A comparative evaluation of skeletal, dental, and soft tissue changes with skeletal anchored and conventional facemask protraction therapy

Tulika Tripathi, Priyank Rai, Navneet Singh and Shilpa Kalra

ABSTRACT

Objective: To cephalometrically evaluate and compare the skeletal, dentoalveolar, and soft tissue changes after maxillary protraction with skeletally anchored and conventional facemask.

Methods: The data for the study were collected from the pre- and post-treatment records of patients of maxillary retrusion treated with skeletally anchored and conventional facemask therapy. Twenty subjects were included in the study and were categorized into two groups, namely skeletal anchored maxillary protraction (SAMP) group with the mean age of 10.10 ± 1.1 years and conventional facemask maxillary protraction (CFMP) group with the mean age of 9.90 ± 1.1 years. Pre and post-treatment lateral cephalograms were assessed.

Results: The data were analyzed by Mann–Whitney test and Wilcoxon signed-rank test. The mean duration of treatment in SAMP group and CFMP group was 5.8 months and 10 months, respectively. The mean forward displacement of the maxilla (vertical point A) was 3.40 ± 1.07 mm in SAMP group and 2.80 ± 0.79 mm in CFMP group. The mandible showed downward and backward rotation in both the groups with more rotation in CFMP group. A significant increase in maxillary incisor inclination was seen in CFMP group as compared to SAMP group. A significant decrease was found in mandibular incisor inclination in both the treatment groups. The soft tissue changes corresponded to underlying skeletal tissue.

Conclusions: SAMP is proven to be a better treatment modality as compared to CFMP for achieving true skeletal changes and minimal dental changes in cases with developing skeletal Class III with maxillary retrusion.

Key words: Class III, facemask, skeletally anchored

INTRODUCTION

Class III malocclusion is one of the most challenging malocclusions for clinicians to treat due to the unpredictability of the growth pattern. A Class III malocclusion might be due to maxillary retrognathism, mandibular prognathism, protrusive mandibular dentition, retrusive maxillary dentition, and/or combinations of these components.[1,2]

Since late 1960s, conventional facemask has been used widely for correction of skeletal Class III malocclusion with maxillary hypoplasia.[3,4] The effects of this treatment were more dentoalveolar (mesialization of maxillary dentition) than skeletal in nature, with a significant chance of relapse of reverse overjet until mandibular growth had ceased. This observation has led to an increase in the focus toward more of skeletal maxillary advancement than just dentoalveolar improvement. With the advent of the temporary anchorage devices, the use of

Department of Orthodontics and Dentofacial Orthopedics, Maulana Azad Institute of Dental Sciences, New Delhi, India

Address for correspondence: Dr. Tulika Tripathi, Department of Orthodontics and Dentofacial Orthopaedics, Maulana Azad Institute of Dental Sciences, New Delhi, India. E-mail: drtulikatripathi@yahoo.com

Access this article online

Quick Response Code:

Website: www.jorthodsci.org

DOI: 10.4103/2278-0203.186166

How to cite this article: Tripathi T, Rai P, Singh N, Kalra S. A comparative evaluation of skeletal, dental, and soft tissue changes with skeletal anchored and conventional facemask protraction therapy. J Orthodont Sci 2016;5:92-9.

skeletal anchored maxillary protraction (SAMP) with miniplates has proven to be a promising treatment modality for growing Class III patients in the mixed to permanent dentition.

The literature concerning the maxillary protraction with bone anchored miniplates is very scarce and none in context to the Indian population. Considering prevalence of Class III malocclusion in Indian Population which is quite significant (3.4%),[5] we conducted a retrospective study. In this study, we attempted to evaluate the skeletal, dentoalveolar, and soft tissue effects of maxillary protraction with skeletal anchorage compared with conventional facemask through cephalometric readings on the lateral cephalograms.

METHODS

The present retrospective study included pre-treatment and post-treatment lateral cephalograms of patients treated in Department of Orthodontics at Maulana Azad Institute of Dental sciences, New Delhi, India. Of the 97 patients of Class III malocclusion completing treatment from January 2011 to December 2013 (3 years duration), twenty satisfied the inclusion criteria, which were considered as the final sample size. Ten subjects with mean age of 10.10 ± 1.1 years were treated with SAMP, and ten subjects with mean age of 9.90 ± 1.1 years were treated with conventional facemask maxillary protraction (CFMP). All the patients had a prepubertal or pubertal stage of skeletal maturity in cervical vertebrae maturation Stage I–III.[6]

Selected subjects had no systemic diseases or congenital deformities and had essential features of skeletal III malocclusion with maxillary deficiency (point A, nasion and point B <0), edge to edge bite or reverse incisor relationship and normal or increased overbite.

The records of the patients were divided among two groups. SAMP group (overjet = −2 mm ± 2) included patients in which protraction of maxilla was achieved by bone plates placed in lateral nasal wall area [Figures 1-3], whereas CFMP group (overjet = −2.4 mm ± 1.3) included patients in which maxilla was protracted through hooks soldered to rapid maxillary expansion (RME) appliance [Figures 4 and 5].

Before maxillary protraction, bonded RME appliance was given in both the groups and was activated twice per day for 7 days for loosening the circumaxillary sutures.

The facemask protraction protocol was same for both the groups, involving elastics (attached to hooks/bone plates) directed 20–30° downward from the occlusal plane delivering a force of 400 g per side as determined by Dontrix gauge [Figures 6 and 7]. The patients were instructed to wear facemask at least 12–14 h/day[7] until a positive overjet of 4 mm was achieved.

Pre- and post-treatment lateral cephalograms were assessed (termed as T_0 and T_1, respectively). For the assessment of treatment changes on the lateral cephalograms horizontal plane (HP) and vertical plane (VP), references were constructed for linear and angular measurements. A horizontal line constructed by subtracting 7° from the sella-nasion line was used as the HP plane.[8,9] A vertical line passing through sella and perpendicular to the HP was the VP. The parameters selected for evaluation are shown in Table 1.

These cephalometric parameters were recorded and their difference was measured at the treatment completion (T_1–T_0). The mean difference among these parameters in both the treatment groups was compared and evaluated.

Statistical analysis was performed by SPSS v15.0. For the sample size of ten, the Shapiro–Wilk test showed the nonnormal distribution of data and hence nonparametric test was applied. The Mann–Whitney test was used for comparison between the groups, whereas Wilcoxon signed-rank test was used for comparison within the groups to observe the changes with treatment. The variables having dissimilar initial values (T_0) were calculated using their "relative change" ($[T_1–T_0/T_0] \times 100$). The $P < 0.05$ was considered to be statistically significant.

RESULTS

The cephalometric changes in skeletal, dental, and soft tissue parameters are summarized in Table 2. The results revealed that the mean duration of treatment in SAMP group and CFMP group was 5.8 months and 10 months with protraction rate of 0.61 mm and 0.28 mm/month, respectively. The amount of maxillary forward displacement (sagittal maxillary position, Co-A, vertical point A [A-VP]) as compared to the pretreatment values was significant ($P < 0.05$) for both the treatment groups. The mean forward displacement of the maxilla (A-VP) was 3.40 ± 1.07 mm in SAMP group and 2.80 ± 0.79 mm in CFMP group. The difference in total displacement between SAMP group and CFMP group was not significant; however, the difference in protraction rates between the two groups was

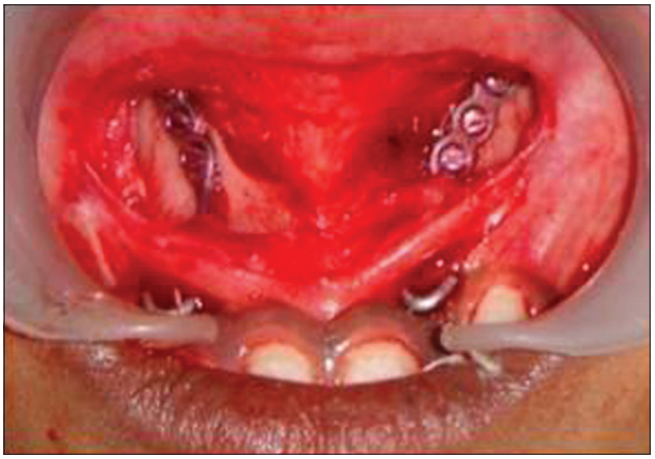

Figure 1: Intraoral view with surgical miniplates placed bilaterally in the lateral nasal wall area

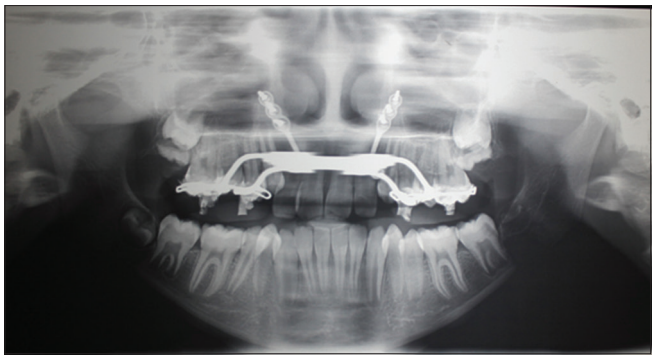

Figure 2: Orthopantomogram showing miniplates placed lateral to the apertura piriformis in the lateral nasal wall area

Figure 4: Intraoral view of rapid maxillary expansion appliance with hook soldered in deciduous canine–deciduous first molar region

Figure 6: Profile view of the patient with a facemask and extraoral elastics (attached bone plates) directed 20–30° downward from the occlusal plane in skeletal anchored maxillary protraction group

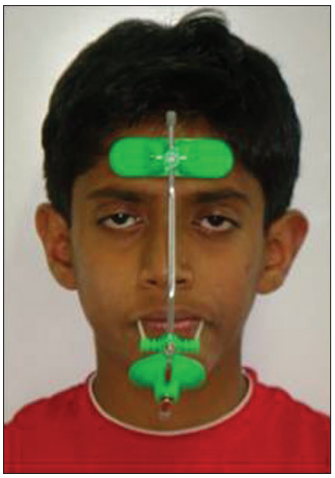

Figure 3: Extraoral frontal view showing application of protraction force with skeletally anchored protraction

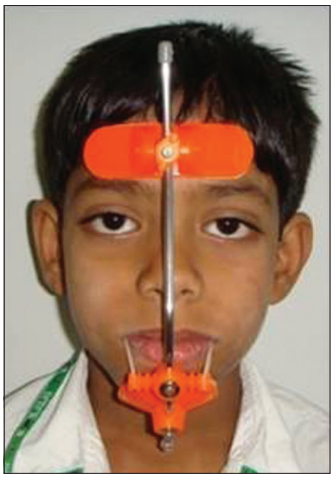

Figure 5: Extraoral frontal view showing application of protraction force via hooks soldered to the rapid maxillary expansion appliance

Figure 7: Profile view of the patient with a facemask and extraoral elastics (attached to hooks) directed 20–30° downward from the occlusal plane in conventional facemask maxillary protraction group

statistically significant ($P < 0.05$). A non-significant difference in palatal plane inclination (HP-palatal plane [PP]) after treatment was observed in both the groups. A significant ($P < 0.05$) increase in the distance HP-posterior nasal spine (PNS) in CFMP group was observed. A significant ($P < 0.05$) decrease in VP pogonion (Pg-VP) was found in SAMP group, whereas significant ($P < 0.05$) increase in mandibular length (condylion- gonion distance) was seen in both

Table 1: Definition of cephalometric parameters used in the study

Parameter	Definition
Maxillary parameters	
SNA (°)	The angle formed between sella-nasion and point A
HP-PP (°)	The angle formed between horizontal plane and palatal plane
HP-ANS (mm)	The length of a perpendicular line dropped from horizontal plane intersecting the anterior nasal spine
HP-PNS (mm)	The length of a perpendicular line dropped from Horizontal plane intersecting the posterior nasal spine
Co-A (mm)	The distance between condylion and point A
A-VP (mm)	The length of a perpendicular line dropped from vertical plane intersecting the point A
Mandibular parameters	
SNB (°)	The angle formed between sella, nasion, and point B
Pg-VP (mm)	The length of a perpendicular line dropped from vertical plane intersecting the pogonion
B-VP (mm)	The length of a perpendicular line dropped from vertical plane intersecting the point B
Co-Gn (mm)	The distance between condylion and gonion
Vertical Parameters	
SN-GoGn (°)	The angle formed between mandibular and sella-nasion planes
HP-GoMe (°)	The angle formed between mandibular and horizontal planes
S-Go (mm)	The distance from sella to gonion
N-Me (mm)	The distance from nasion to menton
ANS-Me (mm)	The distance from anterior nasal spine to menton
N-ANS (mm)	The distance from nasion to anterior nasal spine
Maxillomandibular Parameters	
ANB (°)	The angle formed between point A, nasion, and point B
(A-VP)-(B-VP) (mm)	The difference between A- vertical plane and B- vertical plane
Dental parameters	
UP1-SN (°)	The angle formed between a line drawn along the long axis of the maxillary incisor and sella-nasion plane
UP1-HP (°)	The angle formed between a line drawn along the long axis of the maxillary incisor and horizontal plane
UP1-VP (mm)	The length of a perpendicular line dropped from vertical plane intersecting the tip of maxillary incisor
IMPA (°)	The angle between mandibular plane and a line drawn down the long axis of the mandibular incisor
L1-VP (mm)	The length of a perpendicular line dropped from vertical plane intersecting the tip of mandibular incisor
U6-HP (mm)	The length of a perpendicular line dropped from horizontal plane intersecting the mesiobuccal cusp tip of the maxillary first molar
U6-VP (mm)	The length of a perpendicular line dropped from vertical plane intersecting the mesiobuccal cusp tip of the maxillary first molar
Overjet (mm)	The horizontal overlap between maxillary central incisors over the mandibular central incisors
Overbite (mm)	Vertical (superior-inferior) overlap of the maxillary central incisors over the mandibular central incisors
Soft tissue parameters	
Z angle (°)	The angle between Frankfort horizontal plane and line tangent to soft tissue pogonion passing through the most prominent point of upper or lower lip
N'-Me' (mm)	The distance between soft tissue nasion and soft tissue menton
Sn-Me' (mm)	The distance between subnasale and soft tissue menton
A'-VP (mm)	The length of a perpendicular line dropped from vertical plane intersecting the soft tissue point A
B'-VP (mm)	The length of a perpendicular line dropped from vertical plane intersecting the soft tissue point B
UL-VP (mm)	The length of a perpendicular line dropped from vertical plane intersecting the most prominent point of upper lip
LL-VP (mm)	The length of a perpendicular line dropped from vertical plane intersecting the most prominent point of lower lip
Pg'-VP (mm)	The length of a perpendicular line dropped from vertical plane intersecting the soft tissue pogonion

groups. A statistically significant ($P < 0.05$) increase was found in mandibular plane parameters (sella-nasion-gonion gnathion [SN-GoGn], HP-GoMe) and facial height parameters (nasion to menton [N-Me], anterior nasal spine to menton) in both the treatment groups. The intergroup comparison also showed a statistically significant ($P < 0.05$) difference among the two groups with a higher increase in CFMP group. A significant increase ($P < 0.05$) in maxillary dental parameters (UP1-SN, UP1-HP, UP1-VP, U6-HP, and U6-VP) was seen in CFMP group, whereas no significant changes in SAMP group were observed. A statistically significant ($P < 0.05$) decrease was found in mandibular incisor parameters (incisor mandibular plane angle, L1-VP) in both the treatment groups. The intergroup comparison also showed a statistically significant ($P < 0.05$) difference among the two groups. The soft tissue total facial height and lower facial height (N'-Me', subnasale to soft tissue menton [Sn-Me']), increased significantly ($P < 0.05$) in both treatment groups. The intergroup comparison for N'-Me' and Sn-Me' showed a statistically significant ($P < 0.05$) difference among the two

Table 2: Comparison of cephalometric parameters of skeletal anchored maxillary protraction and conventional facemask maxillary protraction group

Parameters	SAMP (T1 to T0)		CFMP (T1 to T0)		SAMP versus CFMP (*P*)
	Mean±SD	*P*	Mean±SD	*P*	
Maxillary parameters					
SNA (°)	3.80±1.032	0.004*	3.40±0.843	0.004*	0.315
HP-PP (°)	−0.40±1.429	0.473	−0.80±4.685	0.875	0.579
HP-ANS (mm) +	−0.20±0.658	0.317	0.55±8.603	0.957	0.481
HP-PNS (mm) +	2.87±1.841	0.010	13.27±6.678	0.004*	0.000*
Co-A (mm)	3.20±1.032	0.004*	2.80±1.782	0.005*	0.190
A-VP (mm)	3.40±1.074	0.005*	2.80±0.788	0.004*	0.247
Protraction rate	0.61±0.26		0.28±0.09		0.002*
Mandibular parameters					
SNB (°)	0.60±1.264	0.105	0.20±2.250	0.375	0.912
Pg-VP (mm)	−1.60±0.843	0.004*	−1.00±3.055	0.504	0.481
B-VP (mm)	−1.00±1.154	0.023	−0.80±2.149	0.234	0.684
Co-Gn (mm) +	3.36±1.1375	0.005*	4.09±0.676	0.004*	0.315
Vertical parameters					
SN-GoGna (°)	1.60±0.516	0.011*	4.40±0.516	0.004*	0.000*
HP-GoMe (°)	1.60±1.074	0.011*	4.40±0.516	0.004*	0.000*
S-Go (mm) +	0.58±2.113	0.251	0.67±0.875	0.046	0.796
N-Me (mm) +	2.49±0.487	0.003*	5.15±0.843	0.004*	0.000*
ANS-Me (mm) +	3.97±1.541	0.004*	8.67±1.370	0.004*	0.000*
N-ANS (mm) +	−0.73±0.951	0.046	0.40±0.516	0.046	0.015
Maxillomandibular parameters					
ANB (°)	3.60±1.577	0.004*	3.20±2.149	0.005*	0.481
(A-VP)-(B-VP) (mm)	4.40±2.065	0.004*	3.80±1.229	0.004*	0.796
Dental parameters					
UP1-SN (°)	2.00±1.154	0.010	6.40±3.098	0.005*	0.003*
UP1-HP (0)	1.80±1.549	0.014	7.20±3.675	0.004*	0.003*
UP1-VP (mm)	1.60±1.429	0.023	5.60±1.074	0.005*	0.000*
IMPA (°) +	−3.60±1.820	0.005*	−6.81±2.402	0.005*	0.009*
L1-VP (mm)	−1.60±0.843	0.004*	−1.40±1.021	0.005*	0.393
U6-HP (mm) +	2.16±2.795	0.046	18.26±8.089	0.004*	0.000*
U6-VP (mm)	0.60±0.516	0.014	6.00±1.333	0.004*	0.000*
Overjet (mm)	5.60±2.716	0.005*	5.80±0.258	0.004*	0.481
Overbite (mm)	−1.70±2.859	0.074	−0.70±0.918	0.033	0.481
Soft tissue parameters					
Z Angle (°) +	4.600±2.686	0.011	7.54±6.551	0.020	0.315
N'-Me' (mm) +	2.16±0.364	0.004*	4.54±0.510	0.003*	0.000*
Sn-Me' (mm) +	2.69±0.735	0.004*	3.78±0.641	0.004*	0.001*
A'-VP (mm)	3.60±1.577	0.004*	3.60±1.264	0.004*	0.912
B'-VP (mm)	−1.20±1.813	0.065	−1.00±2.357	0.245	0.739
UL-VP (mm)	2.60±1.074	0.005*	2.40±1.712	0.011	0.684
LL-VP (mm)	−0.20±1.686	0.557	−0.20±2.859	0.875	0.684
Pg'-VP (mm)	−1.80±1.686	0.003*	−3.20±3.084	0.004*	0.052

*$P<0.05$ significant, + – Relative change $\frac{\text{Pre-post}}{\text{Pre}} \times 100$. SNA – Sella-nasion and point A; HP-PP – Horizontal plane and palatal plane; HP-ANS – Horizontal plane-anterior nasal spine; HP-PNS – Horizontal plane the posterior nasal spine; CO-A – Condylion-point A; A-VP – Vertical plane-point A; SNB – Sella-nasion and point B; pg-VP – Vertical plane pogonion; B-VP – Vertical plane point B; Co-Gn – Condylion and gonion; S-Go – Sella to gonion; N-Me – Nasion to menton; ANS-Me – Anterior nasal spine to menton; N-ANS – Nasion to anterior nasal spine; ANB – Point A, nasion and point B; A-VP – Vertical point A; B-VP – Vertical plane point B; UP1-SN – Sella-nasion plane; HP – Horizontal plane; VP – Vertical plane; IMPA – Incisor mandibular plane angle; N'-Me' – Nasion and soft tissue menton; Sn-Me' – Subnasale and soft tissue menton; SAMP – Skeletal anchored maxillary protraction; CFMP – Conventional facemask maxillary protraction; SD – Standard deviation

groups. A significant increase ($P < 0.05$) in UL-VP was seen in SAMP group. A significant decrease ($P < 0.05$) in Pg'-VP was seen in both the treatment groups; however, the difference between the two groups was not significant.

DISCUSSION

The conventional facemask had been used widely for correction of skeletal Class III malocclusion with undesirable effects such

as anterior rotation of the maxilla, proclination of the maxillary incisors, excessive forward movement, and extrusion of the maxillary molars due to indirect application of force.[10-12] These effects camouflage the malocclusion and conflict with the main goals of the skeletal Class III treatment. To overcome these undesirable effects and achieve true maxillary protraction with direct force application to circumaxillary sutures, it is desirable to use an alternate protocol with rigid skeletal anchorage.

Site for Miniplates Placement

In our study, miniplates were placed in the lateral nasal wall of the maxilla in SAMP group, and orthopedic forces were applied directly to the intraoral extensions of the miniplate. The lateral nasal wall area of the maxilla has an advantage of being anterior to the center of resistance of the nasomaxillary complex (the posterosuperior ridge of the pterygomaxillary fissure)[13] and hence, allows resulting force vector close to the center of resistance and in line with the downward and forward growth of the maxilla. Furthermore, the lateral nasal wall of the maxilla is the most appropriate anatomic site for achieving the fullness of the nasobuccal folds, the infraorbital region, and consequently, the soft-tissue profile.[14] In an animal model, Smalley *et al*.[15] used osseointegrated implants to protract the maxillofacial complex where greatest remodeling took place in the sutures and the bones closest to the application of force. Similarly, our patients showed remarkable midfacial protraction and had positive improvement in their soft-tissue profiles.

Treatment Duration

A significant difference in treatment durations for protraction phase between the two groups was observed. In SAMP group treatment duration was 5.8 months, whereas it was 10 months in CFMP group. A possible explanation for this difference could be the reason that it was decided to continue protraction therapy in the patients until a positive overjet of 4 mm was achieved. Different types of anchorage units used in the two groups could also be the reason for the difference in duration.

Rapid Maxillary Expansion

RME with a bonded appliance was performed in both treatment groups. The use of an expansion appliance shortens the duration of overall treatment with the same degree of improvement as in nonexpansion group. Moreover, it is suggested that expansion appliance enhances the protraction effects in terms of time with less dental and more skeletal effects. RME can disarticulate circumaxillary sutures to facilitate the forward movement of the maxilla via facemask therapy and lead to downward and forward movement of A-point.[16]

Maxillary Advancement

Baik[11] reported mean forward movement of A-point of 1.9 mm in an age group of 8–13 years with conventional facemask protraction. Franchi *et al*.[17] and Takada *et al*.[18] in their study reported minimal forward movement of maxilla at the age of 12 years and 13 years, respectively. A meta-analysis by Kim *et al*.[19] reported mean forward movement of A-point between 0.9 and 2.9 mm in the age group of 10 years. The results of our study were in concordance with the study by Kim *et al*.[19] with the mean forward movement of A-point of 2.80 mm in CFMP group. Recent studies by various authors[9,20] reported maxillary advancement with the forward movement of A point between 2.9 and 4 mm with SAMP. Our results were similar to these studies with the mean A-point advancement of 3.40 mm in 5.8 months. Therefore, one can conclude that maxillary advancement is enhanced by using rigid skeletal anchorage rather than conventional dental anchorage in growing patients.

Rate of Maxillary Advancement

When the difference of the treatment duration between two protraction groups is considered, evaluating the protraction rate would be more meaningful with 0.61 mm/month in the SAMP group and 0.28 mm/month in the CFMP group. These findings support the observations of Kircelli and Pektas[14] and Sar *et al*.[9] It can be interpreted that SAMP protocol is twice as efficient as conventional maxillary protraction protocol, with reduced treatment timing.[21] Applying the force directly to the maxilla in the SAMP group instead of indirect application via the maxillary teeth and their surrounding periodontia as in the CFMP group might be the reason for this difference. Although the total maxillary displacement has increased significantly in both the groups, the rate is more in SAMP group.

Rotation of Palatal Plane

A significant increase in the distance HP-PNS leading to tipping of palatal plane down posteriorly and upward anteriorly was observed in CFMP group as the protraction force was applied 30° downward and forward from the hook of RME appliance to the occlusal plane passing above center of resistance, whereas in SAMP group, no change is observed as the force applied from aperture piriform region (30° pull downward to occlusal plane) was passing close to center of resistance of maxilla.[22]

Mandibular Changes

In our observation, we found Pg-VP decreased more in SAMP group which may be due to more vertical growth pattern of the subjects included in SAMP group (Sn-GoGn 35.6 ± 2.17) as compared to CFMP group (Sn-GoGn 32.60 ± 3.50). The backward rotation of the mandible was seen in both groups, whereas the rotation in the CFMP group was significant. The possible explanation for this finding might be downward movement of the posterior maxilla and maxillary molar teeth, which in turn rotates the mandible downward and backward. In addition, the longer treatment duration in the CFMP group might be the other possible reason affecting the position of the mandible. Further, there is chin cap effect of the facemask therapy which causes the chin to go downward and backward. Accordingly, lower anterior and total anterior facial heights increased significantly in both treatment groups; greater changes were seen in the CFMP group compared with the SAMP group. The findings observed in the CFMP group are in concordance with results of previous studies.[10-12,14,23] Hence, SAMP may be preferred over conventional facemask therapy in patients with severe vertical growth pattern.[24]

Dentoalveolar Changes

Proclination of the maxillary incisors, mesialization and extrusion of the maxillary molars, and retroclination of the mandibular incisors are the main effects of conventional facemask therapy.[25,26] These were also reported in CFMP group of our study.

In SAMP group, maxillary incisors and the maxillary molars did not show significant movement. These findings are in agreement with the observations of other studies[8,9] using facemask with skeletal anchorage. The possible explanation is that the type of anchorage unit used in facemask therapy determines the movement of the maxillary teeth. The undesired dental effects of conventional facemask therapies were eliminated with miniplate anchorage except for significant retrusion of mandibular incisors. The possible explanation of retrusion of mandibular incisor could be the restrictive chin cap effect of facemask therapy. This was observed in both the groups.

Soft Tissue Changes

Improvements in the soft-tissue profile followed the underlying skeletal components in both treatment groups.

Limitation of the Study

In our study, sample size was relatively small and no control group was taken due the ethical reasons, further study needs to be done on larger sample size.

CONCLUSIONS

- The maxillary skeletal protraction was 3.4 ± 1.07 mm in SAMP group and 2.8 ± 0.79 mm in CFMP group
- The rate of protraction was 0.61 mm and 0.28 mm/month in SAMP group and CFMP group, respectively. This difference between the groups was found to be highly statistically significant
- The total duration for protraction was 5.8 months and 10 months in SAMP and CFMP groups, respectively
- The downward and backward rotation of mandible was significantly higher in CFMP group as compared to SAMP group
- In CFMP group, the incisors proclined forward by 5.6 mm and 1.6 mm in SAMP group. This difference between the groups was statistically significant
- The mesial movement of maxillary molars was significant in CFMP group
- In both the groups, retroclination of mandibular incisors was observed but it was statistically insignificant
- The soft tissue changes corresponded to underlying skeletal tissues in both the groups with a significant difference only in the vertical dimension.

Class III correction by SAMP has significant skeletal effects with minimal dentoalveolar effects. Hence, although invasive in nature, SAMP would be a better treatment modality, especially in Class III cases having dentoalveolar protrusion and vertical growth pattern.

Declaration of Patient Consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial Support and Sponsorship

Nil.

Conflicts of Interest

There are no conflicts of interest.

REFERENCES

1. Ellis E 3rd, McNamara JA Jr. Components of adult class III open-bite malocclusion. Am J Orthod 1984;86:277-90.
2. McNamara JA, Brudon WL. Orthodontic and orthopedic treatment in the mixed dentition. Ann Arbor, Michigan: Needham Press; 1993. p. 285-93.
3. Delaire J. Maxillary development revisited: Relevance to the orthopaedic treatment of Class III malocclusions. Eur J Orthod 1997;19(3):289-311.
4. Mermigos J, Full CA, Andreasen G. Protraction of the maxillofacial complex. Am J Orthod Dentofacial Orthop 1990;98:47-55.
5. Kharbanda OP, Sidhu SS, Sundaram KR, Shukla DK. Prevalence of malocclusion and its traits in Delhi children. J Indian Orthod Soc 1995;26:98-103.
6. Hassel B, Farman AG. Skeletal maturation evaluation using cervical vertebrae. Am J Orthod Dentofacial Orthop 1995;107:58-66.
7. Proffit WR, Fields HW, Sarver DM. Contemporary Orthodontics. St. Louis: Elsevier Mosby; 2007.
8. Kaya D, Kocadereli I, Kan B, Tasar F. Effects of facemask treatment anchored with miniplates after alternate rapid maxillary expansions and constrictions: A pilot study. Angle Orthod 2011;81:639-46.
9. Sar C, Arman-Özçirpici A, Uçkan S, Yazici AC. Comparative evaluation of maxillary protraction with or without skeletal anchorage. Am J Orthod Dentofacial Orthop 2011;139:636-49.
10. Baccetti T, McGill JS, Franchi L, McNamara JA Jr., Tollaro I. Skeletal effects of early treatment of class III malocclusion with maxillary expansion and face-mask therapy. Am J Orthod Dentofacial Orthop 1998;113:333-43.
11. Baik HS. Clinical results of the maxillary protraction in Korean children. Am J Orthod Dentofacial Orthop 1995;108:583-92.
12. Macdonald KE, Kapust AJ, Turley PK. Cephalometric changes after the correction of class III malocclusion with maxillary expansion/facemask therapy. Am J Orthod Dentofacial Orthop 1999;116:13-24.
13. Kambara T. Dentofacial changes produced by extraoral forward force in the Macaca irus. Am J Orthod 1977;71:249-77.
14. Kircelli BH, Pektas ZO. Midfacial protraction with skeletally anchored face mask therapy: A novel approach and preliminary results. Am J Orthod Dentofacial Orthop 2008;133:440-9.
15. Smalley WM, Shapiro PA, Hohl TH, Kokich VG, Brånemark PI. Osseointegrated titanium implants for maxillofacial protraction in monkeys. Am J Orthod Dentofacial Orthop 1988;94:285-95.
16. McNamara JA Jr. An orthopedic approach to the treatment of class III malocclusion in young patients. J Clin Orthod 1987;21:598-608.
17. Franchi L, Baccetti T, McNamara JA. Postpubertal assessment of treatment timing for maxillary expansion and protraction therapy followed by fixed appliances. Am J Orthod Dentofacial Orthop 2004;126:555-68.

18. Takada K, Petdachai S, Sukada M. Changes in dentofacial morphology in skeletal class III children treated by a modified maxillary protraction headgear and a chin cup: A longitudinal cephalometric appraisal. Eur J Orthod 1993;15:211-21.
19. Kim JH, Viana MA, Graber TM, Omerza FF, BeGole EA. The effectiveness of protraction face mask therapy: A meta-analysis. Am J Orthod Dentofacial Orthop 1999;115:675-85.
20. Singer SL, Henry PJ, Rosenberg I. Osseointegrated implants as an adjunct to facemask therapy: A case report. Angle Orthod 2000;70:253-62.
21. 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. Angle Orthod 2013;83:540-52.
22. Tanne K, Hiraga J, Sakuda M. Effects of directions of maxillary protraction forces on biomechanical changes in craniofacial complex. Eur J Orthod 1989;11:382-91.
23. Vaughn GA, Mason B, Moon HB, Turley PK. The effects of maxillary protraction therapy with or without rapid palatal expansion: A prospective, randomized clinical trial. Am J Orthod Dentofacial Orthop 2005;128:299-309.
24. Sar C, Sahinoglu Z, Özçirpici AA, Uçkan S. Dentofacial effects of skeletal anchored treatment modalities for the correction of maxillary retrognathia. Am J Orthod Dentofacial Orthop 2014;145:41-54.
25. Sung SJ, Baik HS. Assessment of skeletal and dental changes by maxillary protraction. Am J Orthod Dentofacial Orthop 1998;114:492-502.
26. Ngan P, Hägg U, Yiu C, Merwin D, Wei SH. Soft tissue and dentoskeletal profile changes associated with maxillary expansion and protraction headgear treatment. Am J Orthod Dentofacial Orthop 1996;109:38-49.