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Original Article

Correction of Class III Malocclusion Using Modified Maxillary Protraction Appliance

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ABSTRACT:
Background: Class III malocclusion in growing individuals is common in our daily practice. Protraction headgear is the most common appliance used in Class III patients. Headgear does not have a positive feedback aesthetically by young adults. The use of temporary anchorage devices (TADs) in orthodontics has increased over recent years. One type of temporary anchorage device, a modification of the titanium miniplate has been used successfully as a skeletal anchorage device for various orthodontic applications. This new Bone Anchored Maxillary Protraction method may be preferable as it does not involve an extra oral appliance during treatment, compliance requirements are limited to the use of elastics, maintenance of oral hygiene and ability to apply orthopedic force for a longer period without causing root resorption. **Aim:** To assess the efficacy of modified maxillary protraction appliance in treating Class III growing patients with maxillary deficiency using lateral cephalogram and Cone Beam Computed Tomography. **Methodology:** 10 individuals, in the age group 10-15 years with Class III skeletal pattern were selected as per inclusion criteria. Lateral cephalograms and Cone Beam Computed Tomography were obtained before and after the study to assess the degree of maxillary protraction. Bonded rapid maxillary expansion appliance was placed on to the maxilla and was activated for 2 weeks. Titanium miniplates were placed in the anterior region of the mandible. Rapid maxillary expansion (RME) appliance and the miniplates were attached with intermaxillary elastics, force of 200-250 gms was applied on each side. The data obtained was statistically evaluated using paired t test to compare the pre and post- treatment values. **Results:** On comparison of pre- treatment and post- treatment values obtained from lateral cephalogram and Cone Beam Computed Tomography, significant forward positioning of maxilla was noted, with counter clockwise rotation of the mandible, which is beneficial in high angle Class III cases.
Conclusion: Significant sagittal and vertical changes were encountered on comparison of the pre and post study Cone Beam Computed Tomography and lateral cephalograms. The post study values showed forward movement of the maxilla in all the 10 cases and a significant increase in SNA angle. There was a significant decrease in the SNB angle, due to the counter clockwise rotation of the mandible, resulting in an improvement in facial profile. Further controlled trials are required to substantiate this finding.
Key words: Class III malocclusion, Maxillary protraction, Miniplates, RME, Lateral cephalogram, CBCT.

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INTRODUCTION

The components of Class III malocclusion comprises skeletal and dental problems. Maxillary retrognathism, mandibular prognathism, or a combination of these forms the origin of this malocclusion.[1] Class III malocclusion in growing individual is common in our daily practice and it needs and urgent attention as utilisation of growth for skeletal correction is utmost important. Class III malocclusions are considered to be among the most challenging orthodontic problems to treat. The prevalence of Class III malocclusion is approximately as high as 14% in Asian populations.[2]

Early interception with orthopaedic appliance would advance the maxilla and at the same time restrict the mandibular growth. This enables a morphologic and functional condition that favours normal facial growth, in addition to establishing more acceptable esthetics in the early stages[3]. Interceptive approaches include removable appliances, removable functional appliances, chin cup, Protraction head gear, and skeletal anchorage systems[4].Protraction headgear is the most common appliance used for the protraction of the deficient maxilla in class III patients. Headgear does not have a positive feedback esthetically by young adults and can be an obstruction in daily routine. The short outcomes of maxillary protraction treatment have been documented with limited orthopedic effect on the maxilla. There was a relapse of 25%-33% in long term follow ups of maxillary protraction[5].Other undesirable effects associated with conventional therapy include anchorage problems in mixed dentition, unaesthetic appearance, discomfort, patient compliance problem, clockwise rotation of the mandible, upper incisor proclination and lower incisor retroclination[6].The field of orthodontics has advocated an increased application and use of temporary anchorage devices over the recent years. In orthognathic surgeries for osteotomy procedures and to fix the fractures temporary anchorage device which has been modified from titanium miniplate were used. In orthodontics it has been used as to provide skeletal anchorage and has various applications to bring about tooth movements. However recently it has shown to find its application in orthopaedic treatment modality[5].

The new bone anchored maxillary protraction may be a preferable method as it eliminates the use of elastics extra orally thereby better oral hygiene is promoted. Forces can also be applied for longer duration without causing any adverse effects on the resorption of roots[6].However, difficulty has been encountered while placing miniplates in the region of infrazygomatic crests, and insufficient vertical maxillary growth can be restrictive in this area. Maxilla has demonstrated greater failure rate in general for the use of stationary anchorage as the density of bone is less and presence of more number of trabeculations when compared to mandible[6].Conventional maxillary protraction studies have been done using lateral cephalogram which is a 2D projection of 3D structures. But, if the same is observed using CBCT we may get a better measurement of the maxillary protraction following maxillary correction. But not many studies have been done using CBCT.

Hence in the present study the correction of maxillary deficiency in a growing child has been tried using a modified appliance which will avoid bony anchorage from maxilla and the changes were observed using lateral cephalogram and CBCT.

MATERIALS AND METHODS

Ten Patients reporting to the Department of Pedodontics and Preventive Dentistry, A.B. Shetty Memorial Institute of Dental Sciences, Mangaluru, requiring correction of maxillary retrognathia.

Ethical clearance was obtained from the ethical committee before the study.

Informed consent and assent were obtained from children and parent respectively. Young growing patients presenting with skeletal class III malocclusion with maxillary deficiency within the age group of 10- 15 years were included in this study. Patients with Cleft lip/ palate, with syndromes and gross facial asymmetry and non-growing patients were excluded.

Materials:

1. Acrylic appliance with hyrax screw (Figure 1)
2.. I- shaped Titanium miniplates (Figure 2)
3. Titanium bone screws (2.0×6 mm) (Figure 3)
4. Intra oral elastics (Figure 4)
6. Planmeca- Romexis software (version 4.3)

Methodology:

Ten growing Class III patients (10-15 yrs.) with maxillary deficiency were selected. Detailed Case History and Clinical examination were done. An Ultra- low dose Cone beam scan and lateral cephalogram were obtained before insertion of miniplates and bonded rapid maxillary expansion appliance to check for the inter-maxillary relationship. Upper and lower Alginate Impressions were recorded. The location of placement of miniplates were assessed using an Orthopantomogram. I-shaped titanium miniplates were placed between the roots of mandibular lateral incisor and canine, hooks of which was 1mm below the incisal edge. Three weeks after surgery, bonded rapid maxillary expansion appliance was cemented followed by the loading of the miniplates with the Class III elastics with an initial force of about 150g on each side, increased to 200g after 1 month of traction, and to 250g after 2 months[3].This bonded rapid maxillary expansion appliance was continued for an average of 10 months and the patient was advised to activate once daily for two weeks. Patient was recalled once in every 4 weeks for regular checkup. After first phase of treatment of 10 months, a post- treatment Cone Beam Computed Tomography scan and lateral cephalogram were taken to assess the degree of maxillary protraction.A virtual cephalogram was obtained from the Cone Beam Computed Tomography using ROMEXIS software to assess skeletal changes.The degree of maxillary protraction was measured using skeletal angular measurements as well as linear measurements. (Figure 5&6)

Skeletal angles measured in pre and post study using lateral cephalogram and Cone Beam Computed Tomography (Figure 5)

SNA (º) - The angle between the anterior cranial base (sella to nasion) and the NA (nasion to point A) line.

SNB (º) - The angle between the anterior cranial base (sella to nasion) and NB (nasion to point B) line.

Linear measurements seen in pre and post study using lateral cephalogram and Cone Beam Computed Tomography(Figure 6)

Co-A (mm) –The length between the condylion (Co) and point A

Wits appraisal (mm) – Line drawn perpendicular from point A and B onto occlusal plane and measured the distance between these two points.

Statistical analysis:

All data was statistically analyzed using descriptive statistics. Paired t test was used to compare the pre-treatment and post- treatment values.

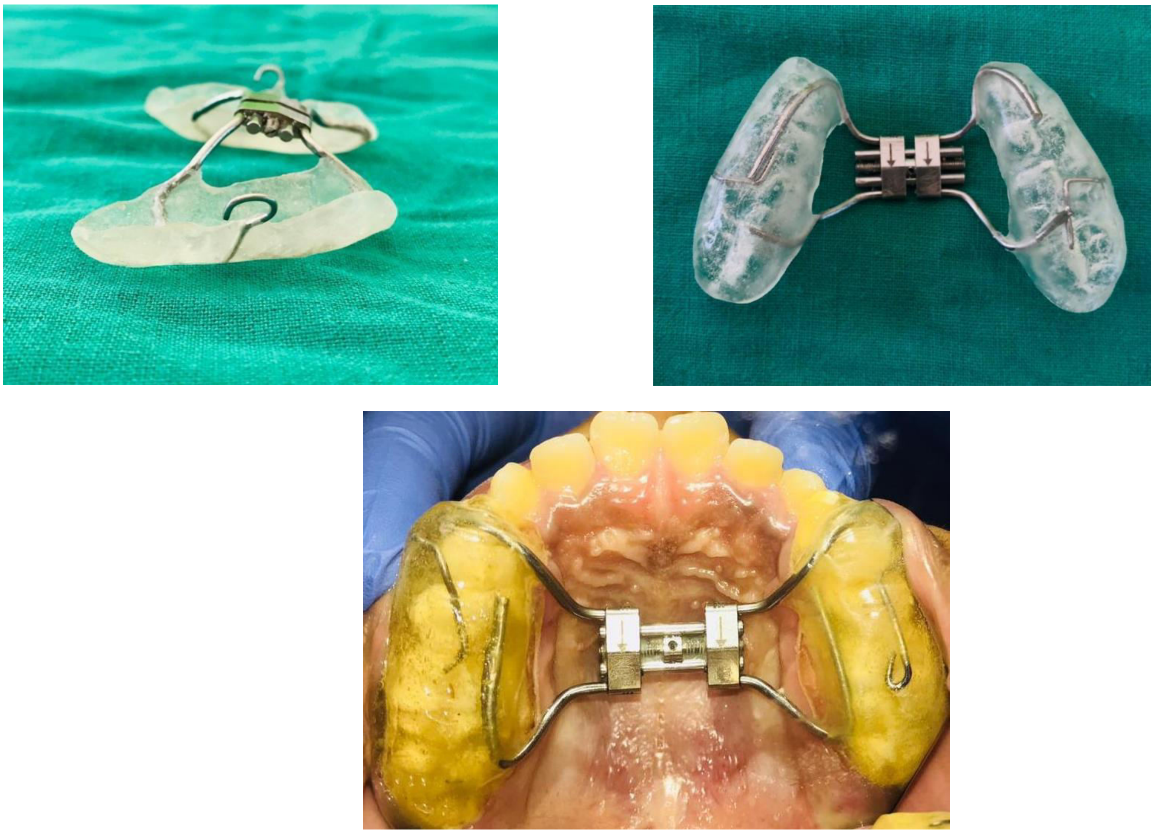


Figure 1- Acrylic appliance with hyrax scew

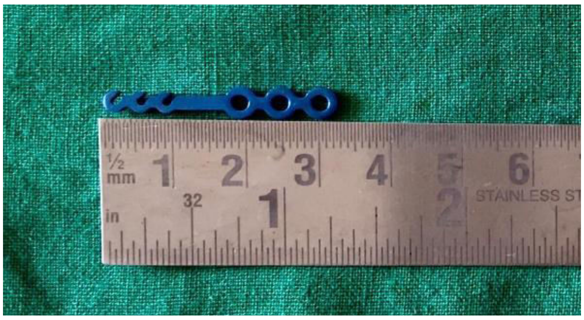


Figure 2- I- shaped titanium miniplates

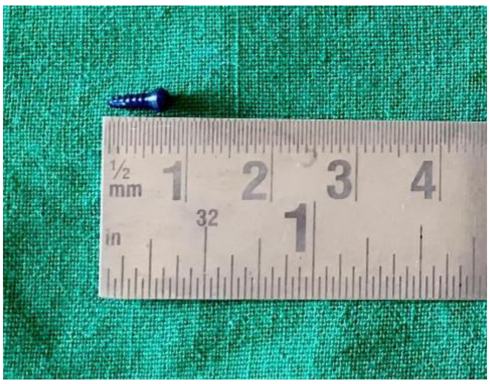


Figure 3- Titanium bone screws

Figure 4 – Intra oral elastics

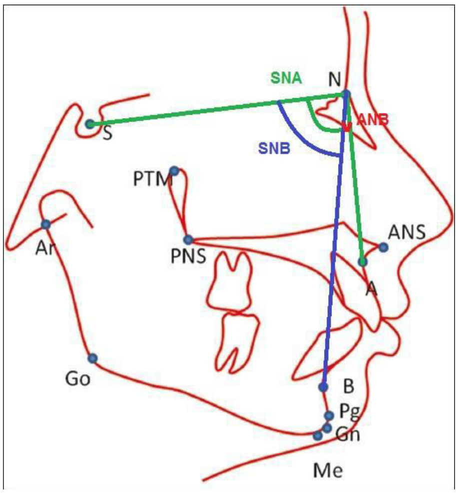


Figure 5- Diagram showing skeletal Angular measurements

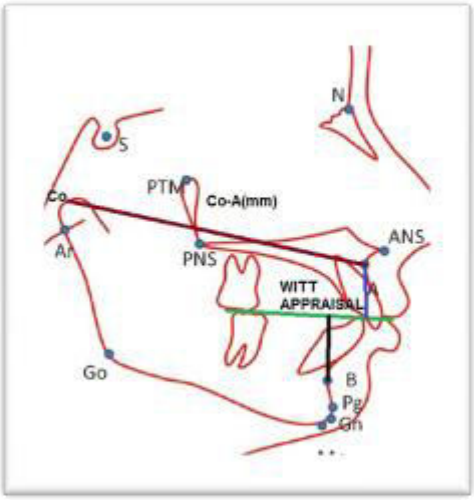


Figure 6- Diagram showing linear measurements

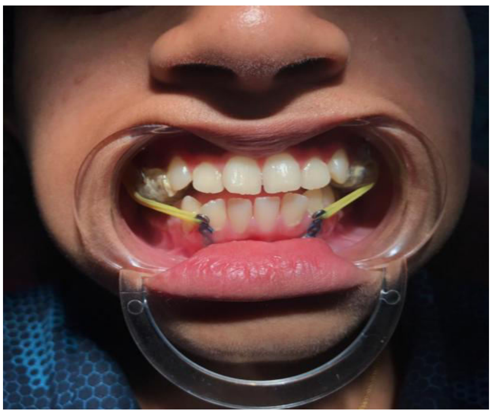


Figure 7- Modified appliance for maxillary protraction

RESULTS

Skeletal angles measured in pre and post study using lateral cephalogram and Cone Beam Computed Tomography

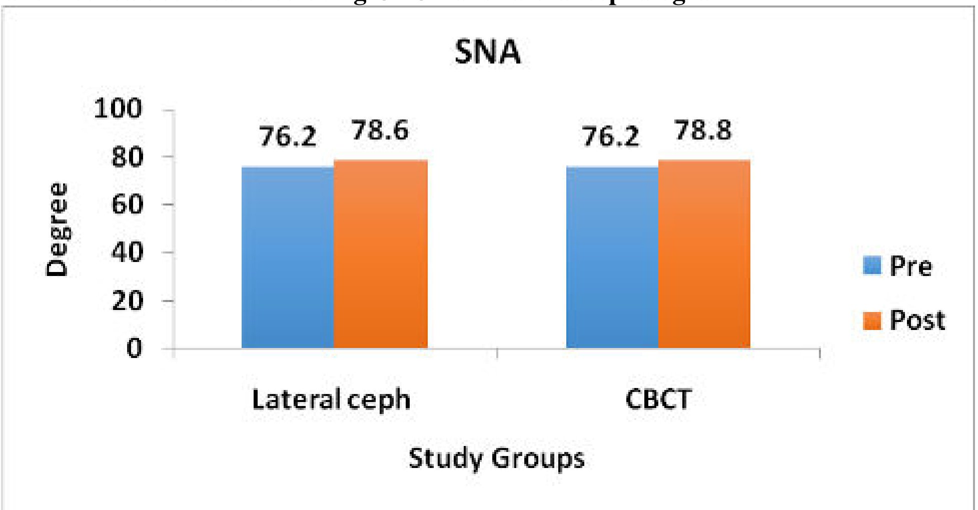
a) SNA (°) - The angle between the anterior cranial base (sella to nasion) and the NA (nasion to point A) line.
The mean pre and post treatment SNA was (76.2± SD 1.93) and (78.6± SD 1.43) respectively using lateral cephalogram. The point A moved forward by 2.4 degrees and the P value was <0.001 which was statistically highly significant.
The mean pre and post treatment SNA was (76.2± SD 1.93) and (78.8± SD 1.32) respectively using Cone Beam Computed Tomography. The point A moved forward by 2.6 degrees and the P value was <0.001 which was highly significant. (Table 1 & Graph 1)

Table 1: Pre and Post treatment SNA values measured using Lateral cephalogram and CBCT

SNA				
Variables	Lateral Cephalogram		CBCT	
	Pre treatment	Post treatment	Pre treatment	Post treatment
N	10	10	10	10
Mean Value	76.20	78.60	76.20	78.80
SD	1.93	1.43	1.93	1.32
p Value	<0.001*		<0.001*	

***p<0.05 Statistically Significant, p>0.05 Non Significant, NS**

Graph 1: Pre and Post values measured using CBCT and lateral cephalogram



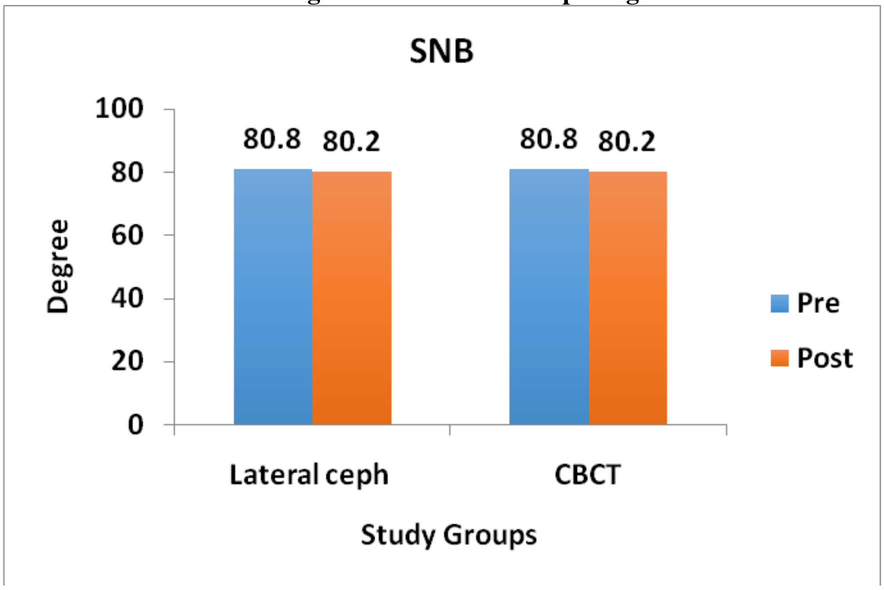
b) SNB(°) - The angle between the anterior cranial base (sella to nasion) and NB (nasion to point B) line.
The mean pre and post treatment SNB was (80.8± SD 1.32) and (80.2± SD 1.03) respectively using lateral cephalogram. The point B moved posteriorly by 0.6 degrees and the P value was 0.005 which was statistically significant.
The mean pre and post treatment SNB was (80.8± SD 1.32) and (80.2± SD 1.03) respectively using Cone Beam Computed Tomography. The point B moved posteriorly by 0.6 degrees and the P value was 0.005 which was statistically significant. (Table 2 & Graph 2)

Table 2: Pre and Post treatment SNB values measured using Lateral cephalogram and CBCT

SNB				
Variables	Lateral Cephalogram		CBCT	
	Pre treatment	Post treatment	Pre treatment	Post treatment
N	10	10	10	10
Mean Value	80.80	80.20	80.80	80.20
SD	1.32	1.03	1.23	0.92
p Value	0.005*		0.005*	

***p<0.05 Statistically Significant, p>0.05 Non Significant, NS**

Graph 2: Pre and Post values measured using CBCT and lateral cephalogram



Linear measurements seen in pre and post study using lateral cephalogram and CBCT

a) CoA (mm) –The length between the condylion (Co) and point A

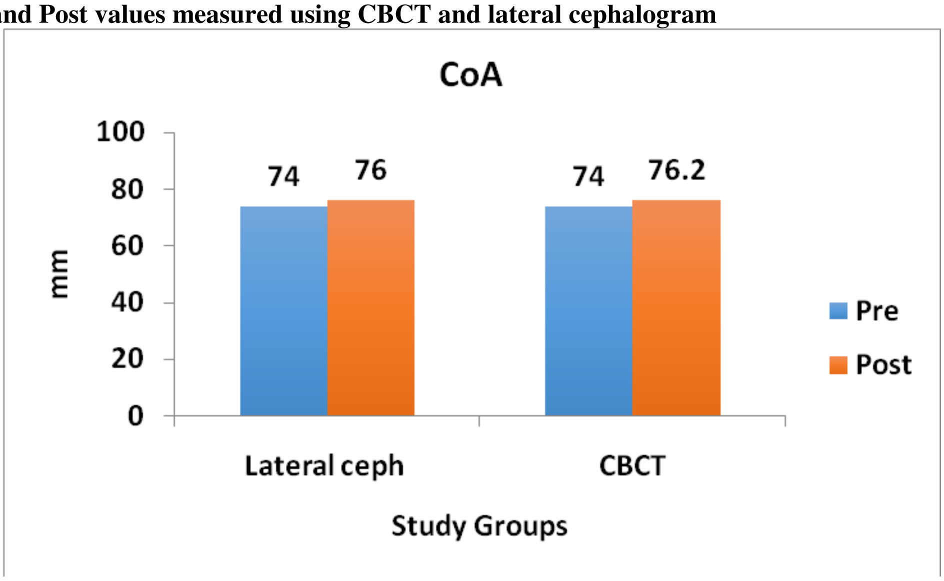
The mean pre and post treatment condyle to point A linear measurement was (74± SD2.98) and (76± SD 2.58) respectively using lateral cephalogram. The point A moved forward by 2mm and the P value was <0.001 which was stastically significant.

The mean pre and post treatment condyle to point A linear measurement was (74± SD3.06) and (76.2± SD 2.44) respectively using Cone Beam Computed Tomography. The point A moved forward by 2.2mm and the P value was <0.001 which was stastically significant. (Table 4& Graph 4)

Table 3: Pre and Post treatment Co-A values measured using Lateral cephalogram and CBCT

Co-A (mm)				
Variables	Lateral Cephalogram		CBCT	
	Pre treatment	Post treatment	Pre treatment	Post treatment
N	10	10	10	10
Mean Value	74.00	76.00	74.00	76.20
SD	2.98	2.58	3.06	2.44
p Value	<0.001*		<0.001*	

Graph 3: Pre and Post values measured using CBCT and lateral cephalogram



b) Wits Appraisal (mm) – Line drawn perpendicular from point A and B onto occlusal plane and measured the distance between these two points.

The mean pre and post treatment Wits appraisal measurement was (-6.85± SD 4.33) and (-2± SD 2.93) respectively using lateral cephalogram. The point A moved forward by 4.85mm and the P value was <0.001 which was stastically significant.

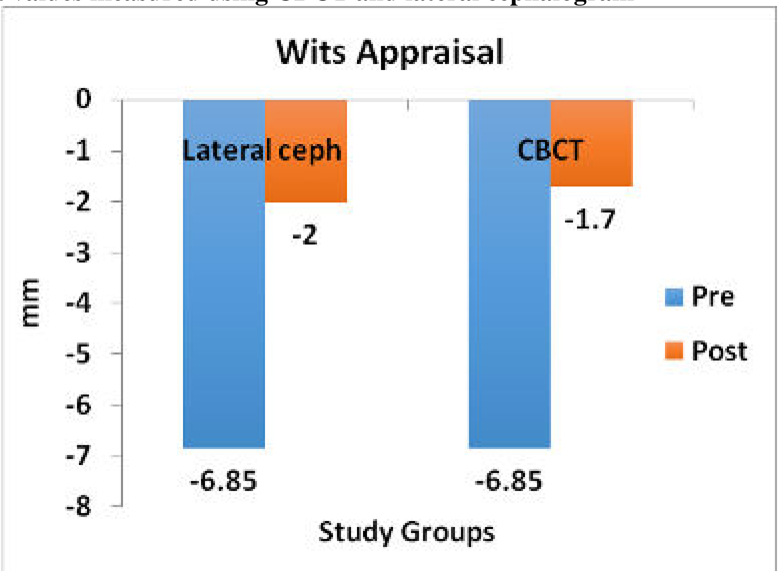
The mean pre and post treatment Wits appraisal measurement was (-6.85± SD4.1) and (-1.7± SD 2.2) respectively usingCone Beam Computed Tomography. The point A moved forward by 5.15mm and the P value was <0.001 which was stastically significant. (Table 5& Graph 5)

Table 4: Pre and Post treatment Wits appraisal values measured using Lateral cephalogram and CBCT

Wits appraisal(mm)				
Variables	Lateral Cephalogram		CBCT	
	Pre treatment	Post treatment	Pre treatment	Post treatment
N	10	10	10	10
Mean Value	-6.85	-2.00	-6.85	-1.70
SD	4.33	2.93	4.10	2.20
p Value	<0.001*		<0.001*	

***p<0.05 Statistically Significant, p>0.05 Non Significant, NS**

Graph 4: Pre and Post values measured using CBCT and lateral cephalogram



DISCUSSION

Growth of an individual and the timing of the treatment when the malocclusion is intervened are the two factors that governs the success of the treatment of class III malocclusion. Pseudo class III malocclusion and mandibular shift can be managed by simple appliances used in orthodontic practice and results in maintenance of the correction when long term evaluation is done. The decision to begin the treatment early or to delay it based on the severity of malocclusion for class III malocclusion is critical. The extent of skeletal discrepancy should be diagnosed to formulate an appropriate treatment plan[7].

In this study a new a treatment plan was formulated for young class III malocclusion patients to observe orthopedic response without much dentoalveolar side effects. This treatment plan also required minimal patient compliance. The results were in synchronous with the hypothesis proposed and the results displayed that skeletal responses were favorable without creating disturbances in dentoalveolar effects. This treatment plan produced better results when compared with the literature in which facemask was used to treat similar malocclusion. In this study, the design of the appliance, anchorage device, treatment duration, force magnitude and direction were standardized so as to minimize the number of variables to be interpreted when reviewing the data.

Titanium miniplates in the mandibular anterior region added several benefits and made the treatment plan greatly compliant. The various advantages were it posed less risk of damage to the roots of the teeth, it could be easily adapted to the bone and hence enhanced its anchorage. It was also very stable and was well toleratedby patients as the number of flap surgeries were greatly reduced in placing this when compared to other treatment modalities. All of this contributed to the success of the miniplates used for treatment plan in this study[6].

For the protraction of maxilla rapid maxillary expansion appliance was used. It facilitates the opening of circummaxillary sutures and aids in expansion of the maxilla thereby correcting the posterior crossbite due to constricted maxilla. As the sutures opens up forward movement of maxillary bone takes place and the overall arch length is increased. The maxillary dentition is also splinted while protraction using RME.[2]

The rapid maxillary expansion appliance activation was carried out once daily for two weeks. The miniplates were loaded with the Class III elastics with an initial force of about 150g on each side, increased to 200g after 1 month of traction, and to 250g after 2 months. The force was measured using the dontrix gauge and was maintained accordingly. The effect of these were evaluated with pre-treatment and post- treatment Cone Beam Computed Tomography (CBCT) and lateral cephalograms.

There is substantial variability regarding the magnitude of force used to obtain orthopedic results. De Clerck et al using the bone-anchored maxillary protraction protocol, used 150g on each side in the initial phase, 200g after 1 month of treatment, and 250g after 3 months to avoid possible clinical failure. This new orthopedic approach produced significant skeletal changes [8].

SNA angle values in this study increased from 76.2-78.60 in the lateral cephalogram and 76.2º-78.80 in the CBCT suggesting an angulation increase due to the forward positioning of the point A and suggesting that maxillary protraction has successfully taken place.

Findings of our study was in agreement with the study done by Heymann and co-workers, where they assessed degree of maxillary protraction using CBCT following BAMP protocol and they observed an increase of 3.70 in the SNA angulation[5].

SNB anglulation changed from 80.8º-80.2º in the lateral cephalogram and CBCT in our study suggesting a decrease of 0.60 in these patients with maxillary protraction without much setback of the mandible. Since these cases were of maxillary deficiency and not mandibular excess. So a setback of 0.60 of point B can be considered to have occurred due to retaining effect of the miniplate on the mandible.

Linear measurement condyle to point A (CoA) has changed from 74 -76mm in the lateral cephalogram and 74 -76.2mm in the CBCT. This shows that the point A moved forward by 2mm in the lateral cephalogram and by 2.2mm in the CBCT, these values suggest that there was significant maxillary protraction.

Another linear measurement considered was Wits Appraisal, there was a change from -6.85mm to -2 mm in the lateral cephalogram and a decrease of -6.85 to -1.7mm in the CBCT. These values implies that point A moved forward by 4.85mm in the lateral cephalogram and 5.15mm in the CBCT.

Results shows that this modified treatment protocol produced significant maxillary protraction when pre and post- treatment lateral cephalogram and CBCT were compared. Findings of this study show that both the pre- treatment and post treatment values obtained using lateral cephalogram and CBCT were comparable. Although CBCT values were marginally more accurate than lateral cephalogram values, the difference found was not statistically significant. So, lateral cephalogram was foundto be as accurate as CBCT in assessing the maxillary protraction. Therefore, lateral cephalogram is a valuable tool for orthodontic diagnosis, treatment planning as well as in assessing the treatment progress in Class III patients. But, long term treatment changes and the accurate assessment of growth will beneeded to substantiate the long term stability for this treatment protocol.

A percentage of patients who might still require surgical correction after completion of facial growth need to be further assessed.

CONCLUSION

Significant maxillary protraction was achieved when pre and post treatment lateral cephalogram and CBCT were compared.

a. There was a significant increase in the SNA angle, suggestive of effective maxillary protraction.
b. This treatment protocol has a high success rate in comparison to conventional treatment protocol, since it does not depend on patient compliance and is aesthetically more acceptable.
c. The pre- treatment and post- treatment values obtained using lateral cephalogram and CBCT were comparable. So, lateral cephalogram was found to be as accurate as CBCT in assessing the maxillary protraction.

REFERENCES

1. Keles A, Tokmak EC, Erverdi N, Nanda R. Effect of varying the force direction on maxillary orthopedic protraction. Angle Orthod. 2002;72:387–396.
2. Şar Ç, Arman-Özçırpıcı A, Uçkan S, Yazıcı AC. Comparative evaluation of maxillary protraction with or without skeletal anchorage. American Journal of Orthodontics and Dentofacial Orthopedics. 2011 May 1;139(5):636-49.
3. Chugh VK, Tandon P, Prasad V, Chugh A. Early orthopedic correction of skeletal Class III malocclusion using combined reverse twin block and face mask therapy. Journal of Indian Society of Pedodontics and Preventive Dentistry. 2015 Jan 1;33(1):3.
4. Cevidanes L, Baccetti T, Franchi L, McNamara JA Jr, De Clerck H. Comparison of two protocols for maxillary protraction: bone anchors versus face mask with rapid maxillary expansion. Angle Orthod. 2010;80:799–806.
5. Heymann GC, Cevidanes L, Cornelis M, De Clerck HJ, Tulloch JC. Threedimensional analysis of maxillary protraction with intermaxillary elastics to miniplates. American Journal of Orthodontics and Dentofacial Orthopedics. 2010 Feb 1;137(2):274.
6. Ağlarcı C, Esenlik E, Fındık Y. Comparison of short-term effects between face mask and skeletal anchorage therapy with intermaxillary elastics in patients with maxillary retrognathia. European journal of orthodontics. 2015 Jul 27;38(3):313-23.
7. Cha BK, Choi DS, Ngan P, Jost-Brinkmann PG, Kim SM. Maxillary protraction with miniplates providing skeletal anchorage in a growing Class III patient. American Journal of Orthodontics and Dentofacial Orthopedics. 2011 Jan 1;139(1):99-112.

8. Morales-Fernández M, Iglesias-Linares A, Yañez-Vico RM, Mendoza-Mendoza A, Solano-Reina E. Bone-and dentoalveolar-anchored dentofacial orthopedics for Class III malocclusion: new approaches, similar objectives? A systematic review. The Angle orthodontist. 2012 Sep 26;83(3):540-52.

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