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A Cephalometric Evaluation Of Skeletal, Dental And Soft Tissue Changes After Orthopaedic Treatment Of Class III Malocclusion With Rapid Maxillary Expansion And Facemask Among 8-12 Year Old Children.

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Background & Objectives
Young patients with skeletal Class III malocclusion due to maxillary deficiency are treated effectively using combined Rapid Maxillary Expansion (RME) and Protraction Facemask therapy. The aim of this cephalometric study is to evaluate the skeletal, dental and soft tissue changes following six months of RME and facemask therapy in skeletal class III patients of 8-12 years.
Methods
The study sample consisted of pre and post-treatment lateral cephalograms of patients with skeletal class III malocclusion due to maxillary deficiency treated using RME and facemask therapy. There were a total of 46 lateral cephalometric radiographs used in the study; which included pre and post- treatment radiographs of 12 male and 11 female patients. The paired t test was used to evaluate the effect of RME and facemask therapy.
Results and Discussion
The skeletal changes showed that the craniofacial patterns have achieved a more orthognathic profile after treatment. There was a mean increase in SNA and N perpendicular to A point by 1.30° and 2.01 mm ($p < 0.001$) respectively following RME facemask therapy. The mean change in SNB and N perpendicular to pogonion was -1.57° and -2.93 mm ($p < 0.001$) respectively. A statistically significant increase in effective maxillary and mandibular length of 2.77 mm and 1.09 mm ($p < 0.001$) was obtained in this study. The maxillo-mandibular relations improved and there was highly significant change in ANB, Wits appraisal and Beta angle ($p < 0.001$). There was significant increase in vertical growth pattern and upper incisor proclination whereas the lower incisor retroclined significantly after treatment ($p < 0.001$). There was significant increase in Ls – E line by 1.48 mm ($p < 0.001$) but the Li – E line and
nasolabial angle showed a significant decrease of 1.67 mm and 3.69° ($p < 0.001$) respectively following RME facemask therapy.
Conclusion
RME facemask therapy significantly improved the skeletal, dental and soft tissue relationships in patients with Class III skeletal malocclusion.
Key words: *Class III malocclusion; Maxillary deficiency; Rapid maxillary expansion; Facemask; Maxillary protraction.*

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I. Introduction

Class III skeletal malocclusion is one of the most difficult problems to treat in the mixed dentition period. It has a multi-factorial etiology, involving both genetic and environmental. The clinical presentation of skeletal class III malocclusion has a wide spectrum ranging from edge to edge bite to a large negative overjet, with extreme variations of underlying skeletal jaw bases; ie, mandibular progathism, maxillary deficiency or combination of both. The patients with skeletal Class III malocclusion typically presents with a concave profile and mid-face retrusion of the naso-maxillary area(1)(2).

The indications for treatment of early class III malocclusion are preventing progressive, irreversible, soft tissue or bony change, improving occlusal function, correcting skeletal discrepancies, minimizing the need for orthognathic surgery and providing more pleasing facial esthetics; thus, enhancing the psycho-social development of a child(3). The management of developing Class III malocclusion remains one of the most challenging problems confronting the practicing dentist. Treatments in the permanent dentition can be relatively easy when the problem is confined to the alveolar bone. However, when the deformity affects basal bones, such

as with a deficient maxilla, an overgrowth of the mandible, or a combination of both, then our treatment options are greatly reduced.

The treatment strategies in class III malocclusion are :

1. Interception of problems through dento-facial orthopaedics. (Protraction facemask , FR-III, Reverse twin block, Class III bionator, chin cup)
2. Camouflage treatment.
3. Orthognathic surgery (undertaken when growth is completed).

Until 1970s, treatment of class III malocclusion was mainly directed at surgical correction of maxilla or the mandible, as it was believed that these malocclusions were beyond the boundaries of orthodontic and orthopaedic treatment. Recent studies, however, have shown significant improvement in class III patients with the use of protraction headgear(4)(5)(6)(7).

It is found that benefits of early intervention which essentially are aimed to restrain the growth of mandible and sagittal forward movement of the maxilla may certainly lessen the severity of deformity. In some instances, it may even eliminate the need for orthognathic surgery. The benefits derived from a protraction phase of treatment may be normalization of sagittal maxillary position and hence need for surgery on maxilla may be eliminated and thereby converting a two jaw surgery case , i.e. maxilla and mandible to one jaw (mandible) alone. This is indeed a great benefit to the patient. Several animal experiments also have shown that due to maxillary protraction the entire maxilla is displaced anteriorly(8). The optimal time to begin class III treatment is in the early mixed dentition period.

Rapid maxillary expansion (RME), a technique born more than a century ago was first introduced by Emerson C Angell(9). RME along with Reverse Pull Headgear (RPHG)/ Facemask therapy is accepted as the cornerstone of early orthopaedic interception in developing skeletal Class III cases(10)(11)(12). Maxillary expansion is an important part of protraction with facemask as it disarticulates the circum-maxillary suture; which results for more pronounced orthopaedic effects. The average protraction by using RME/RPHG is reported to be 1.5-3 mm in 10-12 months(12)(13).

The orthopedic facemask system has three basic components. The facemask, a bonded maxillary splint, and elastics. In essence, the facemask of Petit type is composed of a forehead pad and a chin cap that are connected by a heavy steel support rod. To this support rod is connected a cross bow to which are attached rubber bands to produce a forward and downward elastic traction on the maxilla. The position of the pad / cap and crossbow can be adjusted simply by loosening and tightening the screws within each part of the appliance.

At the first appointment when maxillary bonded or banded expander is inserted, neither expansion nor protraction facemask is commenced. This will allow the patient to become accustomed to the appliance. Rapid maxillary expansion and protraction can be started at the second appointment. The rate of expansion is 0.5mm/day i.e. one quarter turn twice daily. Most clinicians suggest one week of expansion prior to starting protraction. According to the literature, the combination of maxillary expansion with the use of protraction headgear will increase the amount of skeletal effect(14). The expansion is stopped after one week if posterior cross bite did not exist or when overcorrection of the transverse problem has been achieved. Schedule of facemask wear is on an average of 10-12 hours maximum although it is recommended for 14 hours use. Generally, force in the range of 350-450 grams / side is used(4).

The skeletal and dento-alveolar effects of facemask treatment includes maxillary skeletal protraction, forward movement of the maxillary dentition, counter-clockwise rotation of the palatal plane, labial tipping of the maxillary incisors, inhibition of anterior mandibular growth, augmentation of face height, clockwise rotation of the mandible and lingual tipping of the lower incisors. The combination of these changes improves the maxillo-mandibular jaw relation and the occlusal balance of the upper and lower dentition. The soft tissue changes included forward movement of the nose and upper lip, and a downward movement of the menton. The contra-indications of rapid maxillary expansion with facemask therapy includes single tooth crossbite, anterior open bite, vertical growers with steep mandibular plane angle, skeletal asymmetry, weak periodontium and poor patient co-operation.

The aim of this cephalometric study is to determine the skeletal, dental and soft tissue changes associated with rapid maxillary expansion and maxillary protraction with facemask therapy in patients with class III malocclusion.

II. Materials And Methods

This record based cross-sectional study was conducted in the Department of Pedodontics and Preventive Dentistry, Govt. Dental College, Kozhikode, Kerala on lateral cephalograms of a sample of skeletal Class III patients with retrusive maxilla. Prior approval from the Institutional Ethics Committee was obtained for the study.

The study sample consisted of pre and post-treatment lateral cephalograms of patients with skeletal class III malocclusion due to maxillary deficiency treated using RME and facemask therapy. The cephalograms

were obtained from pre-treatment records of the Department of Pedodontics and Preventive Dentistry, Govt. Dental College, Kozhikode, Kerala. The minimum sample size for the study was calculated to be around 23.

Pre and Post-treatment lateral cephalograms of patients aging 8-12 years with following features were included in the study:

1. Skeletal class III malocclusion with maxillary deficiency indicated by ANB < 0°
2. Wits appraisal of < - 4mm.
3. Cervical Vertebrae Maturation Indicators (CVMI) Stage - Lateral cephalograms of patients below CS3 group.

Poor quality radiographs and radiographs with congenitally missing teeth were excluded from the study.

For each patient, the first lateral cephalogram was taken at the initiation of protraction headgear treatment (T1). A second radiograph was taken 6 months after protraction headgear treatment (T2). Thus (T2-T1) represented the effect as a result of appliance therapy. Thus the total time period of the study was 6 months for each sample.

Table 1:- Total number of males and females and age of the sample

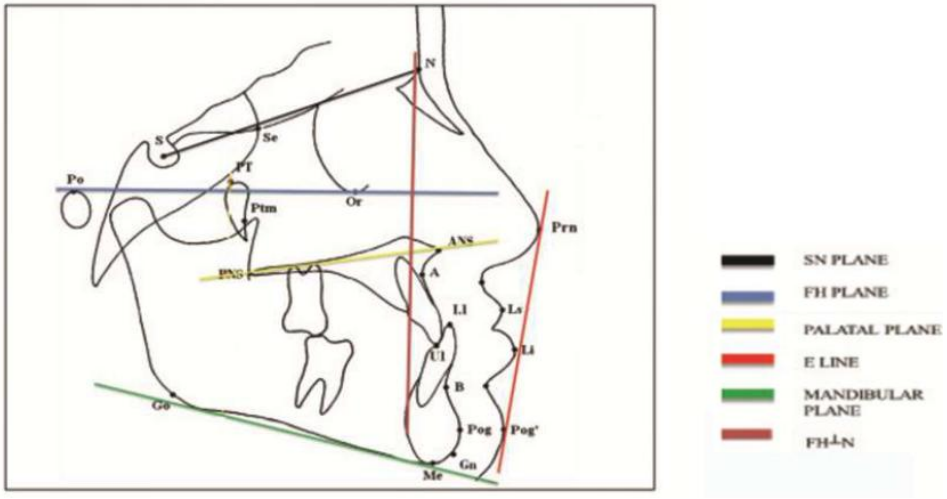
Sex	Total number	Average Age (years)	Mean age of the sample (years)
Males	12	9.5	9.6
Females	11	9.72	

All lateral cephalometric radiographs of patients were taken with Frankfurt Horizontal plane parallel to the floor, lips in relaxed position, the teeth in maximum intercuspal position and with the patient in the end inspiration phase of respiration. All the radiographs were taken by the trained radiographic technician of the institution using the same Cephalostat in a standardized manner. The Plan Meca 2002 CC Proline Cephalostat was used.

Lateral cephalograms were hand traced onto 0.003 inch transparent cellulose acetate matte tracing sheet by the same investigator under optimal illumination. The soft tissue outline was traced first followed by the hard tissue outline using 0.35 mm 3HB lead pencil. All the selected reference points were first identified, located and then marked. The selected reference planes were drawn and where the bilateral structures cast double shadows on the film, the technique of averaging the bilateral images was followed. Any disparities were addressed by retracing the structure. A total of 21 skeletal, dental and soft tissue parameters were evaluated which included 10 linear and 11 angular measurements.

All the statistical analyses were performed using SPSS statistical package (version 18) (SPSS Inc., Chicago III) for windows. The analyses performed were the **Paired't' test** to quantify the changes before and after treatment with RME and facemask.

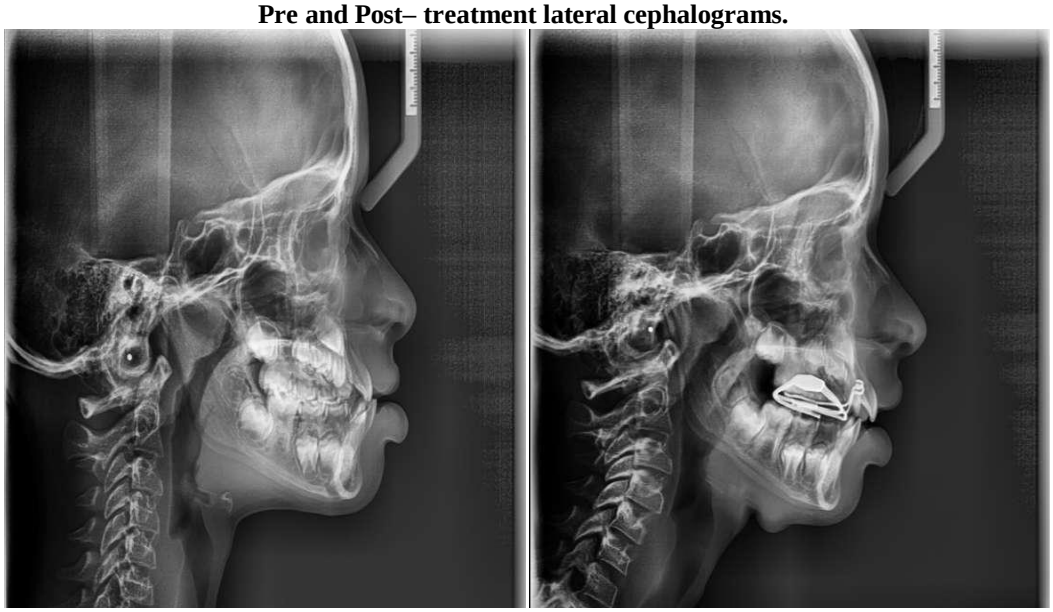
Cephalometric landmarks and planes used in the study



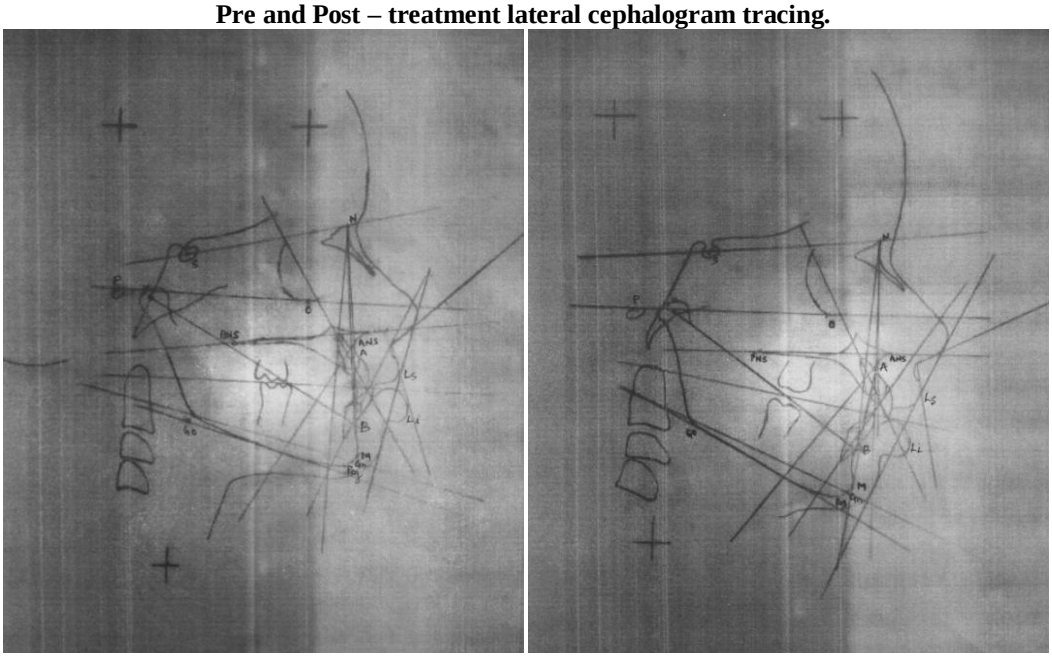
Cephalometric parameters used in the study

Maxillary sagittal relationships (skeletal). • SNA (°) • N perpendicular to Point A (mm) • Co – A point (mm) **Mandibular sagittal relationships (skeletal).** • SNB (°) • Co-Gn (mm) • N perpendicular to Pogonion (mm) **Intermaxillary relationships.** • ANB (°) • Wits appraisal (mm) • Beta angle (°) **Vertical relationships.** • FMA angle (°) • SN to Go-Gn (°) • Jarabak ratio	**Inclination of maxillary dentition** • Upper incisor to N-A (°) • Upper incisor to A-Pog (mm) • Upper incisor to palatal plane (°) **Inclination of mandibular dentition** • Lower incisor to N-B (°) • Lower incisor to A-Pog (mm) • Lower incisor to mandibular plane (IMPA) (°) **Soft tissue relationships** • Ls-E line (mm) • Li- E line (mm) • Nasolabial angle (°)

Pre and Post– treatment lateral cephalograms.



Pre and Post – treatment lateral cephalogram tracing.



III. Results

There were a total of 46 lateral cephalometric radiographs used in the study; which included pre and post- treatment radiographs of 12 male and 11 female patients. The mean age of the entire sample (age of patients whose lateral cephalograms was used in the study) was calculated to be 9.6 years.

The skeletal changes showed that the craniofacial patterns have achieved a more orthognathic profile after treatment. The maxilla was protracted significantly forward (SNA -+1.3^0, N perpendicular to A point - +2 mm) and there was significant increase in the maxillary length (Co-A point) by +2.76 mm. Whereas the mandible was positioned backward significantly (SNB - -1.6^0, N perpendicular to Pog - -2.9 mm); but there was also significant increase in the mandibular length (Co-Gn) by +1.08 mm.

Maxillo-mandibular relations improved and there was significant change in ANB, Wits appraisal and Beta angle. The ANB angle and Wits appraisal was increased by 2.7^0 and 2.2 mm respectively ; while Beta angle was decreased by 2.9 mm. The vertical relationship was also significantly increased as evidenced by increased FMA and SN to Go – Gn angles by 2.9^0 and 3.1^0 respectively. The Jaraback ratio was found to decrease by 1.9, which also suggests an increased vertical growth pattern after treatment.

Favourable dental changes were achieved following RME and facemask therapy. The U1 to NA angle and U1to palatal plane angle was significantly increased by 2.8^0 and 3.3^0 respectively and U1 to A Pog length was also increased significantly by 2 mm. Whereas the L1 to NB angle and IMPA was significantly reduced by 2.6^0 and 3.2^0 respectively and L1 to A Pog length was also reduced significantly by 1.6mm. Thus it was seen that there was considerable increase in the inclination of maxillary dentition and decrease in the inclination of mandibular dentition following RME and facemask therapy.

The soft tissue changes following RME and facemask therapy was also significantly favourable. The Ls- E line length was significantly increased by 1.5mm while the Li- E line length was significantly reduced by 1.7mm. The Nasolabial angle was found to be reduced significantly by 3.7^0. Thus it was concluded that the upper lip moved forward; while the lower lip moved backwards following RME and facemask therapy.

Table 2 : Skeletal changes that occurred following RME facemask therapy for six months

Sl. No.	Parameter	Pre-treatment Mean,T1 (S.D)	Post-treatment Mean,T2 (S.D)	Mean difference, T2-T1 (S.D)	t , df	P value (Significance)
1.	SNA	78.7 (2.5)	80.0 (2.8)	1.3 (1.0)	6.1, 22	<0.001
2.	N ⊥to Pt A	-4.5 (3.6)	-2.5 (3.6)	2.0 (1.7)	5.7, 22	<0.001
3.	Co-A point	81.0 (6.0)	83.8 (6.1)	2.8 (1.9)	7.1, 22	<0.001
4.	SNB	82.0 (2.2)	80.5 (2.1)	-1.6 (1.1)	6.6, 22	<0.001
5.	Co – Gn	109.1 (8.7)	110.2 (8.9)	1.1 (1.0)	5.1, 22	<0.001
6.	N ⊥to Pog	-0.5 (7.4)	-3.4 (7.2)	-2.9 (2.0)	6.7, 22	<0.001
7.	ANB	-3.3 (1.3)	-0.7 (2.0)	2.7 (1.3)	9.9, 22	<0.001
8.	Wits Analysis	-8.0 (2.5)	-5.9 (2.7)	2.2 (1.2)	8.7, 22	<0.001
9.	Beta angle	40.7 (3.3)	37.8 (4.2)	-2.9 (1.7)	8.1, 22	<0.001
10.	FMA	29.0 (4.4)	31.9 (4.5)	2.9 (2.1)	6.6, 22	<0.001
11.	SN to Go-Gn angle	33.7 (4.2)	36.8 (4.4)	3.1 (1.9)	7.9, 22	<0.001
12.	Jarabak ratio	63.4 (3.5)	61.5 (2.9)	-1.9 (1.4)	6.4, 22	<0.001

P value <0.001- Statistically highly significant.

Table 3 : Dental changes that occurred following RME facemask therapy for six months

Sl. No.	Parameter	Pre-treatment Mean,T1 (S.D)	Post-treatment Mean,T2 (S.D)	Mean difference, T2-T1 (S.D)	t , df	P value (Significance)
1.	U1 to NA angle	28.1 (3.8)	30.9 (3.7)	2.8 (1.6)	8.3, 22	<0.001
2.	U1 to A Pog	5.7 (2.0)	7.7 (2.0)	2.0 (1.1)	9.0, 22	<0.001
3.	U1 to Palatal plane angle	116.7 (4.7)	120.0 (4.3)	3.3 (2.0)	7.7, 22	<0.001
4.	L1 to NB angle	27 (5.3)	24.4 (5.6)	-2.6 (2.3)	5.4, 22	<0.001
5.	L1 to A Pog	8.2 (2.3)	6.6 (2.2)	-1.6 (0.9)	7.8, 22	<0.001
6.	IMPA	90.5 (6.9)	87.3 (6.5)	-3.2 (2.7)	5.6, 22	<0.001

P value <0.001- Statistically highly significant.

Table 4 : Soft tissue changes that occurred following RME facemask therapy for six months

Sl. No.	Parameter	Pre-treatment Mean,T1 (S.D)	Post-treatment Mean,T2 (S.D)	Mean difference, T2-T1 (S.D)	t , df	P value (Significance)
1.	Ls – E line	-2.5 (2.2)	-0.9 (1.9)	1.5 (0.9)	7.6, 22	<0.001
2.	Li – E line	4.8 (2.5)	3.1 (2.4)	-1.7 (1.2)	6.9, 22	<0.001
3.	Nasolabial angle	95.1 (10.3)	91.4 (9.5)	-3.7 (2.1)	8.3, 22	<0.001

P value <0.001- Statistically highly significant.

IV. Discussion

The treatment of Class III malocclusion poses one of the most difficult tasks for the dentist. The different treatment options for management of class III malocclusion are growth modification, camouflage or surgery. Growth modification mainly involves maxillary protraction or mandibular growth restriction. Maxillary protraction is usually done by rapid maxillary expansion along with facemask therapy. A meta-analysis(15) of clinical studies that used facemasks was undertaken to determine the most convenient time to employ this treatment method. The authors found major orthopaedic alterations in younger patients. In summary, maxillary protraction may be effective during the period in which the maxillary sutures are still open. Major orthopaedic

changes can be achieved and retained in permanent dentition as long as the face mask treatment happens in the deciduous or early mixed dentition(16).

The current study evaluated the skeletal, dental and soft tissue changes with bonded RME and facemask therapy. A sample of 46 lateral cephalometric radiographs of twenty three patients were taken and pre treatment and post treatment lateral cephalograms were traced and compared. The mean age of the sample was 9.6 years and the treatment duration for all patients were 6 months. Although the treatment goal when using a face mask is to displace the maxilla forward by applying force to the circum-maxillary sutures, there are skeletal and dental changes with forward displacement of the maxilla, maxillary incisors flaring, downward and backward mandibular rotation and, finally, lingual inclination of mandibular incisors(17) (18) (19).The orthopaedic alterations are responsible for 75% of the correction (25% dental) with maxillary advancement representing 75% of the skeletal correction (25% due to downward and backward mandibular rotation)(12). In comparison with the average, the results of this research are in agreement with other findings in the literature.

This study showed significant sagittal advancement of maxilla following RME facemask therapy with a mean increase in SNA of 1.3^0. The result was very similar to those obtained from various previous studies. All facemask studies conducted in different age groups showed significant increase in SNA, though the amount of SNA change varied. A study by Kapust et al(5) showed that 4 -7 age group class III patients who were treated for one year with RME facemask therapy had 3.71^o increase in SNA, while 7-10 and 10-14 age groups had 1.98^o and 1.89^o increase in SNA. It can also be concluded by analyzing various studies that SNA change depends on many factors like the age, force of protraction and duration of protraction. More duration of force in a smaller age group brings about more change in SNA.

A significant increase of 2.0 mm was found in N perpendicular to A point following RME facemask therapy. It shows that the maxilla has linearly moved forward. Kapust et al (5) found that the increase in N perpendicular to A point in three different age groups were 3.3 mm, 2.3 mm and 1.28 mm (in 4-7, 7-10 and 10-14 respectively) following RME facemask therapy. In this study, there was an increase in maxillary length (Co-A point) of 2.8 mm and the change was statistically significant. Significant increase in maxillary length was found in various studies. The mean change in SNB obtained from this study was -1.57^0 indicating that the mandible rotated backwards and the result was statistically significant. Kapust et al (5) study on different age groups showed mean decrease in SNB of 1.19^o, 2.07^o and 1.15^o in 4-7, 7-10 and 10-14 age groups respectively following facemask therapy along with expansion. The study showed an increase in the effective mandibular length (Co-Gn) by 1.01 mm. A significant decrease of -2.93 mm was found in Nasion perpendicular to Pogonion following RME facemask therapy; and this was in agreement with previous studies. Though there was increase in mandibular length, SNB and Nasion perpendicular to Pogonion significantly decreased indicating a backward rotation of the mandible after treatment with RME and facemask.

The mean difference in ANB was 2.67^0 and this was statistically significant. The mean average improvement of Wits appraisal obtained from the study was 2.21 mm and the result was statistically significant. Beta angle is a relatively new parameter introduced by Chong YolBaik(20) to find out sagittal skeletal discrepancies. Very few studies have evaluated this parameter for quantifying skeletal class III correction. A mean beta angle change of 3.9^0 was obtained in this study following RME facemask therapy. ANB, Wits appraisal and beta angle changes showed that following facemask therapy maxillomandibular changes took place and significant skeletal class III correction occurred. Concavity decreased and there was improvement in the profile.

The FMA angle and SN to Go – Gn angle was increased by 2.9^0 and 3.1^0 respectively in this study following RME facemask therapy ; indicating an increased vertical growth tendency. Jarabak ratio, which determines the percentage of the anterior and posterior facial proportions was also evaluated in this study. The higher the ratio greater is the vertical deficiency of the face and vice versa. Usually a ratio of less than 62% expresses vertical growth pattern whereas more than 65% expresses horizontal growth pattern. In this study the post treatment ratio was lower (61.53%) compared to pre treatment ratio (63.43%) and the mean difference (1.91) was statistically significant. The increased FMA and SN to Go – Gn angles and reduced jarabak ratio indicates increased anterior facial height and vertical growth tendency.

The upper incisor to NA angle and upper incisor to palatal plane angle was seen increased by 2.8^0 and 3.3^0 respectively in this study; suggesting an increased proclination of upper incisors following RME facemask therapy. The upper incisor to A-Pog line is a linear measurement between incisal edge of the maxillary central incisor and the line joining point A to Pogonion. The mean difference in upper incisor to A-Pog line was 2.0 mm and this was statistically significant and also indicated upper incisor proclination . The lower incisor to NB angle and lower incisor mandibular plane angle was seen decreased by 2.6^0 and 3.2^0 respectively in this study suggesting retroclination of lower incisors following RME facemask therapy. The lower incisor to A-Pog line was seen decreased and the mean difference was -1.57 mm, which further indicated retroclination of lower incisors.

Significant change was obtained for the various soft tissue parameters evaluated in this study like Ls – E line and Li – E line and nasolabial angle. The upper lip (Ls – E line) moved forward for about 1.5 mm following RME facemask therapy and the change was statistically significant; whereas significant backward movement of lower lip (Li – E line) of about -1.67 mm was obtained in this study. The nasolabial angle was found to decrease in this study and the mean difference was -3.7^0 and the change was statistically significant. Ngan et al(19) concluded from their study that the forward movement of maxilla was accompanied by corresponding increase in the soft tissues, whereas mandibular retropositioning was accompanied by a corresponding reduction of the soft tissues. So, it is assumed that various soft tissue changes combined to improve the class III profile. Forward movement of the upper lip coupled with soft tissue pogonion moving back and menton moving down must have contributed to the profile becoming more convex.

The present study evaluated various skeletal, dental and soft tissue parameters incident to maxillary protraction following RME. Lack of control group can be considered as one of the limitations of the present study. Control group was not used because of the ethical issues involved.

V. Conclusion

This study cephalometrically evaluated the skeletal, dental and soft tissue changes following combined RME - facemask therapy in young children between 8 – 12 years with class III malocclusion for maxillary expansion and protraction for six months and has lead to the following conclusions.

The skeletal component showed improvement with significant forward movement of maxilla (SNA 1.34^0; N perpendicular to A point 2.01 mm) and mandible was rotated downwards and backwards (SNB -1.57^0; N perpendicular to Pogonion -2.93 mm). There was a statistically significant increase in effective maxillary and mandibular length (Co – A 2.77 mm; Co – Gn 1.09 mm) and the maxillo-mandibular relationship improved significantly (ANB 2.67^0; Wits analysis 2.21 mm; Beta angle -2.87^0) with significant increase in vertical growth pattern (FMA angle 2.87^0; SN to Go – Gn angle 3.09^0; Jarabak ratio -1.9).

The dental component showed improvement with significant upper incisor proclination (U1 to NA angle 2.83^0; U1 to A- Pog 2.0 mm; U1to palatal plane angle 3.35^0) and significant lower incisor retroclination (L1 to NB angle 2.61^0; L1 to A- Pog 1.56 mm; IMPA 3.17^0). The soft tissue component also showed improvement with significant forward movement of upper lip and backward movement of lower lip making the profile less concave (Ls – E line 1.48 mm; Li – E line -1.67^0; Nasolabial angle -3.69^0).

Thus skeletal and dental changes changes coupled with soft tissue changes following treatment with RME combined with face mask was effective in the correction of Class III malocclusion and resulted in an increase in convexity of facial profile.

New treatment protocols have emerged for maxillary traction, alternating rapid expansion and constriction of the maxilla, where previous studies(21) reported an average protraction of 5.8 mm at point A. Several studies was conducted using anchorage implants in the search for a device capable of providing an extremely stable and secure anchorage in maxillary orthopedic treatments. Osseointegrated mini-implants(22) have emerged which can also be used as anchorage for maxillary protraction. Thus alternative evidence-based treatment protocols will afford more efficient orthopedic corrections that minimizes undesirable side effects; and more researches should be conducted in this aspect.

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