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Research Article

HARD AND SOFT TISSUE CHANGES ASSOCIATED WITH EXPANSION AND MAXILLARY PROTACTION IN CLASS III MALOCCLUSION

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A B S T R A C T

This study evaluated the treatment response of children with Class III malocclusions treated with rapid maxillary expansion and protraction therapy. The sample included 15 patients aged between 7- 14 years. Protraction force of 600 to 800 gram was applied and the patients were treated until a 2 mm positive overjet had been attained. Radiographs were taken before treatment (T1), immediately after face mask treatment (T2). The results showed that the maxilla was protracted forward by 2.3mm. The mandible was rotated downward and backward, while the lower incisors were retroclined. The Class III malocclusion and concave facial profile of the subjects were mainly corrected by skeletal and dentoalveolar improvements in the sagittal direction and to some extent by vertical movement / clockwise rotation of the mandible. Thus, the present study proves that Rapid Maxillary Expansion along with Maxillary Protraction is a suitable treatment modality for early correction of Class III Malocclusion.

INTRODUCTION

Class III malocclusions are considered to be among the most challenging ortho orthopaedic/ dontic problems encountered by the orthodontists. The prevalence of Class III malocclusions is around 1% to 5% in caucasian populations.[1,2] However, in Asian populations, the incidence of Class III malocclusion is as high as 14%.[3-5]A Class III malocclusion might be due to prognathic mandible, retrognathic maxilla, protrusive mandibular dentition, retrusive maxillary dentition, and/or combination of these components. It has been reported that two thirds of skeletal Class III malocclusions are due to either retrognathic maxilla or a combination of retrognathic maxilla and prognathic mandible. [6 -10] Ellis and McNamara found that 65-67% of all Class III malocclusions were characterized by maxillary retrognathism.[6] Maxillary protraction is recommended for skeletal Class III patients with maxillary deficiency.[11- 13]The developing skeletal Class III malocclusion is one of the most challenging problems confronting the orthodontist with respect to timing and mechanics of treatment. Many clinicians have attempted early interventional approach with appliances such as the protraction facemask, chin cup, or the frankel's functional reglator.

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Various studies have reported that using chin cup for the treatment of Class III malocclusion resulted in limited stability due to latent mandibular growth and a return to the pre-treatment condition. Recent studies suggest that a majority of Class III malocclusions have maxillary retrusion as the main component or at least part of the cause of Class III malocclusions. [14]

Class III malocclusions associated with deficient maxilla has been treated by Protraction facemask along with a maxillary expansion appliance. The use of a protraction facemask was first described more than 100 years ago with other modifications appearing in twentieth century. Delaire *et al*. revived the interest in using Protraction headgear for correction of Class III malocclusion. Basic concepts of Delaire was later modified by the Petit, by increasing the amount of force generated by the appliance, thus decreasing the overall treatment time.[14]Maxillary expansion is commonly needed in the treatment of patients with Class III malocclusion, because of insufficient maxillary arch width. Rapid maxillary expansion (RME) is typically used on young patients and has been shown to produce effects that favour Class III correction.[16, 17] Haas reported that RME produces a slight forward movement of Point A and a slight downward and forward movement of the maxilla. According to McNamara and Turly, RME may also serve to disrupt the maxillary suture

system and enhance the protraction effect of the face mask. [15-17]

MATERIALS AND METHODS

The sample consisted of 15 children (10 boys and 5 girls) aged between 7-14 years, who had a Class III malocclusion with an anterior crossbite and a component of maxillary deficiency. None of the children had cleft lip or cleft palate. The sample included patients treated rapid maxillary expansion followed by maxillary protraction and who met the following criteria:

1. Skeletal Class III pattern with Negative/Zero overjet.
2. ANB angle of zero degree or less.
3. Age group of 7 to 14 years of age at the time of starting orthodontic/ orthopaedic treatment without the history of previous orthodontic treatment.
4. Patients who consented to undergo proposed treatment modality.

Two radiographs were evaluated: The first was taken before the beginning of treatment (T1); the second was taken immediately after face mask and expansion therapy. (T2)The mean age at the beginning of treatment was 9 years 7 months, with a range from 7 years to 14 years. The mean treatment time was 9 months, with a range from 3 months to 15 months. The treatment time varied as a result of patient compliance, severity of the problem, and response of the patient to treatment.

Treatment Regiment

All the patients were treated with a combination of rapid maxillary expansion followed by protraction face mask and until at least 2 mm positive overjet was achieved. Bonded HYRAX appliances were used which covered the posterior teeth bilaterally or extended upto deciduous canines depending upon presence / absence of deciduous molars. The intraoral hooks were soldered to the buccal surface of the metal framework. The Parent of the patient activated the expansion screw up to the desired amount of expansion needed by following the Activation schedule as proposed by Zimring & Isaacson. The amount of expansion necessary was determined clinically based on buccal crossbite. The facemask was adjusted to rest on the forehead and the chin of the patient. Elastics (5⁄16 inch by 14 ounces) were worn from hooks located 2 to 3 cm in front of the lips to the intraoral attachments located on the expansion appliance, approximately at the gingival level of the canine. The force generated by the elastics were measured using Correx Guage such as to apply 600 to 800 grams of force bilaterally.

Cephalometric Analysis

Modified Pancherz analysis as described by Illing *et al*.[18] was used for cephalometric analysis. The lateral cephalograms were traced on acetate matte tracing paper of 0.003 inch using a 0.3mm 3H lead pencil. All tracings and measurements were done by the same investigator. The post-treatment radiographs were superimposed on the pre-treatment radiograph to evaluate treatment changes. Twenty-seven linear and angular measurements were used to evaluate the treatment changes. Horizontal and vertical movements were evaluated parallel and perpendicular to a reference plane registered on sella.

Statistical Analysis

The mean and standard deviation of each variable was calculated and subjected to Paired t- test/Wilcoxon Signed Ranks test. If the p value is less than 0.05, then it was considered that the change is significant.

RESULTS

The data was collected from pre-treatment (T0) and post functional (T1) lateral cephalograms of 15 patients treated by protraction headgear with rapid maxillary expansion using 27 variables (includes 20 linear measurements and 7 angular measurements). Paired t- test or Wilcoxon Signed Ranks test were applied to interpret the results, which are tabulated as follows:

Skeletal parameters

Maxillary jaw base (Point-A/ TVLs) increased by 2.3mm, which was statistically highly significant (P value =0.002) and Mandibular jaw base (Pog/ TVLs) increased by 1.1mm, which was statistically non-significant (P value =0.338). Mandibular length (Pog/ TVLs+ Co/ TVLs) increased by 10.6mm, which was statistically non-significant (P value =0.002). Facial angle increased by 2.1 degree, which was statistically non-significant (P value =0.279). Changes in Position of the maxillary jaw base relative to Nasion (Point A to N perpendicular) was 2.2mm, which was statistically highly significant (P value =0.001). Angle of inclination increased by 0.467degree, which was statistically non-significant (P value =0.612). Lower Anterior facial height increased by 4.73mm, which was statistically very highly significant (P value <0.001).

Dental parameters

Maxillary Anteriors moved forward by 4.9 mm, which was statistically very highly significant (P value <0.001) with Angulation of upper incisor increased only by 0.6 degree, which was statistically non-significant (P value = 0.764). Lower Incisors moved distally by 2.5mm, which was statistically significant (P value =0.025), with angulation of lower incisor decreased by 6.6 degree, which was statistically highly significant (P value = 0.003).

Overall Changes in Overjet was 6.2mm, which was statistically very highly significant (P value <0.001*). Maxillary permanent first molars moved forward by 6.1 mm, which was statistically highly significant (P value = 0.009). and mandibular permanent first molar moved forward only by 0.1 mm, which was statistically non-significant (P value = 0.959). Molar relationship showed overall correction of 5.0 mm, which was statistically highly significant (P value = 0.002).

Soft tissue parameters

Change in Nasolabial angle values was 1.7 degree, which was statistically non-significant (P value = 0.542) and Labiomental angle decreased by 6.7 degree, which was also statistically non-significant (P value = 0.134). Also, Z angle, decreased by 1.2 degree, which was statistically non- significant (P value 0.498). Upper sulcus depth decreased by 0.267mm, which was statistically non- significant (P value = 0.658), while lower sulcus depth also decreased by 1.1mm, which was statistically significant (P value = 0.021).

The patients showed significant changes in maxillomandibular relations throughout the observation periods (Tables I and II). The maxilla was displaced anteriorly, whereas there was no significant restraining effect on mandibular growth. Maxillomandibular showed significant improvements during

the treatment period, with changes primarily due to the increase in the Maxillary length. The dental measurements showed a tendency for the proclination of upper incisors and significant retroclination of lower incisors. Upper or lower molar angulations did not change significantly during treatment (Table II). The linear measurements more clearly showed that the maxilla moved anteriorly and inferiorly. (Table I) The Lower Anterior facial height increased significantly. The horizontal changes in mandibular position during treatment were not statistically significant. The most significant soft tissue change was increase in Lower sulcus depth, whereas other soft tissue parameters did not show any significant changes during the treatment period. (Table III)

DISCUSSION

Cephalometric analysis of the data revealed that the effects of treatment vary among different parts of the craniofacial complex. The treatment enhanced forward and downward movement of the maxilla, as noted by forward movement of Point A. This direction of movement is desirable for Class III correction and is a result of applying protraction forces from a more anterior part of the maxillary dentition. Previous studies have shown that posteriorly directed forces have been shown to cause the deleterious effect of upward and forward rotation of the nasal floor in maxillary protraction.[19] The treatment also induced a forward movement of the maxillary molars and incisors with little change in the incisal angle.

In the mandible, no significant change was observed in the length of the mandible indicating that treatment did not have any significant inhibitory growth effect on the mandible. It was observed that the lower incisors retroclined after protraction therapy. It is postulated that this effect occurs as a result of the pressure exerted by the chin cup and soft tissues. This is in accordance with studies done by Ngan *et al*., Kim *et al*. and Arman *et al*.[20]

The Class III malocclusion and concave facial profile of the subjects were mainly corrected by skeletal and dentoalveolar improvements in the sagittal direction and to some extent by vertical movement / clockwise rotation of the mandible.

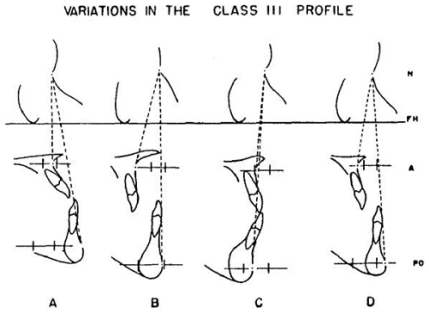
CONCLUSIONS

The findings of the present cephalometric study to assess the skeletal, dentoalveolar, and soft-tissue effects of orthopaedic therapy for correction of Skeletal Class III malocclusion by means of maxillary expansion and protraction are:

a. Facemask therapy is effective in treatment of Class III malocclusion with maxillary deficiency.
b. Skeletal changes observed are forward movement of maxilla and the downward and backward rotation of the mandible with a decrease in prognathism, resulting in favourable changes in the facial profile.
c. Dentoalveolar changes are mainly forward movement of the maxillary molars and incisors, linguoversion of the lower incisors with very little changes in the axial inclination of upper incisors.
d. There were no significant changes in the soft tissues except for an increase in Lower sulcus depth.

Clinical Significance

The present study proves that Rapid Maxillary Expansion along with Maxillary Protraction is a suitable treatment modality for early correction of Class III Malocclusion, which helps in reducing the severity of malocclusion, along with reducing the need for surgical intervention at later stages of life.



A: Normal Maxilla And Prognathic Mandible, **B:** Maxillary Retrusion and Normal Mandible, **C:** Normal Maxilla And Mandible, **D:** Maxillary Retrusion And Prognathic Mandible.

Fig I Tracings of Different Types of Class III Profiles**.**

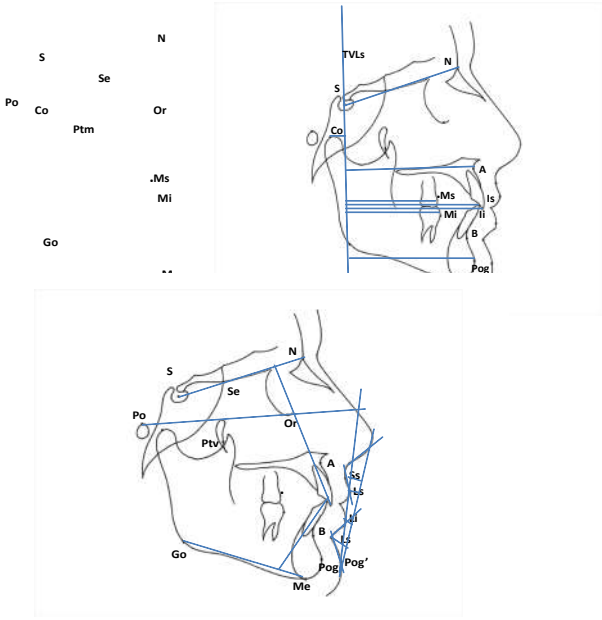


Fig II Dentoskeletal and Soft Tissue Landmarks Used in the Cephalometric Analysis

Table I Comparison of Skeletal Parameters

Skeletal Parameters		Mean	Std Dev	Mean Difference	t/z	P-Value
Position of the maxillary jaw base	Pre	63.33	8.47	-2.333	-3.845	0.002*
	Post	65.67	8.93			
Position of the mandibular jaw base	Pre	65.53	10.72	1.067	0.992	0.338
	Post	64.47	11.10			
Mandibular length	Pre	78.40	12.27	1.067	1.524	0.150
	Post	77.33	12.57			
Facial angle†	Pre	88.27	4.08	2.133	-1.082	0.279
	Post	86.13	22.43			
Point A to N perpendicular	Pre	5.80	2.46	2.200	4.404	0.001*
	Post	3.60	1.88			
Angle of inclination	Pre	89.93	4.61	-0.467	-0.519	0.612
	Post	90.40	3.07			
L.A.F.H	Pre	61.80	12.64	-4.733	-7.625	<0.001*
	Post	66.53	13.18			

† Wilcoxon Signed Ranks test * significant difference

Table 2 Comparison of Dental Parameters

Dental Parameters		Mean	Std Dev	Mean Difference	t	P-Value
Is to TVLs (mm)	Pre	66.60	9.77	-4.867	-8.569	<0.001*
	Post	71.47	10.25			
Li to TVLs	Pre	69.00	10.01	1.467	2.509	0.025*
	Post	67.53	10.38			
Overjet	Pre	3.00	1.69	-6.200	-12.412	<0.001*
	Post	9.20	2.62			
Position of max. incisor	Pre	4.80	3.08	-1.933	-2.660	0.019*
	Post	6.73	2.94			
Position of mand. incisor	Pre	4.13	2.67	0.467	0.502	0.624
	Post	3.67	3.44			
Ms to TVLs	Pre	37.80	8.63	-5.867	-5.235	<0.001*
	Post	43.67	8.03			
Mi to TVLs	Pre	43.13	8.49	-0.400	-0.526	0.607
	Post	43.53	9.32			
Position of max. permanent. molar to maxilla	Pre	28.27	9.87	6.133	3.031	0.009**
	Post	22.13	4.00			
Position of mand. permanent molar to maxilla	Pre	22.40	4.39	0.067	0.053	0.959
	Post	22.33	6.03			
Molar Relation	Pre	7.13	3.54	3.667	3.783	0.002**
	Post	3.47	2.72			
Angulation of upper incisor *(U1 – SN)* (deg)	Pre	109.27	11.76	-0.600	-0.306	0.764
	Post	109.87	8.53			
Angulation of lower incisor(IMPA) (deg)	Pre	85.80	7.45	6.067	3.623	0.003*
	Post	79.73	8.71			

† Wilcoxon Signed Ranks test * significant difference

Table 3 Comparison of Soft Parameters

Soft Tissue Parameters		Mean	Std Dev	Mean Difference	t/z	P-Value
Nasolabial angle (deg)	Pre	93.00	16.44	1.733	0.625	0.542
	Post	91.27	15.98			
Labiomental angle (deg)	Pre	128.67	12.56	6.733	1.589	0.134
	Post	121.93	16.62			
Z angle (deg)	Pre	69.27	11.62	1.200	0.696	0.498
	Post	68.07	8.48			
Upper sulcus depth	Pre	10.47	3.87	0.267	0.452	0.658
	Post	10.20	2.73			
Lower sulcus depth	Pre	3.80	1.93	-1.133	-2.605	0.021*
	Post	4.93	2.46			
Position of labrale superior†	Pre	4.67	3.64	-1.067	-1.101	0.271
	Post	5.73	5.92			
Position of labrale inferior†	Pre	2.93	2.25	0.000	-0.394	0.694
	Post	2.93	3.31			

† Wilcoxon Signed Ranks test * significant difference

Bibliography

1. Haynes S. The prevalence of malocclusion in English school children aged 11-12 years. Trans Eur Orthod Soc 1970; 89-98.
2. Thilander B, Myrberg N. The prevalence of malocclusion in Swedish schoolchildren. *European Journal of Oral Sciences*. 1973; 81 (1):12–20.
3. Iwagaki H. Hereditary influence of malocclusion. *American Journal of Orthodontics and Oral Surgery*. 1938;24 (4):328–36.
4. Allwright WC, Burndred WH. A survey of handicapping dentofacial anomalies among Chinese in Hong Kong. Int Dent J 1964;14:505-19.
5. Irie M, Nakamura S. Orthopedic approach to severe skeletal Class III malocclusion. *American Journal of Orthodontics*. 1975;67(4):377–92.
6. Ellis E, Mcnamara JA. Components of adult Class III open-bite malocclusion. *American Journal of Orthodontics*. 1984;86(4):277–90.
7. Nanda R. Biomechanical and clinical considerations of a modified protraction headgear. *American Journal of Orthodontics*. 1980;78(2):125–39.
8. Sanborn, R. T. Differences between the facial skeletal patterns of Class III malocclusion and normal occlusion. Angle Orthod 1955. 25:208–222.
9. McNamara JA, Brudon WL. Orthodontic and orthopedic treatment in the mixed dentition. 1st ed. Michigan: Needham Press; 1993. :285-93.
10. Guyer EC, Ellis EE 3rd, McNamara JA Jr, Behrents RG. Components of class III malocclusion in juveniles and adolescents. Angle Orthod. 1986 Jan;56(1):7-30.
11. Sakamoto T, Iwase I, Uka A, Nakamura S. A roentgenocephalometric study of skeletal changes during and after chin cup treatment. *American Journal of Orthodontics*. 1984;85(4):341–50.
12. Ritucci R, Nanda R. The effect of chin cup therapy on the growth and development of the cranial base and midface. *American Journal of Orthodontics and Dentofacial Orthopedics*. 1986;90 (6):475–83.
13. Sugawara J, Asano T, Endo N, Mitani H. Long-term effects of chincap therapy on skeletal profile in mandibular prognathism. American Journal of Orthodontics and Dentofacial Orthopedics. 1990;98 (2):127–33.
14. Ngan P. Cephalometric and occlusal changes following maxillary expansion and protraction. *The European Journal of Orthodontics*. 1998Jan;20(3):237–54.
15. Oppenheim A. A possibility for physiologic orthodontic movement. *American Journal of Orthodontics and Oral Surgery*. 1944;30(6):277–328.
16. Haas AJ. Palatal expansion: Just the beginning of dentofacial orthopedics. *American Journal of Orthodontics*. 1970;57(3):219–55.
17. Bishara SE, Staley RN. Maxillary expansion: Clinical implications. *American Journal of Orthodontics and Dentofacial Orthopedics*. 1987;91(1):3–14.
18. Illing H. A prospective evaluation of bass, bionator and twin block appliances. Part I - the hard tissues. *The European Journal of Orthodontics*. 1998Jan;20(5):501–16.
19. Ishii H, Morita S, Takeuchi Y, Nakamura S. Treatment effect of combined maxillary protraction and chincap appliance in severe skeletal Class III cases. *American Journal of Orthodontics and Dentofacial Orthopedics*. 1987;92(4):304–12.
20. Kilic N, Catal G, Kiki A, Oktay H. Soft tissue profile changes following maxillary protraction in Class III subjects. *The European Journal of Orthodontics*. 2010Jun;32 (4):419–24.

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