuromuscular activity of the orofacial muscles.

CLINICAL EVALUATION

A 6 months time period was used and the treatment effects were assessed. We have limited initial advancement of mandible to approximately 4 to 6 mm being careful to stretch only muscle and not TM joint ligament. Okeson11 states “Ligaments do not stretch. If traction force is applied, they become elongated i.e. their length increases. This compromises TM joint function. S. Caldwell and P. Cook in 1999 found that there was a strong relationship between the pretreatment overbite and reduction in overjet after 6 months of treatment with Twin Block. By using regression analysis they have given an equation. Pretreatment overbite and angle SNB act as a useful predictor for expected % reduction in overjet. The validity of same equation was assessed in our study. Findings of our study were in accordance with the findings of Susi Caldwell and P Cook. Also, the values of actual overjet reduction in 6 months and values of expected percentage reduction in overjet with prediction equation were similar. So, the equation can be considered valid for predicting the percentage of overjet reduction in first 6 months of treatment with Twin Block Appliance. However, valuable time, finance and future co-operation can be saved, through the use of a predictive equation, if successful cases could be identified.

CEPHALOMETRIC EVALUATION

Many authors feel there is a little evidence to support the claim that functional appliances significantly affect mandibular growth. Bjork15 and Pancherz16 demonstrated only small change in mandibular growth. By contrast, Harris17, De Vincenzo18 and Windmiller19 suggested that there might be significant influences on mandibular growth after timely intervention. According to Robertson20 principal changes with functional appliance were dentoalveolar in nature. Nevertheless, it seems desirable to stimulate mandibular growth as
much as possible in young patients with severely retrognathic mandible in the hope of avoiding more complex treatment after maturity. For this reason, many Orthodontists prefer to intervene early with orthopedic treatment in order to decrease skeletal dysplasia before 

patients with Class II malocclusions reach their teen years. Reduction in the anteroposterior apical base discrepancy via an <SNB was observed in all subjects. This finding is supported by different studies. This correction of skeletal base relationship was mainly due to increase in <SNA with a small reduction in <SNB. Thus, so-called headgear effect was minimal and was not clinically significant. The effective mandibular length demonstrated a significant increase in post treatment group during study period. The increase of this length is also supported by different studies. In dentoalveolar changes lower incisors were tipped labially. Lund and Sandler and Mills and McCullough reported the similar results. This can be explained as with the anterior displacement of the mandible, the amount of anterior migration of the mandibular dentition also increases. This finding was supported by Reey and Eastwood. The force returning the mandible to its original position is transmitted by the appliance and its labial bow to the maxillary dentition and particularly to the maxillary incisors. That is why even with southend clasps, tipping of palatal plane is commonly seen with Twin Block Appliance.

Soft tissue changes revealed effective anterior oral seal in the posttreatment group. The Twin Block positions the mandible downward and forward thus increasing the intermaxillary space. This makes it difficult to form a contact between the tongue and lower lip. The patient adopts a natural lip seal without any instructions when Twin Block was fitted. The lip seal was maintained throughout and improved facial balance was evident in 6 months of treatment.

ELECTROMYOGRAPHIC EVALUATION:

EMG is a measurement of the electrical activity of muscle and the use of multiple electrodes permits the maximum voluntary isometric clenching recording from the group of muscles. Schanne, Chaffin, Carles and Van steenberghge observed significant change in the post stimulus EMG complex of the masseter muscles in children undergoing treatment with Bionator. When forward positional response of the mandible was achieved during the first few months of treatment a stretch of the masseter muscle chiefly of the vertical deeper part was present. Before structural adaptation to the masseter muscle lengthening took place, increased activity could act to restore the original muscle length. The EMG activity of Masseter and Temporalis muscles were recorded before and after 1, 3 and 6 months of treatment. One month EMG was chosen because neuromuscular changes might occur earlier than the morphologic changes. Three months EMG was selected because a positional response of the mandible is often achieved at this time with functional appliance and 6 months EMG reveals that some children have late response. Insertion of Twin Block caused a change in the EMG pattern, both the muscles were stimulated, however the masseter (Table no. III) showed a more definite pattern of change. Temporalis did show a trend toward the increase in activity (Table no. IV). The EMG activity of anterior temporal muscle was much lower than that of masseter muscle during whole observation period. This can also be interpreted as the temporalis muscle being an antagonistic muscle to protrusive movement of the mandible. The fan shaped temporal muscle has been divided into 3 separate components i.e. an anterior part in which the fibers are almost vertical, a middle part and a posterior part. The vertically directed fibers (anterior part) showed the greatest number of active motor units during biting in habitual (centric), retruded and the ipsilateral molar occlusion. Fewer motor units were active in protruded position and there were very few active motor units during incisor and contralateral movements.

Pancherz and Anehus-Pancherz reported decreased masseter activity during clenching without twin block after 3 months. It is due to occlusal instability and or lack of occlusal contacts of teeth in the posterior segments. The occlusal instability caused by changed tooth position and intermaxillary relations brought about by treatment is reflected in a reduced EMG activity of masseter muscle during clenching. A stable occlusion has been shown to be a prerequisite for maximal activity during biting. The activity decreases with lessening number of posterior teeth in contact and drops dramatically to low when only the incisors are in contact. Goldberg, found that activation of a vast number of mechanoreceptors, located in the PDL of posterior teeth during maximum incursion occlusions. This number decreases when the incisor are brought into the edge-to-edge position. Our study also showed a decrease in masseter activity during clenching without Twin Block (249.76 ± 74.79) as compared to with Twin Block (456.98 ± 114.79).

Activity with Twin Block was quite high because Twin Block provided the necessary interocclusal contacts and better stabilization of the mandible. After 6 months, mandible gets stabilized in a better way and occlusal contacts were also increased. This has distributed the occlusal load of clenching over a larger periodontal
area and a significant increase in clenching activity had occurred. Our study concluded that the mean masseter activity during maximal clenching with Twin Block showed a progressive increase from the initial to the last recording at 6 months. The findings of this study supports the results obtained by Pancherz and Anehus-Pancherz, David Leung, Hagg, Urban Hagg. So, the quantitative EMG of the masticatory muscles can be considered as an informative tool in the evaluation of treatment results, and can be added to the conventional dentofacial measurements (investigations).

AN ULTRASONOGRAPHIC ASSESSMENT OF MASSETER MUSCLE

As a masseter muscle is a prime muscle for maintaining the desired results achieved with Functional Jaw Orthopaedics, the Ultrasonographic study has been concentrated on its alteration due to Twin Block Appliance. The study shows increase in the length of masseter muscle suggests increase in compensatory length due to change in sagittal position of lower jaw. Change in mandibular posture is always associated with lengthening or shortening of muscles attached to the mandible. Consequently, since the distribution of force in the muscles and at the bone-muscle interface is changed, the process of adaptation can begin in both systems; the muscle adaptation to a new functional length and the bone remodeling to new stress distribution at its surface. The degree of adaptation varies in the different parts of the dentofacial system.

Theoretically, one also expects a neurally mediated contribution to the force generation in a muscle after its lengthening by means of the autogenetic tonic stretch reflex — especially in the elevator muscles as was also proposed by Stockli & Teuschler. A comparison of our Ultrasonographic study results with those of other workers is limited due to the lack of previous studies in this area.

SCOPE OF THE STUDY IN INDIAN SCENERIO

Almost 80% of the population resides in the rural part of the country where services rendered by the Orthodontists is almost nil. Even though the parents and the patients wish to seek the treatment for that they have to travel very long and visit frequently to the town and pay the fees which is beyond their capacity.

The Rural Dental College Loni is purely rural institute where almost all patients are from low social economic group hence the need was felt to search for an efficient & low cost appliance which is useful for the prevalent malocclusion i.e. Class II malocclusion in growing individuals which is common in these local population. Hence search and efforts was made to evaluate efficacy of the removable twin block in all aspects.

Advantages of Removable Twin block over other fixed functional appliances:

1. More of the skeletal changes as compared to the dental with the fixed functional appliance because of continuous force on dentition.
2. Versatility of the appliance.
3. Easy to fabricate as compared to the complicated fabrication of the fixed twin block.
4. Transverse as well as anterioposterior corrections can be done simultaneously.
5. Hygienic and cost effective appliance.
6. In well aligned arches, the treatment can be finished with single appliance.

CONCLUSION

The following conclusions were drawn from the present study:

1. Twin Block appliance repositions the mandible and thus evokes an accelerated phase of growth which transforms the skeletal Class-II base to Class-I base. Also, the correction of Class-II molar and canine relationships have been observed. A significant decrease in the overjet and overbite was observed in the post treatment group after the 6 months.

2. A predictive equation given by Susi Caldwell and P Cook for evaluating the expected percentage of overjet reduction was tested in our treatment group and results of study confirmed its validity.

3. Cephalometric changes have revealed significant increase in angle SNB. Also there was marked increase in mandibular length (Go-Gn). No statistically significant restriction of maxillary growth was noted. The anterior face height increased in post treatment group. Dentoalveolar changes showed retraction of upper incisors and proclination of the lower incisors. So the Twin Block appliance produces both skeletal and dentoalveolar adaptations.

4. During maximal voluntary clenching the children with Class-II malocclusion exhibited less EMG activity in the masseter and anterior temporalis muscles than children with normal occlusion. The EMG of anterior temporalis was much lower than that of masseter muscle.
5. Definite response of anterior temporalis and masseter muscles to Twin Block appliance was observed electromyographically. The mean masseter muscle activity during maximal voluntary clenching showed a most significant change from the start to the end of 6 months indicating neuromuscular adaptation to the altered position of mandible. The mean anterior temporalis muscle activity also showed a change during clenching but showed a variable pattern. So, with skeletal and dentoalveolar adaptations, neuromuscular adaptation was also observed with Twin Block appliance treatment.

6. Morphologic alteration in the masseter muscle length was observed ultrasonographically. The increase in length of masseter muscle was statistically significant indicating structural adaptation to the newly repositioned lower jaw. Thus, the study demonstrates that the Twin Block Appliance is a very effective and efficient tool with which severity of overjet can be reduced. Quantitatively the changes are impressive. However, qualitatively, they leave something to be desired, which invariably necessitate finishing with fixed appliance. Findings of the present study may contribute a positive testimony to the effectiveness of Twin Block Appliance in beneficial skeletal growth and may help to answer the doubts still being cast on such therapy.

REFERENCES


27. Meach C L. A cephalometric comparison of bony profile changes in Class-II Division 1 patients treated with extraoral force and functional jaw orthopaedics. Am J. Orthod 1966; 52: 353 – 70. 6 A
31. Lund DI, Sandler PJ. The effects of Twin Block: A prospective controlled study. AJO DO – 1998 Jan; 113 (1)104 – 10

Legends

Fig. 1. A,B,C : Pre treatment extraoral photographs
Fig. 2. A,B,C : Pre treatment intraoral photographs
Fig. 3. A,B,C,D,E : With Twin Block Appliance
Fig. 4. A,B,C,D,E : Post Functional Extra & Intraoral Photographs
Fig. 5. A,B,C : Placement of Ground and Active Electrodes on determined sites
Fig. 6. : Representative sections of EMG Activity
Fig. 7. A,B : Reference line for positioning of probe, position of probe
Fig. 8. : Ultrasonographic image of masseter muscle
Fig. 9. A,B,C : Post Treatment Extraoral Photographs
Fig. 10. A,B,C,D,E : Post Treatment Intraoral Photographs
Fig. 11. : Pre & Post treatment cephalometric superimposition
### TABLE NO. I: Cephalometric analysis in pretreatment and post treatment group

<table>
<thead>
<tr>
<th>Analysis</th>
<th>Pre - treatment (n=20)</th>
<th>Post - treatment (n=20)</th>
<th>S.E.</th>
<th>'t' value</th>
<th>'p' value</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;SNB</td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td>0.8</td>
<td>3.47</td>
<td>p&lt;0.05</td>
<td>Significant</td>
</tr>
<tr>
<td></td>
<td>74.95° ± 2.578° (69-77)</td>
<td>77.725° ± 2.46° (72-83)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;ANB</td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td>0.47</td>
<td>8.14</td>
<td>p&lt;0.01</td>
<td>Highly significant</td>
</tr>
<tr>
<td></td>
<td>6° ± 1.48° (4-10)</td>
<td>2.175° ± 1.51° (0-7)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;SN-Pog</td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td>0.84</td>
<td>3.52</td>
<td>p&lt;0.01</td>
<td>Highly significant</td>
</tr>
<tr>
<td></td>
<td>77.0° ± 2.77° (74-84)</td>
<td>79.95° ± 2.54° (74-86)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Co-Gn</td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td>1.38</td>
<td>3.73</td>
<td>p&lt;0.01</td>
<td>Highly significant</td>
</tr>
<tr>
<td></td>
<td>107.35 ± 4.10 (mm)</td>
<td>112.5 ± 4.01 (mm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Go-Gn</td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td>0.95</td>
<td>2.84</td>
<td>p&lt;0.01</td>
<td>Highly significant</td>
</tr>
<tr>
<td></td>
<td>72.35 ± 3.10 (67-78)</td>
<td>75.05 ± 2.91 (70-79)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Art –Go</td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td>0.91</td>
<td>4.18</td>
<td>p&lt;0.01</td>
<td>Highly significant</td>
</tr>
<tr>
<td></td>
<td>43.5 ± 2.73 (40-48)</td>
<td>47.3 ± 3.00 (44-52)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Co-Go</td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td>0.86</td>
<td>4.50</td>
<td>p&lt;0.01</td>
<td>Highly significant</td>
</tr>
<tr>
<td></td>
<td>54.47 ± 2.68 (48-59)</td>
<td>58.35 ± 2.76 (53-63)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Na-Me</td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td>2.29</td>
<td>2.03</td>
<td>p&lt;0.01</td>
<td>Highly significant</td>
</tr>
<tr>
<td>Incisor overjet</td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td>0.42</td>
<td>12.74</td>
<td>p&lt;0.01</td>
<td>Highly significant</td>
</tr>
<tr>
<td></td>
<td>9.2 ± 1.54 (67-78)</td>
<td>3.85 ± 1.07 (2-5.5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Co-A</td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td>1.8</td>
<td>0.12</td>
<td>p&gt;0.05</td>
<td>Not significant</td>
</tr>
<tr>
<td></td>
<td>87.32 ± 6.79 (mm)</td>
<td>87.54 ± 4.33 (mm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-SN</td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td>2.72</td>
<td>1.96</td>
<td>P&lt;0.05</td>
<td>Significant</td>
</tr>
<tr>
<td></td>
<td>118.5 ± 8.91° (mm)</td>
<td>113.2 ± 8.31° (mm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-Go Gn</td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td>1.69</td>
<td>2.10</td>
<td>P&lt;0.05</td>
<td>Significant</td>
</tr>
<tr>
<td></td>
<td>100.55 ± 5.54° (mm)</td>
<td>103 ± 5.17° (mm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### TABLE NO. II:

Mean values (μv) of Masseter and Temporalis muscle activity in Normal Occlusion Group & Angle’s Class-II Div 1 Malocclusion

<table>
<thead>
<tr>
<th></th>
<th>Normal Occlusion Group (n=20) Mean ± SD</th>
<th>Angle's Class-II Div 1 Malocclusion (n=20) Mean ± SD</th>
<th>S.E. 1</th>
<th>t' value</th>
<th>'p' value</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Masseter muscle</td>
<td>529.998 ± 113.64 (300-803)</td>
<td>255.05 ± 88.78 (32.24)</td>
<td>(102-395)</td>
<td>8.53</td>
<td>p&lt;0.01</td>
<td>Highly significant</td>
</tr>
<tr>
<td>Temporalis muscle</td>
<td>290.794 ± 49.24 (198-340)</td>
<td>211.54 ± 35.74 (156-265)</td>
<td>13.6</td>
<td>5.83</td>
<td>p&lt;0.01</td>
<td>Highly significant</td>
</tr>
</tbody>
</table>
### TABLE NO.III:
Mean values (µv) of Masseter muscle activity with & without Twin Block Appliance

<table>
<thead>
<tr>
<th>Duration in Months</th>
<th>Without Twin (n=20)</th>
<th>With Twin (n=20)</th>
<th>S.E.</th>
<th>'t' value</th>
<th>'p' value</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>301.13 ± 98.68</td>
<td>236.52 ± 77.61</td>
<td>28.07</td>
<td>2.3</td>
<td>P&lt;0.05</td>
<td>Significant</td>
</tr>
<tr>
<td></td>
<td>(150.83-471.15)</td>
<td>(102.33-371.5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>216.62 ± 69.03</td>
<td>368.06 ± 90.29</td>
<td>25.41</td>
<td>5.96</td>
<td>P&lt;0.01</td>
<td>Highly significant</td>
</tr>
<tr>
<td></td>
<td>(125.4-290.16)</td>
<td>(217.7-547.12)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>219.81 ± 72.86</td>
<td>390.16 ± 87.45</td>
<td>25.45</td>
<td>6.69</td>
<td>P&lt;0.01</td>
<td>Highly significant</td>
</tr>
<tr>
<td></td>
<td>(121.1-388.5)</td>
<td>(269.5-533.85)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>249.76 ± 74.79</td>
<td>456.98 ± 114.79</td>
<td>30.63</td>
<td>6.76</td>
<td>P&lt;0.01</td>
<td>Highly significant</td>
</tr>
<tr>
<td></td>
<td>(142.25-377.25)</td>
<td>(253.73-563.75)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### TABLE NO.IV:
Mean values (µv) of Temporalis muscle activity with & without Twin Block Appliance

<table>
<thead>
<tr>
<th>Duration in Months</th>
<th>Without Twin (n=20)</th>
<th>With Twin (n=20)</th>
<th>S.E.</th>
<th>'t' value</th>
<th>'p' value</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>213.37 ± 28.94</td>
<td>173.16 ± 31.24</td>
<td>9.52</td>
<td>4.22</td>
<td>p&lt;0.01</td>
<td>Highly significant</td>
</tr>
<tr>
<td></td>
<td>(160.62-265.12)</td>
<td>(130.25-229.99)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>180.18 ± 29.94</td>
<td>235.79 ± 45.18</td>
<td>12.12</td>
<td>4.59</td>
<td>p&lt;0.01</td>
<td>Highly significant</td>
</tr>
<tr>
<td></td>
<td>(151-247.41)</td>
<td>(186.5-366.92)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>166.86 ± 29.99</td>
<td>259.64 ± 51.64</td>
<td>13.35</td>
<td>6.95</td>
<td>p&lt;0.01</td>
<td>Highly significant</td>
</tr>
<tr>
<td></td>
<td>(136.5-227.5)</td>
<td>(186-323)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>182.18 ± 44.24</td>
<td>244.73 ± 36.43</td>
<td>12.81</td>
<td>4.88</td>
<td>p&lt;0.01</td>
<td>Highly significant</td>
</tr>
<tr>
<td></td>
<td>(89-267)</td>
<td>(186.26-315.29)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### TABLE NO.V:
Mean values of Ultrasonic measurement of Masseter muscle length (mm)

<table>
<thead>
<tr>
<th>Pre-treatment (n=20)</th>
<th>Post- treatment (n=20)</th>
<th>SE</th>
<th>'t' value</th>
<th>'p' value</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>51.38 ± 3.35</td>
<td>55.18 ± 4.56</td>
<td>1.26</td>
<td>3.01</td>
<td>p&lt;0.05</td>
<td>Significant</td>
</tr>
</tbody>
</table>