ORIGINAL RESEARCH

Effect of Vertical Maxillary Skelatal Pattern on Nasal Morphology in High and Low Angle Cases

Vaibhav Khare[1], Kumar B Niwlikar[2]

1-Reader, Dept. of Orthodontics and Dentofacial Orthopaedics, Triveni Institute Of Dental Sciences Hospital & Research Centre, Bodri , Bilaspur. 2-Associate Professor, Dept. of Orthodontics and Dentofacial Orthopaedics, Triveni Institute Of Dental Sciences Hospital & Research Centre, Bodri , Bilaspur.

Correspondence to:
Dr. Vaibhav Khare, Reader, Dept. of Orthodontics and Dentofacial Orthopaedics, Triveni Institute Of Dental Sciences Hospital & Research Centre, Bodri , Bilaspur.
Contact Us: www.ijohmr.com

ABSTRACT

Introduction: The purpose of the study was to investigate the effect of vertical maxillary skeletal pattern on nasal morphology in high and low angle cases. **Materials and method:** The sample included the lateral cephalometric radiographs of 100 Indian adults aged 16 to 25 years, with the mean age of 20 years with vertical maxillary excess divided equally into a high and low angle. Seven different skeletal parameters of vertical facial growth and six different nasal soft tissue parameters were traced and measured on lateral cephalogram. **Results:** On comparing nasal morphology in high and low angle cases, nasal length and nasal depth show satisfactory significant difference while nasolabial angle, upper nasolabial angle, lower nasolabial angle and nasal tip angle were non-significant. A slight positive correlation was seen in between lower gonial angle and nasal morphology in high angle cases except for nasolabial angle and lower nasolabial angle which shows a negative correlation. A negative correlation was seen between lower gonial angle and nasal morphology in low angle cases except for nasal depth which shows slight positive correlation. A satisfactory significant negative correlation was found between facial angle and nasal base inclination in high and low angle cases. **Conclusion**: The clinical significance of this study is that vertical midface discrepancy may not be completely reflected nasolabial angle in itself; however, nasal length, nasal depth, and form may indicate an underlying change in inclination of the palatal plane and skeletal growth pattern. This might be of value during orthodontic diagnosis and treatment planning.

KEYWORDS: Vertical Maxillary Skeletal Pattern, High Angle, Low Angle, Nasolabial Angle, Upturned Nose

INTRODUCTION

As orthodontic diagnosis and treatment planning have become more and more sophisticated and scientific, much attention has been paid to the techniques for determining the skeletal pattern, the amount and direction of facial growth and the position of the dentition.[1,2] However, far less attention has been given to provide information which would aid the clinician in producing a well-proportioned, balanced and harmonious soft tissue profile at the end of treatment.[3,4] Nasal soft-tissue growth proceeds at a relatively constant rate into adolescence and is almost completed by the age of 16 in girls and 18 in boys.[5,6] However, vertical growth of the facial skeleton continues well after puberty both in males and females, even after the completion of growth in the sagittal and transverse dimensions.[7] The relationship between nasal morphology and the facial skeletal pattern has received attention in the orthodontic literature.[8,9] However, the relationship between nasal morphology and vertical maxillary growth remains largely unexplored.

The growth of the nose is closely related to that of the maxilla in antero-posterior direction and the inclination of the maxilla. The vertical position of the maxilla also affects the nasal parameters; Nehra et al[10] found out that there is a significant correlation between vertical maxillary skeletal pattern and soft tissue nasal parameters. The nasal length was significantly correlated with upper anterior facial height and an inclination of the palatal plane. Upward nasal tip inclination showed a significant negative correlation with inclination of the palatal plane. They concluded that the vertical midface discrepancy may not be completely reflected nasolabial angle in itself; however, its upper component, i.e. the degree of the upturn of the nose with decreased nasal length in an adult subject may indicate an underlying change in inclination of the palatal plane. This might be of value during orthodontic diagnosis and treatment planning. The purpose of the study was to investigate the effect of vertical maxillary excess on nasal morphology in high and low angle cases.

MATERIALS AND METHODS

The present study was carried out in the department of Orthodontics and Dentofacial orthopaedics, Sharad Pawar Dental College, Sawangi (Meghe), Wardha. The study

How to cite this article:
Khare V, Niwlikar KB. Effect of Vertical Maxillary Skelatal Pattern on Nasal Morphology in High and Low Angle Cases.Int J Oral Health Med Res 2017;3(6):103-109. Int J Oral Health Med Res 2017;3(6):75-79.

protocol was approved by the ethical committee of Datta Meghe Institute of Medical Sciences, deemed university Sawangi (Meghe), Wardha. The sample consisted of 100 pretreatment lateral cephalometric radiographs collected from the records of the department of orthodontics and dentofacial orthopaedics Sharad Pawar dental college.

All samples were in the post-pubertal stage having age group between 16-25 years with mean age of 20 years, no one had the facial congenital anomaly, no history of prior orthodontic treatment, surgery or trauma to face.

The sample was divided into 2 groups each consisting of 50 lateral cephalometric radiographs.

Group 1- Subject with a high mandibular plane angle.

Group 2 - Subject with a low mandibular plane angle.

The sample was divided into high and low angle cases by using the following parameters:

- GoGn-SN: The mandibular plane inclination to the cranial base (31° ± 1°)[11]
- Jaraback's ratio: (62% - 65%) (below lower limit high angle, above upper limit low angle)[13]
- Lower gonial angle: N-Go-Me (72°-75°) below lower limit low angle, above upper limit high angle)[13]

The following facial skeletal parameter were assessed-[12]

1. GoGn-SN: the mandibular plane inclination to the cranium.
2. S-Go: posterior facial height. Jaraback's Ratio
3. N-Me: anterior facial height.
4. N-ANS: upper anterior face height.
5. ANS-Me: LAFH.
6. SN-Pp: the angle between the sella-nasion plane and the ANS-PNS line (inclination of palatal plane).
7. Angle of inclination: the angle between the perpendicular drawn from N' on Se-N' line and the palatal plane.
8. Facial plane; [glabella-Pog].
9. Lower gonial angle; N-Go-Me.

The following soft tissue landmarks were traced (Fig 1)[12]:

1. Soft tissue nasion (N'): the point of greatest concavity in the midline between the forehead and the nose.
2. Pronasale (Pr): the tip of nose (nasal tip).
3. Posterior columella point (PCm): the most posterior point of the lower border of the nose at which it begins to turn inferiorly to merge with the philtrum of the upper lip.
4. Subnasale (Sn): the deepest point at which the columella merges with the upper lip in the midsagittal plane.
5. Labrale superius (Ls): the point indicating the mucocutaneous border of the upper lip.

The following reference planes and variables were used (Fig 2)[13, 14]:

1. Nasal length (N Lth): the distance between N' and Pr.
2. Nasal depth (N Dpt): the perpendicular distance between Pr and the line drawn through N' to Sn.

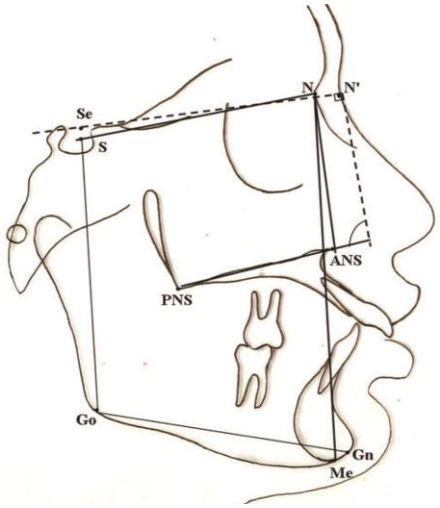

Fig 1: Vertical facial skeletal parameters assessed on lateral cephalogram

3. Nasolabial angle (NLA): the angle formed by the intersection of the PCm tangent (a tangent drawn from PCm along the lower border of the nose at the approximate middle third) and the PCm-Ls line.
4. Nasal upward tip angle (UNLA): the postero-inferior angle formed when PCm tangent is extended anteriorly to intersect the Frankfurt horizontal plane/lower border of the nose to Frankfurt horizontal plane.
5. Upper lip inclination (LNLA): the antero-inferior angle formed by the PCm-Ls line extended superiorly to intersect the Frankfurt horizontal plane/ inclination of upper lip to Frankfurt horizontal plane;
6. Nasal tip angle (NTP): the angle formed by the axis of the dorsum and PCm tangent.

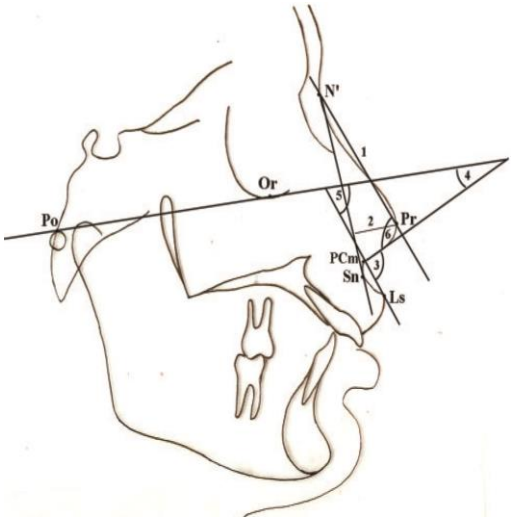

Fig.2: Soft tissue reference planes and variables used to assess nose on lateral cephalogram.

Statistical Analysis: Pair-wise Pearson product moment correlation coefficients and z-test were calculated between the skeletal measurements and the nasal parameters. Results of this comparison are reported as p

value. If the p value was less than 0.05 it was considered that the difference was significant.

RESULTS

On comparing nasal morphology in high and low angle cases, nasal length (P < 0.05) and nasal depth (P < 0.05) shows satisfactory significant difference while nasolabial angle (P = 0.77), upper nasolabial angle (P = 0.74), lower nasolabial angle (P = 0.39) and nasal tip angle (P = 0.08) were non-significant. (Table 1). A slight positive correlation was seen in between lower gonial angle and nasal morphology in high angle cases in terms of nasal length (r = 0.34), nasal depth (r = 0.11), upper nasolabial angle (r = 0.18) and nasal tip angle (r = 0.19)while, nasolabial angle (r = -0.20), and lower nasolabial angle(r = -0.10) shows negative correlation.(Table 2A). A slight negative correlation was seen between lower gonial angle and nasal morphology in low angle cases in terms of nasal length (r = -0.15), upper nasolabial angle (r = -0.41), nasal tip angle (r = -0.35), lower nasolabial angle (r = -0.22) and nasolabial angle (r = -0.35), while nasal depth (r = 0.12) shows slight positive correlation. (Table 2B). A satisfactory significant negative correlation was found between facial angle and nasal base inclination in high (r = -0.17) and low angle (r = -0.36) cases. (Table 3).

		N	Mean	Std. Dev	Std Er	95% Confidence Interval for Mean		Min	Max
						Lowr Bound	Uppr Bound		
NL	High angle	50	50.48	2.83	0.40	49.67	51.28	46.00	57.00
	Low angle	50	47.56	3.97	0.56	46.43	48.68	41.00	55.00
ND	High angle	50	18.00	2.17	0.30	17.38	18.61	15.00	24.00
	Low angle	50	16.68	1.88	0.26	16.14	17.21	13.00	19.00
NLA	High angle	50	116.72	14.20	2.00	112.68	120.75	92.00	138.00
	Low angle	50	117.48	12.79	1.80	113.84	121.11	74.00	132.00
UNLA	High angle	50	23.72	5.76	0.81	22.08	25.35	13.00	38.00
	Low angle	50	24.08	5.42	0.76	22.53	25.62	15.00	40.00
LNLA	High angle	50	92.52	14.17	2.00	88.49	96.54	70.00	119.00
	Low angle	50	94.88	13.38	1.89	91.07	98.68	48.00	111.00
NTA	High angle	50	88.32	8.53	1.20	85.89	90.74	62.00	105.00
	Low angle	50	91.08	7.48	1.05	88.95	93.20	78.00	108.00

Table 1: Comparison of nasal morphology in high and low angle cases

	Lower Gonial Angle	Nasal Morphology	N	Correlation 'r'	p-value
NL	Mean value 76.32±2.97	50.48±2.83	50	0.34	0.01 S,p<0.05
ND		18.00±2.17	50	0.11	0.43 NS,p>0.05
NLA		116.72±14.20	50	-0.20	0.14 NS,p>0.05
UNLA		23.72±5.76	50	0.18	0.19 NS,p>0.05
LNLA		92.52±14.17	50	-0.10	0.47 NS,p>0.05
NTA		88.32±8.53	50	0.19	0.17 NS,p>0.05

Table 2A: Correlation of lower gonial angle with nasal morphology in high angle cases

	Lower Gonial Angle	Nasal Morphology	N	Correlation 'r'	p-value
NL	Mean value 68.12±4.55	47.56±3.97	50	-0.15	0.26 NS,p>0.05
ND		16.60±1.87	50	0.12	0.40 NS,p>0.05
NLA		117.48±12.79	50	-0.35	0.01 S,p<0.05
UNLA		24.08±5.42	50	-0.41	0.003 S,p<0.05
LNLA		94.84±13.37	50	-0.22	0.12 NS,p>0.05
NTA		91.08±7.48	50	-0.31	0.025 S,p<0.05

Table 2B: Correlation of lower gonial angle with nasal morphology in low angle cases

		Mean	Std. Dev	N	Correlation 'r'	p-value
High Angle	Nasal base inclination	110.00	14.94	50	-0.17	0.40 NS,p>0.05
	Facial angle	80.84	6.37	50		
Low Angle	Nasal base inclination	114.76	9.98	50	-0.36	0.07 NS,p>0.05
	Facial angle	81.60	5.23	50		

Table 3A: Correlation of nasal base inclination and facial angle in high and low angle cases

DISCUSSION

The improvement of facial aesthetics has rapidly become one of the desirable objectives of orthodontic treatment. Facial aesthetics have interested orthodontists for many years and although opinions as to what constitutes an attractive face have come from many sources[15]. The soft-tissue covering of the face also plays an important role in facial aesthetics, speech, and other physiologic functions. Thus, it is recognized by all clinicians that success of orthodontic treatment is closely related to the changes in soft tissues of the face.[16]

The nose dominates the middle portion of the face and in close harmony with lips and chin defines the characteristic facial appearance of an individual. Thorough knowledge of the relationship between these facial structures, and the changes expected during and after growth, with orthodontic and surgical treatment is essential for an orthodontist to achieve the desired treatment goals.[17, 18]

A slight positive correlation between lower gonial angle and nasal morphology in high angle cases in terms of nasal length, nasal depth, upper nasolabial angle and nasal tip angle was seen. It suggests that a convex form of the nose is associated with increased lower gonial angle and a concave form of the nose is associated with decreased lower gonial angle in high angle cases. While nasolabial angle and lower nasolabial angle shows the negative correlation with the lower gonial angle which

can be explained by the fact that the value of nasolabial angle and lower nasolabial angle may alter depending upon the position of upper incisors. This can be supported by the findings of Burstone CJ[19] who measured the integumental profiles of forty subjects by relating certain soft-tissue land-marks to this base and then angularly to each other. He found that desirable or undesirable alterations in facial contour could be effected by alteration of the cytoskeletal framework.

A negative correlation was seen between lower gonial angle and nasal morphology in low angle cases in terms of nasal length, upper nasolabial angle, nasal tip angle, lower nasolabial angle, nasolabial angle and nasal depth, which suggest that nose becomes more prominent with the decrease in lower gonial angle and vice versa . The findings of our study correlate with the study of Buschang P H et al[20] and Anderson P et al[21]. They found that with a vertical skeletal growth pattern thicker soft tissue will develop at subnasale and a more prominent nose, but this potential for horizontal growth of the nose is more limited than that of an individual with a horizontal skeletal growth pattern.

On comparing nasal morphology in high and low angle cases the nasal length and nasal depth $p<0.05$, showed the statistically significant difference, which suggests that with the change in the growth pattern there is the change in nasal length and nasal depth to a significant level. Gulsen A et al[9] reported that the nose of the leptoprosopic facial-dolichocephalic skull was quite protrusive, with a convex contour and a tipped-down point. On the other hand, in the brachycephalic skull- euryprosopic facial type, a less protrusive nose tended to be straighter and frequently tipped up. Our study also showed that nasal characteristics were related to facial characteristics.

This study indicates a negative correlation between nasal base inclination and facial angle in high and low angle cases, which suggest that there is an increase in nasal base inclination with decrease in facial angle resulting in convex facial profile and convex form of nose. Similarly with a decrease in nasal base inclination there is the increase in facial angle resulting in concave facial profile and concave nose form of the nose. The finding of present study correlates with the study of Robison J M et al[22] on the relationship of skeletal pattern and nasal form. Patients with convex profiles accompanied convex nasal shapes and concave profiles were found with concave nasal shapes.

Our study contradicts the findings of the study carried out by Genecov J S et al[23]. They correlated development of facial soft tissue with the underlying skeletal pattern in various age groups from early childhood to adolescence. They concluded that no relationship exists between the amount of nasal development and skeletal pattern. The growth observed was relatively independent of the underlying skeletal hard tissue. This may be due to the differences in sample selection as it was carried out in early childhood and different parameters were used to assess the relationship between facial soft tissue and underlying skeletal pattern.

CONCLUSION

Nasal length, nasal depth and nasal form were seen to be significantly correlated to upper anterior facial height and inclination of the palatal plane. With the increase in lower gonial angle, the nose becomes more convex in high angle cases while nose becomes more prominent with the decrease in lower gonial angle in low angle cases. Nasolabial angle and lower nasolabial angle may alter depending upon the position of upper incisors. The nose becomes more convex in high angle cases and it becomes more concave in low angle cases.

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Source of Support: Nil
Conflict of Interest: Nil