doi:10.5368/aedj.2011.3.3.1.2

THE EFFECTS OF ORTHOPEDIC FACEMASK DEPENDING ON VERTICAL FACIAL PATTERNS.

[1] Naveen Shamnur [1]Professor
[2] Mandava Prasad [2] Professor and Head
[3] Kumudini K P [3]Postgraduate student

[1,3]Department of Orthodontics,College of Dental Science, Davangere, Karnataka-India.
[2]Department of Orthodontics,Narayana Dental College, Nellore, Andhra Pradesh- India.

ABSTRACT:
The objective of the study is to evaluate treatment effects of orthopedic facemask on Class III preadolescents depending on the vertical facial pattern. This study was based on 30 patients aged 9–12 years, and were diagnosed as skeletal Class III with maxillary deficiency. They were divided into 2 groups (low and high angle groups) depending on gonial angle and the SNMP (GoGn) angle, respectively. Pretreatment and post-treatment lateral cephalograms were used to compare the effects of facemask and the following conclusions were obtained:1) A significantly large amount of backward movement of the point B was observed in patients with a low SNMP angle. Those with a high SNMP angle had significant forward movement at point A. (2) The patients with low gonial angle had the least forward movement at the point A, and those with a high angle had more forward movement. In comparing the horizontal and vertical movement of the point A, the high angle group showed more horizontal movement while the low angle group showed more vertical movement.

KEYWORDS: ***Facemask appliance,*** **Statistics, SN-MP angle.**

INTRODUCTION

Orthopedic facemask may be used to treat Class III preadolescents depending on the disharmony of the jaws.[1-5] orthopedic facemask is indicated for Class III children with a deficient maxilla. The hooks attached to the intra—oral appliance is the point of force application. Face masks are applied against the chin and the forehead, thus protracting the nasomaxillary complex through elastics. Since 1944 when Oppenheim[6] suggested the capability of treating a Class III malocclusion by protracting the maxilla. These proved histologically that the protraction force applied to the maxilla expands the suture area against the cranial base, consequently induces bone formation.[7,8] The main purpose of facemask is the forward displacement of the maxilla, but in fact other complex effects play a role in improving the Class III malocclusion and in regaining normal overjet and overbite.

These effects include labioversion of the maxillary anterior teeth, downward and backward rotation of the mandible, and linguoversion of the mandibular anterior incisors. The skeletal and dental changes during treatment are the results of both the orthopedic effects and the normal growth. In addition, orthopedic treatment not only have an effect on anterior-posterior disharmony, but also on the vertical facial height.[9] Schudy,[10,11] Bjork,[12,13] Issacson,[14] Ricketts,[15] Jarabak[16] etc. classified the vertical facial height and according to their classification, the high angle facial type shows a vertical growth pattern, a high gonial and SN-MP(Go-Gn) angle, and an open bite tendency by weak occlusal force. In contrast, the low angle facial type shows a heavy occlusion making the posterior teeth difficult to extrude, leading to deep bite tendency.[17-19] Therefore it can be predicted that in low angle facial types, upon maxillary protraction, the skeletal Class III relationship is improved by anterior displacement of the maxilla rather than the rotation of the mandible, while in high angle facial types the downward and backward rotation of the mandible is predominant due to the extrusion of the upper posterior teeth and the downward displacement of the maxilla. Thus it is important to minimize the extrusion of the posterior teeth and vertical growth of the maxilla, in high angle patients, in order not to increase the facial height. However, in low angle patients, some extrusion of molars could be allowed by protracting maxilla in a more downward direction[20,21,22].

The objective of this study was to compare the results from using the facemask on Class III preadolescents with different facial heights

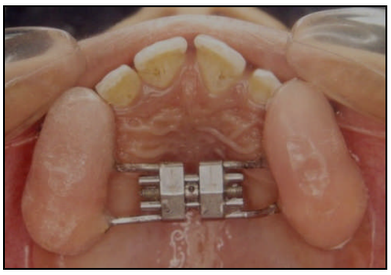
.

Table -1 : Patients taken for study

Groups		
SNMP	Low	15
	High	15
Gonial Angle	Low	14
	High	16

A

B



C

D

Fig.1. Appliances used in this study
A. Face mask appliance.
B. Rapid palatal expansion
C. Before treatment
D. After treatment

Materials and methods:

A) Subjects : Thirty patients were selected as subjects for this study, who visited Department of Orthodontics, College of Dental Sciences, Davangere with a chief complaint of anterior cross bite. All patients had skeletal Class III malocclusion with deficient maxilla, Class III molar relationship and with anterior cross bite. The initial age of the children ranged from 9 years to 12 years (**Table-1**).

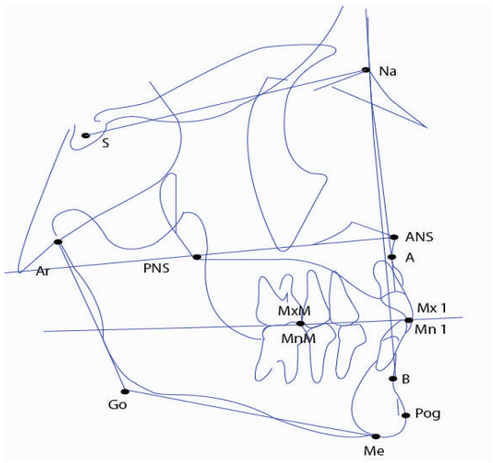


Fig. 2 : The land marks for the measurements
S, Na, A, B, Pog, Me, ANS, PNS, Ar, Go.

Mx1 : Incisal edge of the maxillary incisor
Mx2 : Incisal edge of mandibular incisor
MxM : Mesial cusp tip of the maxillary first molar
MnM : Mesial cup tip of the mandibular first molar

Lateral cephalograms were taken with maximum intercuspation. The samples were subdivided according to their vertical facial type using SNMP angle and gonial angle. Using SNMP angle they were divided into high angle (above 32°) and low angle below (32°). Alternatively using the gonial angle, the samples were divided again into the low angle group (below 120°) and high angle group (above 128°).

B) Methods :

Facemask appliance

Protraction hooks were soldered to the premolar area of intraoral fixed appliance and 300-500g per side force was applied in a15- 30° downward direction to the occlusal plane. Facemask was used for each patient **(Fig.1a).** Depending on the necessity of maxillary expansion, rapid palatal expansion appliance was inserted as the intraoral fixed appliance **(Fig. 1b).** The patients were instructed to wear the appliance for at least 14 hours.

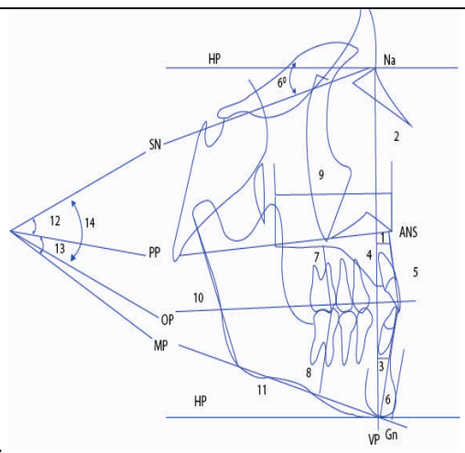


Fig. 3 : Measurements

1. VP-A (mm)
2. HP-A (mm)
3. VP-B (mm)
4. HP-B (mm)
5. U1-PP (mm)
6. L1-MP (mm)
7. U6-PP (mm)
8. L6-MP (mm)
9. PNS-ANS (mm)
10. Ar-Go (mm)
11. Go-Pog (mm)
12. SN-PP (°)
13. PP-MP (°)
14. SN-OP (°)

Table.2 : The mean difference of all sample and their significance

Parameter	Pre-treatment		Post-treatment		Difference		P* Value	Significance
	Mean	SD	Mean	SD	Mean	SD		
SNA (°)	80.30	3.34	82.30	3.59	-2.30	1.1	0.000	HS
SNB(°)	82.80	4.49	80.85	4.00	1.95	1.7	0.000	HS
ANB(°)	-2.60	1.79	1.00	1.45	-3.60	1.6	0.000	HS
WITS(mm)	-5.90	2.29	-2.55	1.96	-3.35	1.9	0.000	HS
POST/ANT(%)	69.23	4.88	67.96	4.49	1.26	1.8	0.005	S
FACIAL CONVEXITY(°)	-4.50	1.67	-1.05	1.76	-3.45	1.9	0.000	S
SN-PP(°)	8.10	3.85	6.45	3.35	1.65	2.0	0.001	S
PP-MP(°)	20.10	2.95	23.15	3.25	-3.05	2.4	0.000	S
SN-OP(°)	14.10	4.56	13.10	4.38	1.00	1.3	0.003	S
VP-A(mm)	-3.15	3.40	-0.90	3.49	-2.25	1.2	0.000	HS
HP-A(mm)	50.00	2.55	52.00	2.53	-2.00	1.6	0.000	HS
VP-B(mm)	-0.90	7.23	-2.90	7.24	2.00	2.4	0.001	S
HP-B(mm)	86.70	4.40	92.45	4.96	-5.75	3.2	0.000	HS
U1-NF(mm)	22.60	1.90	24.10	2.07	-1.50	1.2	0.000	HS
L1-MP(mm)	35.70	1.78	37.45	1.70	-1.75	1.6	0.000	HS
U6-NF(mm)	19.50	1.96	21.15	1.79	-1.65	0.9	0.000	HS
L6-MP(mm)	27.20	2.24	28.95	2.39	-1.75	1.6	0.000	HS
PNS-ANS(mm)	48.50	1.79	49.50	1.79	-1.00	0.9	0.051	NS
Ar-Go(mm)	43.60	4.08	44.90	4.09	-1.30	2.4	0.062	NS
Go-Pog(mm)	73.30	3.42	75.00	3.29	-1.70	2.1	0.002	S

* Student's paired t test Negative values indicate increase in values NS: Non significant, S: Significant, HS : High significant

Analysis of the lateral cephalograms .

Lateral cephalograms were taken before treatment and after the patient gained 2 mm of positive overjet on the anterior teeth which took approximately 6-7 months and tracing was done. The landmarks for the measurements are marked as in **Fig. 2**. The SN line was used as the reference plane for angular measurements. SN line rotated 6° clockwise around the Nasion(Na), was used as the horizontal reference plane (SN-6°), and a perpendicular line to the horizontal reference plane at Na was designated as the vertical reference plane.[23] To examine the skeletal changes, SNA, SNB, ANB, Wits, facial convexity (N-A -Pg), and the Posterior/Anterior facial height ratio were measured before and after treatment. To examine the vertical, horizontal changes in the basal bone, the distance of the A, B point from the vertical/horizontal reference plane was measured. To examine the vertical change of the teeth in relation to the basal bone, the distance of the Mxl, MxM from the palatal plane **(Fig.3)** and the mandibular plane were measured. The length of the maxilla was measured as the distance between PNS and ANS. The size of the mandible was assessed by measuring the length of the ramus (Ar-Go) and the length of the body (Go-Pg). The angle between the SN and palatal plane, SN and occlusal plane, and the angle between the palatal and mandibular plane were also measured to evaluate the skeletal rotation (**Fig 3).**

Statistical analysis :

Comparison of the difference in the different vertical facial patterns .

The difference between the values before and after treatment was calculated. A paired t test was carried out to determine if there was any significant change after treatment. Unpaired t-test was done to ascertain the difference between each group. Comparison analysis was performed on the groups that showed statistical significance. Through comparison analysis, VP-A and VP-B in the SNMP group and VP-A in the gonial angle group showed a significant value.

Results :

(1) Comparison of values before and after treatment in all groups Each value showed significant change after treatment except for the PNS-ANS and Ar-Go. Forward and downward movement of point A, backward and downward movement of the point B, and increase in the ANB and facial convexity were observed

Table .3: The effect and significance of facemask appliance in various SNMP

Parameter	High Angle		Low Angle		Mean Difference	P* Value	Significance
	Mean	SD	Mean	SD			
SNA(°)	-1.40	0.5	-2.40	1.3	1.00	0.161	NS
SNB(°)	2.20	1.9	1.80	1.3	0.40	0.710	NS
ANB(°)	-3.60	1.7	-3.60	1.8	0.00	1.000	NS
WITS(mm)	-3.60	2.9	-3.60	1.7	0.00	1.000	NS
POST/ANT%	1.06	2.4	1.52	1.0	-0.46	0.708	NS
FACIAL CONVEXITY(°)	-3.60	2.5	-2.80	1.6	-0.80	0.567	NS
SN-PP(°)	3.00	1.0	0.40	0.9	2.60	0.200	NS
PP-MP(°)	-4.40	2.3	-2.00	1.2	-2.40	0.074	NS
SN-OP(°)	1.60	1.1	0.80	1.1	0.80	0.291	NS
VP-A(mm)	-2.60	0.5	-1.70	1.9	-0.90	0.030	S
HP-A(mm)	-2.00	1.9	-2.20	1.9	0.20	0.872	NS
VP-B(mm)	1.20	3.8	2.10	1.4	-0.90	0.049	S
HP-B(mm)	-6.20	4.1	-4.80	3.1	-1.40	0.559	NS
U1-NF(mm)	-2.00	1.4	-1.00	1.0	-1.00	0.233	NS
L1-MP(mm)	-2.00	2.3	-2.00	1.0	0.00	1.000	NS
U6-NF(mm)	-2.00	0.7	-1.60	1.1	-0.40	0.524	NS
L6-MP(mm)	-2.40	2.6	-1.40	1.3	-1.00	0.468	NS
PNS-ANS(mm)	-1.00	1.0	-1.00	1.0	0.00	1.000	NS
Ar-Go(mm)	-1.20	1.1	-1.80	3.4	0.60	0.718	NS
Go-Pog(mm)	-1.80	3.0	-1.60	1.9	-0.20	0.904	NS

* Student's unpaired t test

. The upper and lower anterior and posterior teeth all extruded. The palatal and occlusal plane was rotated both forward and upward (counterclockwise). An increase in the angle between the palatal and mandibular plane PP-MP was noted **(Table 2).**

(2) Comparison between the groups according to SN-MP angle: Only the horizontal movement of point A and B showed a significant difference (Table 3). The forward movement of the point A was greatest in the high angle group. In the low angle group, the backward movement of the point B was the most significant. Comparison analysis was carried out with the categories showing significant difference, and the forward movement of the point A showed a significant difference between high and low. The backward movement of the point B also showed a significant difference between high and low angle group **(Fig. 4).**

(3)Comparison of the groups according to gonial angle: Only the horizontal movement of the point A showed a significant difference. The forward movement of the point A was in the following order; low <high. The backward movement of the point B was in the order; high <low. This result is similar to those from the SN-MP grouping **(Fig 4).**

Discussion :

Treatment effects are clearly the summation of both the normal growth and the orthopedic effect. In this study, the A point moved 2.2 mm forward, and SNA was increased by 2.3°. According to Shanker et al.,[24] 1.77 mm forward movement of the point A was achieved in the treated group, whereas the untreated control showed 1.2 mm increase. Ngan and coworkers showed 2.0mm forward movement of point A after 6 months of protraction. [25]. Previous studies have shown that the difference in the various values before and after treatment is much greater than that of non-treated Class III malocclusion patients or normal controls. Since this was not the main objective of this study, it did not include a comparison between the normal control and treated test group, but only demonstrated the different treatment effects depending on the various vertical facial patterns. In this study, two parameters (SN-MP, gonial angle) were used to classify the vertical facial patterns. These parameters have often been used in many studies to classify the vertical facial patterns and to establish the criteria for predicting growth. Some believe that a low SN-MP and gonial angle is related to deep bite, while a high angle suggests an open bite. Furthermore, low angle patients could have a more horizontal growth pattern and the opposite for high angle patients.

Table . 4 : The effect and significance of facemask in various gonial angle

Parameter	High Angle		Low Angle		Mean Difference	P* Value	Significance
	Mean	SD	Mean	SD			
SNA(°)	-2.00	1.22	-2.20	1.30	0.20	0.809	NS
SNB(°)	2.80	2.05	1.00	1.22	1.80	0.130	NS
ANB(°)	-4.20	1.79	-3.00	1.41	-1.20	0.273	NS
WITS(mm)	-3.20	1.92	-3.00	1.41	-0.20	0.856	NS
POST/ANT%	1.36	2.67	1.12	0.88	0.24	0.853	NS
FACIAL CONVEXITY(°)	-4.40	1.82	-3.00	1.58	-1.40	0.230	NS
SN-PP(°)	2.00	1.22	1.40	2.61	0.60	0.654	NS
PP-MP(°)	-4.00	2.35	-1.80	2.86	-2.20	0.220	NS
SN-OP(°)	1.00	1.58	0.60	1.52	0.40	0.694	NS
VP-A(mm)	-2.80	0.84	-1.90	1.02	-0.90	0.040	S
HP-A(mm)	-1.40	0.89	-2.40	1.67	1.00	0.272	NS
VP-B(mm)	3.20	2.39	1.50	1.41	1.70	0.208	NS
HP-B(mm)	-5.60	4.39	-6.40	1.52	0.80	0.710	NS
U1-NF(mm)	-2.40	0.89	-0.60	0.89	-1.80	0.130	NS
L1-MP(mm)	-2.60	1.14	-0.40	1.14	-2.20	0.160	NS
U6-NF(mm)	-2.00	0.71	-1.00	0.71	-1.00	0.056	NS
L6-MP(mm)	-2.00	1.22	-1.20	1.10	-0.80	0.308	NS
PNS-ANS(mm)	-0.80	0.84	-1.20	1.10	0.40	0.535	NS
Ar-Go(mm)	-0.40	0.55	-1.80	3.49	1.40	0.402	NS
Go-Pog(mm)	-2.80	2.17	-0.60	0.55	-2.20	0.059	NS

* Student's unpaired t test

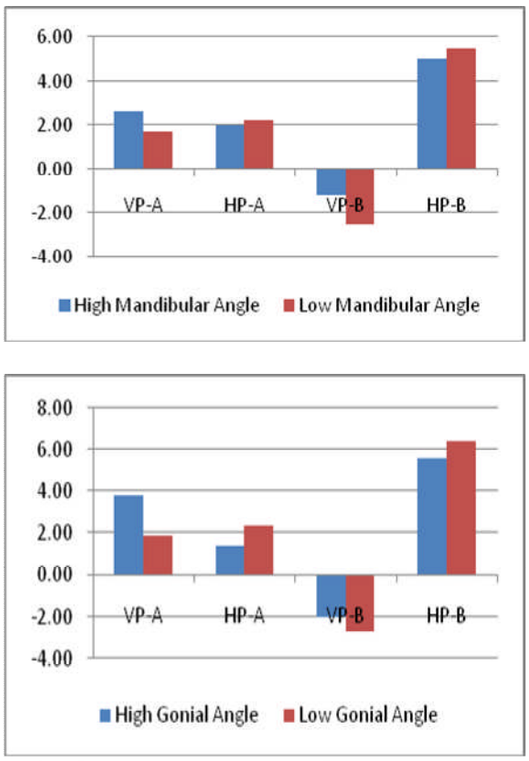


Fig.4 : Graph showing the Positional change of A point and B point in each group.

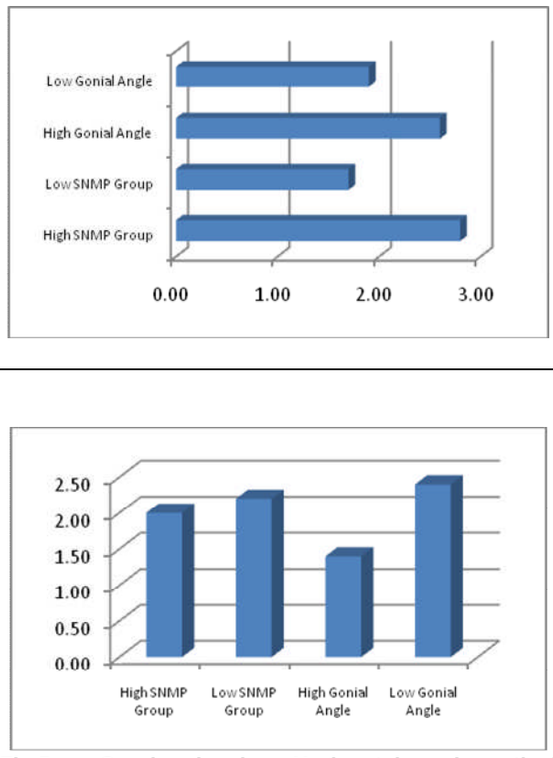


Fig.5 : Graph showing Horizontal and vertical movement of the point A.

Low angle group showed little forward and downward movement of the point A and large amount of backward and downward rotation of the mandible (Table 3 and 4). In the high angle group, the point A showed a great deal of forward movement and the mandible showed less positional change. As shown in figure 4, the parameter that exhibited the most significance in the facial patterns was the horizontal movement rather than vertical movement in the SNMP grouping.

The different amount of forward movement of the point A (low <high) and the backward movement of the point B (high <low) according to the facial patterns were quite notable. Only the forward movement of the point A between the low and high angle groups showed a significant difference in the gonial angle classification. There was no significant difference between groups related to the vertical displacement of in the upper and lower teeth, the rotation of the palatal plane along with other parameters. Therefore, in the low angle group, the mandible showed a backward and downward rotation and in the high angle group, the maxilla showed a great deal of forward displacement, thus improving the overjet and the Class III relationship. Although a long-term effect of growth was not followed up, the results suggest that the high angle group does not exhibit more extrusion in the posterior teeth and backward movement of the maxilla than the low angle group. In comparing the horizontal and vertical movement of point A (**Fig.5)** which suggested there was more horizontal movement in the groups with long facial patterns. Since short facial patterns showed little forward and downward movement of point A, it can be said that the forward and downward growth promotion was insignificant, rather than that the low angle subjects showed more vertical growth.

According to Issacson,[14] the high angle group has a higher tendency for extrusion of the molars, a weaker masticatory force a great lower facial height, and open-bite compared to the low angle group. Miller[17] and Ingervall[18] explained that the different rates of dento-alveolar development and the different growth direction of the two groups were caused by the different masticatory force. In Ueda s study,[26] in the low angle group the masseter muscle, which is a powerful closing muscle, was highly active but the digastric muscle, the opening muscle, also showed high activity. Therefore the difference in the growth pattern cannot be explained by only the masticatory muscle activity.

According to this study, favorable results may be achieved by protracting the maxilla 20-30° downward in all

general preadolescent Class III patients. In addition, the long-term effect of growth cannot be disregarded, and because this differs between facial patterns, the appliance must be modified and followed up to prevent the facial patterns from worsening.

CONCLUSION :

Orthopedic facemask was used to treat preadolescent children with skeletal Class III malocclusion. In order to compare the treatment effects depending on the vertical facial height, the skeletal Class III preadolescents were divided according to the SN-MP and the gonial angles.

By analyzing the data achieved from these groups, the following results were obtained:

1. In the SNMP grouping, more backward and down-ward rotation of the point B was observed in patients with a low angle SNMP, while those with a high angle SNMP showed significant forward movement of the point A.
2. In the gonial angle grouping, patients with a high angle exhibited more significant forward movement of the point A than the low angle group.
3. In comparing the horizontal and vertical movement of point A the high angle showed more horizontal movement while the low angle group showed more vertical movement.

References:

1. Graber LW. Chmcup therapy for mandibular prognathism. Am J Orthod 1977 72:23-41. doi:10.1016/0002-9416(77)90122-1.
2. Sugawara J, Asano T, Endo N, Mitani H. Long term effects of chin cap therapy on skeletal profile in mandibular prognathism. Am J Orthod Dentofac Orthop 1990: 98:127-33. doi:10.1016/0889-5406(90)70006-X
3. Cozzani G. Extraoral traction and Class III treatment. Am J Orthod 1981; 80:638-650. doi:10.1016/0002-9416(81)90266-9
4. HS Baik. Clinical results of maxillary protraction in Korean children. Am J Orthod Dentofac Orthop 1995;108 : 583-592. doi:10.1016/S0889-5406(95)70003-X
5. Chong YH, Ive JC, Artun J Changes following the use of protraction headgear for early correction of Class III malocclusion Angle Orthod 1996; 66 : 351-362. PMid:8893105
6. Oppenheim A. A possibility for physiologic orthodontic movement, Am. J. Orthod., 1944: 30;345-368.
7. Kambara T. Dentofacial changes produced by extraoral forward force in Macaca irus. Am J Orthod 1977; 71: 249-277 . doi:10.1016/0002-9416(77)90187-7
8. Jackson GW, Kokich VG, Shapiro PA. Experimental and postexpenmental response to anteriorly directed extraoral force in young Macaca nemsestrina Am J Orthod 1979; 75 318-333. doi:10.1016/0002-9416(79)90278-1
9. Deguchi T, KurodaT, Hunt NP, Graber TM. Long-term applica¬tion of chincup force alters the morphology of the dolichofacial Class III mandible. Am J Orthod Dentofac Orthop 1999 116: 610-615.
10. Schudy FF. The vertical dimension of the human face. Houston D.Armstrong Co. 1992.
11. Schudy FF. Vertical growth versus anteroposterior growth as related to function and treatment. Angle Orthod 1964; 34: 75-93.
12. Bjork A. Prediction of mandibular growth rotation Am J Orthod 1969-55:585-99.
13. Bjork A, Skieller V. Normal and abnormal growth of the mandible. A synthesis of longitudinal studies over a period of 25 years. Eur J Orthod 1984 6-1-14.
14. Issacson JR, Issacson RJ, Spiedel TM, Worms FW. Extreme variation in vertical facial growth and associated variations in skeletal and dental relations Angle Orthod 1971 : 41 : 219-29. PMid:5283670
15. Ricketts RM Planning treatment on the basis of the facial pattern and an estimate of its growth. Angle Orthod 1957 : 27:14-37.
16. Siriwat PP, Jarabak JR. Malocclusion and facial morphology : Is there a relationship? Angle Orthod 1985; 55 : 127-38. PMid:3874569
17. Miller E The chewing apparatus. An electromyographic study of the action of the muscles of mastication and its correlation to facial morphology. Acta Physiol Scand 69 : Supp.1966; 280 : 1 -229.
18. Ingervall B, Thuer U, Kuster R. Lack of correlation between mouth breathing and bite force. Eur J Orthod 1989;11: 43-46. PMid:2714391
19. Proffit WR, Fields HW. Occlusal forces in normal and long-face adults J Dent Res 1983; 62 : 571-4. PMid:6573374doi:10.1177/00220345830620051301
20. Schendel SA, Eisenfeld J, Bell WH, Epker BN. The long face syndrome ' vertical maxillary excess. Am J Orthod 1976; 70 : 398 -408. doi:10.1016/0002-9416(76)90112-3
21. Opdebeeck H, Bell WH. The short face symdrome. Am J Orthod 1978;73. 499-511doi:10.1016/0002-9416(78)90240-3
22. Sassouni V, Nanda S. Analysis of dentofacial vertical proportions. Am J Orthod 1964; 50: 801 -823. doi:10.1016/0002-9416(64)90039-9
23. Young-Kyu Ryu, Kee-Joon Lee, Chang-Hun Oh. The effects of maxillary protraction appliance (MPA) depending on vertical facial patterns. Korea J Orthod. 2002; 32 (6) : 413-24.
24. Shanker S. Salazar RW, Taiiercio EW et al. Cephalometnc A point changes during and after maxillary protraction and expansion Am J Orthod Dentofac Orthop 1996;110 : 423-430.
25. Ngan P, Hagg U, Yiu C, Merwin D, Wei SHY. Treatment response to maxillary expansion and protraction. Eur J Orthod 1996;18:151-68 doi:10.1093/ejo/18.1.151
26. Ueda HM, Miyamoto K, Saiffuddin, Ishizuka Y, Tanne K Masti¬catory muscle activity in children and adults with different facial types. Am J Orthod Dentofac Orthop 2000; 118 : 63-68. PMid:10893474. doi:10.1067/mod.2000.99142

Corresponding Author

Dr. NAVEEN SHAMNURMDS(Ortho)
Professor,
Department of Orthodontics & Dentofacial Orthopedics,
College of Dental Science, Davangere, Karnataka-India
Email: naveens2005@gmail.com
Phone: +919448455699