Assessment of the relationship between maxillary rotation and nasal morphology in males

RAJARSHI BHUSHAN, SANTOSH KUMAR1, ARUN K. CHAUHAN1, STUTI MOHAN2, MANISH SHEKHAR3, ADITYA NARNOLY1

Abstract

Background: Nasal features are important in treatment planning for orthodontic treatment. Aims and Objectives: The purpose of the study was to assess the relationship between maxillary inclination and nasal morphology in males. Materials and Methods: Forty-five samples were selected for the study between the age group of 18 and 30 years. Selected individuals were subjected to cephalometric radiography. These lateral cephalograms were traced and divided into three groups on the basis of the angle given by Schwarz for rotation of the maxilla. The nasal features of these groups were evaluated and compared using mean, standard deviation, Student's t-test and analysis of variance. Results: The results suggest that there was statistically significant difference in nasal height, nasal bone length (NBL), nasal depth, nasolabial angle (NLA), nasal tip angle and upper lip inclination angle in different maxillary inclination group. Conclusion: The nasal height, NBL, NLA and nasal tip angle had a maximum value in retro inclination group.

Keywords: Maxillary inclination, nasal morphology, underlining hard tissue

Introduction

The profile analysis was primarily an analysis of soft tissue adaptation to the bony skeleton. However, it was recognized that certain skeletal angular criteria, amount of tonicity of the soft tissue, and muscular posture could influence the appraisal of the profile.[1] Orthodontist chooses to analyze the face before treatment by means of observation, photography, cephalometric tracing or direct measurements. The drape of the soft tissue of the lower face could be altered dramatically by orthodontic treatment. It must also be remembered that these changes have to be harmonized with many variations that will take place, regardless of orthodontic treatment to the end that a desirable result is achieved. All of these factors must be considered when the dentofacial analysis is made.[2]

Orthodontists must consider the nose, its growth potential, and its shape changes in profile analysis and treatment planning. Because forward growth of the nose is greater than that of the soft tissue chin, both add to the impression that the lips are receding within the facial profile. When nasal development is excessive, growth produces an even more convex profile. 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.[1,3]

There appears to be an association between nasal morphology and growth of the maxilla.[4] Nehra and Sharma[5] studied that an upturned nose in an individual is significantly correlated with inclination of palatal plane and anti-clockwise rotation of the maxilla. Thus, there can be a correlation between maxillary inclination and nasal morphology. In an attempt to fill this lacuna and get a more thorough understanding of nose morphology in maxillary inclination, this study was undertaken. The purpose of this study was to assess and correlate nasal morphology with different maxillary inclinations in males.

Aims and objectives

The aim of the study was to find a relationship between maxillary inclination and nasal morphology in males.

Materials and Methods

The study was conducted in the Department of Orthodontics and Dentofacial Orthopedics, Kothiwal Dental College and...
Research Center, Moradabad (Uttar Pradesh). Forty-five male individuals in group of 18–30 years were selected on random basis from the outpatient department, dental students of the Kothiwal Dental College and Research Center and from various camps organized in different colleges in and around Moradabad city. Selected individuals were subjected to cephalometric radiography in the Department of Oral Medicine and Radiology on a cephalostat manufactured by Villa (Italy, Strato 2000).

The lateral view of each subject was obtained using a standardized cephalometric technique. Prior to taking cephalogram name, age and sex for each subject was recorded, and consent was taken.

**Inclusion criteria**
- There should be dental Class I molar relationship bilaterally
- Clinically normal arch shapes
- Minimal dental crowding or spacing (<2 mm)
- Over jet should be 0–4 mm
- Clinically there should be no skeletal discrepancy
- No history of previous orthodontic treatment
- No anterior or lateral cross bite
- No pathologic periodontal condition
- No temporomandibular disorders
- No history of orthognathic surgery and/or surgery for developmental disorders like cleft lip and palate.

**The following are the Cephalometric landmarks**[3,6‑9] and **Cephalometric planes**[3,6] [Figure 1a and b] used in the study:
- Soft tissue nasion (N’)
- Nasion (N)
- Constructed soft tissue nasion (NS)
- N1
- N2
- Pronasale (Pr)
- Subnasale (Sn)
- Labrale superius (Ls)
- Alar curvature point (Ac)
- Soft tissue pogonion (Pog’)
- Posterior columella point (PCm)
- Pogonion (Pog)
- Rhinion (R)
- Subspinale (A point)
- Supramentale (B point)
- Sella (S)
- Orbitale (Or)
- Porion (Po)
- Basion (Ba)
- Anterior nasal spine (ANS)
- Posterior nasal spine (PNS)
- Point L
- Point H
- Point SD: Point of intersection of a line from pronasale (Pr) perpendicular to the soft tissue nasion (NS)-soft tissue pogonion (Pog’) line
- Point HD: Point of intersection of a line from pronasale (Pr) perpendicular to the nasion (Na)-pogonion (Pog) line
- Sella-nasion plane (S-N)
- Frankfort horizontal plane (Po-Or)
- Palatal plane (ANS-PNS)
- Pn perpendicular plane
- Nasion-rhinion (N-R)
- Basion-nasion (Ba-N)
- Basion-nasion (Ba-NS’)
- Nasion-point L (N-L)
- Soft tissue nasion-point H (NS-H)
- Point SD-Pronasale (SD-PR)
- Point HD-Pronasale (HD-PR)

**Grouping**
The collected samples were divided into three groups [Table 1] on the basis of reference lines to determine the position of the maxilla according to Schwarz,[10] the plane of the anterior cranial base (N-Se), the Pn-perpendicular, and the palatal plane. Marking of the inclination angle and of the angle between the N-Se line and the palatal plane [Figure 2].

**Following were the linear and angular nasal parameters to assess the nose.**[3,6,8,9,11] [Figure 3a and b]:
- Nasal length (N’-Pr)
- Nasal length NS (NS-Pr)
- Nasal depth (Ac-Pr)
- Nasal depth SD (SD-PR)
- Nasal depth HD (HD-PR)
- Nasal depth (Sn-Pr)
- Nasal depth H (N-H)
- Nasal height L (N-L)
- Nasolabial angle (NLA)
- Nasomental angle (NMA): The inside angle constructed between the line N’-Pr and Pr-Pog’

![Figure 1: (a) Cephalometric maxillary planes (b) Cephalometric nasal planes](image)

**Table 1: Patient distribution according to maxillary inclination**

| Groups   | Parameters          | Angle (°) |
|----------|---------------------|-----------|
| I        | Anteinclination     | >85       |
| II       | Normalinclination   | 85        |
| III      | Retroinclination    | <85       |
• Hump: The perpendicular distance between the axis of the dorsum and the most superior point of the upper part of the nasal dorsum
• Nasal bone length (NBL): The linear distance from N to R
• Nasal bone angle: The posterior angle formed between N1-N2 line and N2-R line
• Nasal upward tip angle (upper nasolabial angle): The posteroinferior angle formed when PCm tangent is extended anteriorly to intersect the Frankfurt horizontal plane/lower border of the nose to Frankfurt horizontal plane
• Upper lip inclination (lower nasolabial angle [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
• Nasal tip angle (NTP): The angle formed by the axis of the dorsum and PCm tangent
• Cranial base angle (BaNR): The angle formed by the intersection of basion-nasion plane (Ba-N) and nasion-rhinion plane (N-R)
• Ba-NS-Pr: The angle formed by the intersection of basion (Ba) soft tissue nasion (NS) plane and soft tissue (NS) Pronasale (Pr) plane.

Statistical analysis
The statistical analysis was done using Statistical Package for Social Sciences version 15.0 (IBM SPSS Modeler) statistical analysis software. The values were represented in number (%) and mean ± standard deviation (SD). Double determination for assessment of inherent error in measurement was done which showed statistically nonsignificant results between first and second readings. The statistical formulas used were mean, SD and analysis of variance.

Results
There were statistically significant difference was found on comparison of linear measurements between Groups I and II for NL with \( P = 0.007 \) [Table 2]. On the comparison of linear measurements between Groups I and III, statistically significant difference was found for NL and NBL with \( P = 0.007 \) and \( P = 0.010 \) respectively [Table 3]. On the comparison of linear measurements between Group II and III, statistically significant difference was observed for Ac-Pr with \( P = 0.019 \) [Table 4].

There were statistically significant difference was found on comparison of angular measurements between Groups I and II for LNLA with \( P = 0.046 \) [Table 5]. On the comparison of angular measurements between Groups I and III, statistically significant difference was found for NLA with \( P = 0.007 \) and NTP with \( P = 0.020 \) [Table 6]. Whereas on, comparison of angular measurements between Group II and III, statistically significant difference was observed for NLA, LNLA and NTP with \( P = 0.036, P = 0.002 \) and \( P = 0.004 \) respectively [Table 7].

Discussion
Facial beauty is a function of harmonious balance among all parts of the face. The nose plays a dominant role in facial esthetics because of its location exactly in the middle of the face.

On conducting a comparison of linear measurements between Groups I and II [Table 2], NL (Nasal height) was found to be statistically significant with maximum value in Group II (normal inclination) and minimum value in Group I (anteinclination). It means that as the maxilla rotates in anticlockwise direction the nasal height decreases.

On conducting, a comparison of linear measurements between Groups II and III [Table 4], Ac-Pr (nasal depth) was found to be statistically significant with maximum value in Group II (normal inclination) and minimum value in Group I (anteinclination). It means that as the maxilla rotates in anticlockwise direction the nasal height decreases.

On conducting, a comparison of linear measurements between Groups I and III [Table 3], NL and NBL both was found to be statistically significant with a maximum value in Group III and minimum value in Group I. Both showed an increase in length with clockwise rotation of maxilla and decrease with anti-clockwise rotation of the maxilla. Gulsen et al.\( ^4 \) found a low negative correlation of NBL with maxillary position in their study whereas in this study a positive correlation was found with maxillary rotation.

On comparing linear measurements between Groups II and III [Table 4], Ac-Pr (nasal depth) was found to be statistically significant with maximum value in Group II and minimum value in Group III but clinically these values were
not very much differentiable and it can be attributed to the 0° range in the normalinclination given by Schwarz\textsuperscript{[10]} because of which the significant changes in nasal depth came only between Groups II and III as the nasal depth decreased in retroinclination than it increased in antineinclination. The mean value for Ac-Pr and SDPR (nasal depth) was 31 mm and 25 mm respectively [Table 4], which was in the range of 22–32 mm as stated by Begg and Harkness.\textsuperscript{[12]} It remained very constant in all the three maxillary inclination groups showing that the nasal depth does not change with the rotation of the maxilla. Nehra and Sharma\textsuperscript{[5]} in their study found a very moderate correlation between nasal depth and maxillary inclination.

On conducting a comparison of angular measurements between Groups I and II [Table 5] and between
Table 7: Comparison of angular measurements between Group II and Group III

| Parameter       | Mean±SD (n=15) | t     | P     | Significance |
|-----------------|----------------|-------|-------|--------------|
| Group II        | Group III      |       |       |              |
| NLA             | 95.07±17.21    |       |       |              |
| NMA             | 123.33±5.29    |       |       |              |
| NBA             | 10.33±5.91     |       |       |              |
| UNL A           | 20.33±15.11    |       |       |              |
| LNLA            | 100.87±15.16   |       |       |              |
| NTP             | 68.13±8.72     |       |       |              |
| BaNR            | 96.93±4.61     |       |       |              |
| BaNSPr          | 91.33±3.04     |       |       |              |

*Level of significance; P<0.05. SD: Standard deviation; NS: Nonsignificant; NLA: Nasolabial angle; NMA: Nasomental angle; NBA: Nasal-base angle; UNLA: Upper nasolabial angle; LNLA: Lower nasolabial angle

Group II and III [Table 7], LNLA (upper lip inclination) was found to be statistically significant with maximum value in Group II and minimum value in Group III. It is in accordance with the study conducted by Nehra and Sharma.[5] Whereas on comparison between Group I and Group III [Table 6] it was found to be nonsignificant. This was probably because of high SD and less sample size. It was observed in the study that no particular pattern was followed by LNLA, so it was observed that it’s a very variable parameter. It even seems that with retroinclination of maxilla the upper lip follows it and the Frankfort horizontal plane even seems to move downward which is not seen with anteroinclination of maxilla

On comparing angular measurements between Group I and III [Table 6] NLA and NTP (nasal tip angle) was found to be statistically significant with maximum value in Group III and minimum value in Group I, as well on comparison of angular measurements between Group II and III [Table 7] NLA and NTP was statistically significant with maximum value in Group III and minimum value in Group II. The value of NLA was found to be increased in the retroinclination group and gradually decreases as the inclination progresses toward normalinclination and further toward anteroinclination, this result is similar to that of the study conducted by Nehra and Sharma.[5] The mean value was found to be 100° ±10° which is almost similar to the norms set by McNamara.[2] It was slightly <110° ±3.71° and 111° ±14° for Egyptian and American males, respectively as was observed by El-Hadidy et al.[14] in their study.

In angular measurements, NMA had a mean value of 123° ± 4°. It coincides with the findings of Begg and Harkness,[12] where the range given by them for was 113°–132°. Though statistically nonsignificant, the NMA angle decreases with an increase in the angle of maxillary rotation. It means that facial convexity increases with upward rotation of the maxilla and decreases with retroinclination or downward rotation. The BaNR (cranial base angle) did not show any significant change with the change in maxillary inclination indicating that there is no relationship between the cranial base angle and maxillary rotation. Posen[5] in his study found an immediate and sharp decrease in the angular relationship between the nasal bones and the cranial baseline with age. He even stated that the depression of the nasal bones ended and leveled off at 1-year of age. A steady increase in this angle began at 1.5 years and lasted to the age of 17 years, when it once again leveled off. Thus, this angle will remain stable even after 18 years of age.

**Conclusion**

From the analysis and results obtained following conclusions can be drawn:

- On comparing different maxillary inclination with linear nasal parameters, nasal height, and NBL was found to be increased in the retroinclination inclination group and gradually decreases as the inclination progresses toward normalinclination and further toward anteroinclination, whereas nasal depth was found to be increased in normalinclination group and decreased in retroclination group
- On comparing the different maxillary inclination groups with angular nasal parameters, the NLA and nasal tip angle was found to be maximum in retroinclination group and minimum in the anteroinclination group whereas upper lip inclination was maximum in normalinclination and minimum in retroinclination group
- The NMA depicting the facial convexity including the nose showed a convex profile in anteroinclination group and a decreased convexity in retroinclination group
- The change in maxillary inclination has no effect on cranial base angle.

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