Nasal Integument as an Indicator of Maxillary Skeletal Pattern

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INTRODUCTION

Now-a-days there is a shift of paradigm from Angles hard tissue to soft tissue profile as soft tissues largely determines the limitations of orthodontic treatment, from the perspectives of aesthetics, anchorage planning, function, retention, relapse and stability.¹,² Nose dominates the middle portion of the face and in close harmony with lips and chin defines the characteristic facial appearance of an individual.¹,³ Orthodontists should consider the nose, its growth potential, and its shape changes in profile analysis and treatment planning. Because the forward growth of the nose is greater than that of the soft tissue chin, create an 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.⁵–¹¹

Nasal growth proceeds at a relatively constant rate into adolescence and is almost completed by the age of 16 in girls and 18 in boys.¹²–¹⁷ However long term studies by Behrens¹⁸ indicate a considerable amount of nasal growth during adulthood. 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.¹⁹,²⁰ Scott¹¹ suggested that the cartilaginous nasal septum is a primary growth center that pushes and thrusts the midface downwards and forward. Although this hypothesis is not unanimously accepted, numerous authors²²–²⁵ have shown that prenatal and/or postnatal impaired growth of the nasal septum due to genetic or traumatic etiology causes maxillary hypoplasia in the sagittal dimension. The relationship between nasal morphology and the facial skeletal pattern has received attention in the orthodontic literature.²⁶–²⁹ The primary purpose of this study was, therefore to study the relationship between maxillary and mandibular vertical and horizontal skeletal pattern and nasal morphology. The nasolabial angle depicts a close relationship between the lips and the nose and has been studied with great interest by various authors in the orthodontic literature.³⁰,³¹ Acuteness of the nasolabial angle may be due to a proclined maxillary dentition, a short nasal projection and/or a lower nasal tip. An acute

ABSTRACT

Objectives: 1.To investigate the relationship between nasal morphology in relation to sagittal and vertical maxillary skeletal pattern and 2.To know the relationship between the degree of upturn of the nose and the inclination of the palatal plane. Materials and Methods: Pretreatment lateral cephalograms of 60 adults of age 18-27 years with no previous history of trauma, surgical intervention, and congenital disease are obtained from records of the department of Orthodontics and Dentofacial Orthopedics, G. Pulla Reddy Dental College, Kurnool. Facial skeletal parameters and 6 nasal parameters were measured on lateral cephalograms. Pearson correlation analysis was used for statistical analysis. Results: Facial heights, lengths, and the anteroposterior/vertical position of the maxilla were found to be correlated to nasal length and form. Nasal length is significantly positively correlated with anterior maxillary height (r = 0.436, P < 0.005) and inclination of the palatal plane (r = 0.344, P < 0.03). Nasal length is significantly positively correlated with maxillary length (r = 0.39, P < 0.012). Upward nasal tip inclination showed a significant negative correlation with an inclination of the palatal plane (r = -0.345, p < 0.018). Conclusion: The clinical significance of this study is that Nasal length, prominence, and form are associated with height and length of the maxilla. Nasolabial angle in itself may not indicate a mid face vertical discrepancy; however its upper component, 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.

KEYWORDS: Nasal length, Nasolabial angle, Sagittal and Vertical maxillary skeletal pattern, Upturned nose
Nasal angle due to a protrusive maxilla or maxillary incisors may be corrected with extraction of premolars and retraction of the maxillary anterior teeth.\textsuperscript{32-35} The nasal angle has two components: the inclination of the upper lip (lower nasolabial angle-LNLA) and the upward nasal tip inclination (upper nasolabial angle-UNLA). While the change in inclination of the upper lip (LNLA) has demonstrated a strong correlation with the amount of retraction of the upper incisors and increase in the lower anterior facial height (LAFH), the UNLA has not been found to be correlated either with incisor retraction or sagittal skeletal parameters.\textsuperscript{35,36} It is, however, a clinical observation of the authors that an upturned nose is frequently associated with change in the inclination of the palatal plane.

The aim of this study was thus twofold:
- To investigate the relationship between maxillary skeletal pattern and nasal morphology;
- To explore the relationship between the degree of the upturn of the nose and the inclination of the palatal plane.

**MATERIALS AND METHODS**

Pretreatment lateral cephalometric radiographs of 60 South Indian adults are obtained from records of the department of Orthodontics, G.Pulla Reddy Dental College.

**Inclusion Criteria:**
- Patients within the age group of 18 to 27 years.
- Patients with the full complement of permanent teeth (excluding third molars).

**Exclusion Criteria:**
- Patients who have undergone Orthodontic/Orthopedic/Orthognathic surgical treatment.
- Patients with the history of trauma.
- Patients with gross nasal deformity.

**Cephalometric analysis:**
10 facial skeletal parameters and 6 nasal soft tissue parameters identified on the standardized lateral cephalometric radiographs. Tracing of the cephalometric radiograph was made by hand using a sharp 3H pencil on acetate tracing paper.

The following vertical facial skeletal parameters were assessed (Figure 1):
1. GoGn-SN: The mandibular plane inclination to the cranium;
2. S-Go: Posterior facial height;
3. N-Me: Anterior facial height;
4. N-ANS: Anterior maxillary height;
5. ANS-Me: Lower Anterior Facial Height;
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 (entry of sella to soft tissue nasion) and the palatal plane.

The following sagittal skeletal parameters were assessed (Figure 2):
1. SNA: Anterior maxillary position;
2. N per-A: Anterior maxillary position;
3. Co-A: Maxillary length

The following soft tissue landmarks were identified to assess the nose (Figure 3):
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 columnella merges with the upper lip in the midsagittal plane;
5. labrale superius (Ls): the point indicating the mucocutaneous border of the upper lip;
6. The following reference planes and variables were used to assess the nose (Figure 2)
7. Nasal length (N Lth): the distance between N’ and Pr;
8. Nasal depth (N Dpt): the perpendicular distance between Pr and the line drawn through N’ to Sn;
9. Nasalabial 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;
10. Nasal upward tip angle (UNLA): the posteroinferior angle formed when PCm tangent is extended anteriorly to intersect the Frankfurt horizontal plane/ inclination of upper lip to Frankfurt horizontal plane;
11. Upper lip inclination (LNL A): the anteroinferior angle formed by the PCm-Ls line extended superiorly to intersect the Frankfurt horizontal plane/ inclination of upper lip to Frankfurt horizontal plane;
12. Nasal tip angle (NTP): the angle formed by the axis of the dorsum and PCm tangent.

Statistical Analysis: To determine whether the soft tissue nasal parameters add a linear correlation with the facial skeletal measurements in this sample, pair-wise Pearson product-moment correlation coefficients are calculated between the 10 skeletal measurements and the 6 nasal soft tissue parameters, and also in between 6 nasal parameters

RESULTS

Table 1 shows the descriptive data for the facial skeletal and nasal parameters. The Pearson product-moment correlation coefficients between the facial skeletal pattern and the soft tissue nasal parameters are listed in Table 2.

<table>
<thead>
<tr>
<th>SL</th>
<th>Parametrs</th>
<th>Mean</th>
<th>S.D</th>
<th>Confidence Interval (95%)</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>N Lth</td>
<td>44.42</td>
<td>5.99</td>
<td>42.51-46.34</td>
<td>35</td>
<td>70</td>
</tr>
<tr>
<td>2</td>
<td>N Dpt</td>
<td>16.22</td>
<td>1.80</td>
<td>15.65-16.8</td>
<td>12</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>NLA</td>
<td>88.62</td>
<td>14.09</td>
<td>84.12-93.13</td>
<td>60</td>
<td>118</td>
</tr>
<tr>
<td>4</td>
<td>UNL A</td>
<td>24.00</td>
<td>8.48</td>
<td>21.29-26.71</td>
<td>1</td>
<td>38</td>
</tr>
<tr>
<td>5</td>
<td>LNL A</td>
<td>65.72</td>
<td>9.42</td>
<td>62.71-68.74</td>
<td>40</td>
<td>83</td>
</tr>
<tr>
<td>6</td>
<td>NTP</td>
<td>80.90</td>
<td>7.59</td>
<td>78.47-83.33</td>
<td>61</td>
<td>94</td>
</tr>
<tr>
<td>7</td>
<td>GioSn-SN</td>
<td>31.32</td>
<td>6.57</td>
<td>29.22-33.34</td>
<td>14</td>
<td>43</td>
</tr>
<tr>
<td>8</td>
<td>S-Go</td>
<td>74.65</td>
<td>7.47</td>
<td>72.16-77.04</td>
<td>58</td>
<td>95</td>
</tr>
<tr>
<td>9</td>
<td>N-Me</td>
<td>113.90</td>
<td>7.53</td>
<td>111.49-116.31</td>
<td>98</td>
<td>126</td>
</tr>
<tr>
<td>10</td>
<td>Nams</td>
<td>49.32</td>
<td>3.78</td>
<td>48.12-50.53</td>
<td>39</td>
<td>60</td>
</tr>
<tr>
<td>11</td>
<td>Nth</td>
<td>66.70</td>
<td>5.57</td>
<td>64.92-68.48</td>
<td>54</td>
<td>76</td>
</tr>
<tr>
<td>12</td>
<td>AOh</td>
<td>85.85</td>
<td>5.02</td>
<td>84.24-87.46</td>
<td>65</td>
<td>98</td>
</tr>
<tr>
<td>13</td>
<td>Supp</td>
<td>6.95</td>
<td>2.53</td>
<td>6.14-7.76</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>14</td>
<td>Sn-Pr</td>
<td>83.95</td>
<td>2.16</td>
<td>82.87-85.63</td>
<td>77</td>
<td>87</td>
</tr>
<tr>
<td>15</td>
<td>N perp A</td>
<td>0.10</td>
<td>0.24</td>
<td>0.24-0.41</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>16</td>
<td>Max Lth</td>
<td>86.78</td>
<td>7.55</td>
<td>84.94-88.61</td>
<td>74</td>
<td>99</td>
</tr>
</tbody>
</table>

Table 1: Mean, S.D and Confidence Interval Minimum and Maximum Value

<table>
<thead>
<tr>
<th>N Lth</th>
<th>N Dpt</th>
<th>NLA</th>
<th>UNL A</th>
<th>LNL A</th>
<th>NTP</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.311</td>
<td>0.312</td>
<td>-0.008</td>
<td>0.078</td>
<td>-0.08</td>
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<tr>
<td>0.191</td>
<td>0.417</td>
<td>0.962</td>
<td>0.628</td>
<td>0.644</td>
<td>0.624</td>
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<tr>
<td>-0.073</td>
<td>0.23</td>
<td>-0.23</td>
<td>-0.089</td>
<td>-0.05</td>
<td>-0.17</td>
</tr>
<tr>
<td>0.653</td>
<td>0.153</td>
<td>0.154</td>
<td>0.585</td>
<td>0.723</td>
<td>0.281</td>
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<tr>
<td>0.131</td>
<td>0.464</td>
<td>-0.225</td>
<td>-0.135</td>
<td>-0.019</td>
<td>-0.221</td>
</tr>
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<td>0.421</td>
<td>0.003</td>
<td>0.163</td>
<td>0.406</td>
<td>0.908</td>
<td>0.371</td>
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<tr>
<td>0.005</td>
<td>0.003</td>
<td>0.454</td>
<td>0.317</td>
<td>0.553</td>
<td>0.401</td>
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<tr>
<td>0.066</td>
<td>0.287</td>
<td>0.047</td>
<td>0.015</td>
<td>0.005</td>
<td>-0.106</td>
</tr>
<tr>
<td>0.688</td>
<td>0.072</td>
<td>0.771</td>
<td>0.929</td>
<td>0.978</td>
<td>0.515</td>
</tr>
<tr>
<td>-0.212</td>
<td>-0.107</td>
<td>-0.029</td>
<td>0.412(*)</td>
<td>-0.042</td>
<td>0.216</td>
</tr>
<tr>
<td>0.19</td>
<td>0.513</td>
<td>0.859</td>
<td>0.002</td>
<td>0.797</td>
<td>0.33</td>
</tr>
<tr>
<td>0.344(*)</td>
<td>-0.041</td>
<td>-0.245(*)</td>
<td>0.021</td>
<td>-0.219</td>
<td></td>
</tr>
<tr>
<td>0.03</td>
<td>0.246</td>
<td>0.803</td>
<td>0.018</td>
<td>0.898</td>
<td>0.175</td>
</tr>
<tr>
<td>0.102</td>
<td>-0.024</td>
<td>-0.264</td>
<td>0.112</td>
<td>-0.23</td>
<td>-0.11</td>
</tr>
<tr>
<td>0.532</td>
<td>0.885</td>
<td>0.81</td>
<td>0.492</td>
<td>0.14</td>
<td>0.489</td>
</tr>
<tr>
<td>0.183</td>
<td>-0.016</td>
<td>-0.182</td>
<td>0.041</td>
<td>-0.251</td>
<td>-0.055</td>
</tr>
<tr>
<td>0.259</td>
<td>0.924</td>
<td>0.262</td>
<td>0.8</td>
<td>0.118</td>
<td>0.738</td>
</tr>
<tr>
<td>0.392(*)</td>
<td>0.146</td>
<td>-0.118</td>
<td>0.149</td>
<td>-0.227</td>
<td>0.068</td>
</tr>
</tbody>
</table>

Table 2: Correlations of Nasal Parameters with vertical facial skeletal parameters.

** Correlation is significant at the 0.05 level (2-tailed)
* Correlation is significant at the 0.01 level (2-tailed)

Table 3 shows the Pearson product-moment correlation coefficients between the nasal variables. Significant correlations were seen between the following skeletal and soft tissue nasal variables.

Table 3: Table 3: Correlation between nasal parameters

Nasal length (N Lth, mean 44.4 SD 5.99 mm) depicted a high positive correlation with three variables, inclination of palatal plane (SNPP, r 0.344), upper anterior facial height (NAn, r 0.436) and maxillary length(r 0.392). Within the nasal variables: nasal length had a high positive correlation with nasal depth (N Dpt, r 0.389) however a negative correlation was observed with the upper nasolabial angle (Unla, r -0.388) and nasal tip(Ntp r -0.320).

Nasal depth (N Dpt, mean 16.22 SD 1.80 mm) depicted a highly significant correlation with upper anterior facial height (NANS, r 0.463) and anterior facial height (NMe, r 0.464). With in the nasal variables Nasal depth shows...
DISCUSSION

When nasal length was correlated with sagittal skeletal parameters [Table 2], nasal length depicted an insignificant, weak positive correlation with SNA, and similar findings were also noticed, when it is related to N perpendicular to A. This is contradicted by the findings of Gulsen et al.\(^\text{29}\) who demonstrated a significant weak negative correlation of nasal length with SNA and N perpendicular to A. Nasal length also showed a significant low positive correlation with the length of the maxillary base. When correlated with vertical skeletal parameters [Table 2], it depicted a significant and high positive correlation with anterior maxillary height, which was in accordance with the findings of Gulsen.\(^\text{29}\) Karan Nehra, and Vineet Sharma. Nasal length is highly influenced by the anteroposterior length of maxilla than its position.

When nasal depth was correlated with sagittal skeletal parameters [Table 2], it showed an insignificant, weak negative correlation with SNA, and with N perpendicular to A. Nasal depth when correlated with vertical skeletal parameters [Table 2] depicted a significant and high positive correlation with anterior maxillary height and anterior facial height, which is similar to that of the findings of Gulsen et al.\(^\text{29}\)

Nasal depth has also shown a significant low negative correlation with the angle of inclination. Based on these findings, one can expect long nose with an increased nasal prominence (nasal depth) in sagittal and vertical maxillary excess and a short nose with decreased nasal prominence in sagittal and vertical maxillary deficiency.

Nasolabial angle showed no significant correlation with sagittal and vertical maxillary skeletal parameters. When nasolabial angle was correlated with sagittal skeletal parameters [Table 2], it showed an insignificant low negative correlation with SNA, with N perpendicular to A, and with the length of the maxillary base. With respect to vertical skeletal parameters [Table 2], Nasolabial angle showed an insignificant low negative correlation with anterior maxillary height, anterior facial height and an insignificant low negative correlation with Angle of inclination.

Nasal tip angle (N -Pn - Cm) studied in relation with sagittal skeletal parameters [Table 2] depicted an insignificant low negative correlation with SNA, with N perpendicular to A. When related with vertical skeletal parameters [Table 2], it showed an insignificant low negative correlation with maxillary anterior height and with anterior facial height which was in agreement with the previous studies. When related to the angle of inclination, it showed an insignificant (0.34) low positive correlation which was similar to the findings of Karan Nehra and Vineet Sharma.

Lower Nasolabial angle studied in relation with sagittal skeletal parameters [Table 2] showed an insignificant low negative correlation with SNA and N perpendicular to A. This is similar to the findings reported by Gulsen et al.\(^\text{29}\) When related with vertical skeletal parameters [Table 2] showed insignificant low positive correlation with both anterior maxillary height.

Upper Nasolabial angle depicted an insignificant and a weak positive correlation with all of the maxillary skeletal parameters. Which is similar to the findings of Gulsen et al. When related with vertical skeletal parameters [Table 2], Upper Nasolabial angle showed an insignificant low negative correlation with anterior maxillary height. It also showed significant low positive correlation with the angle of inclination and significant negative correlation with palatal plane inclination.

Within the nasal parameters, [Table 3], nasal length showed significant positive correlation with nasal depth. The nasal length and nasal depth show significant negative correlation with nasal tip and upper Nasolabial angle. Nasolabial angle shows highly significant positive correlation with nasal tip, upper and lower Nasolabial angle.

The results of our study demonstrated a strong relation between the UNLA and the vertical maxillary skeletal pattern. The highly significant negative correlation between the UNLA and the inclination of the palatal plane indicated that the nose tends to get more upturned as the maxilla rotates anticlockwise, thereby decreasing the upper anterior facial height. This fact was further supported by an increase in the AOI with an increase in UNLA. All these findings strongly suggest that if an adult patient presents with an upturned nose during the clinical examination, then it might indicate that the maxillary plane is tipped anticlockwise.

In an adult patient presents with increased nasal length and depth during the clinical examination, then it might indicate that the increased sagittal maxillary length and
increased vertical maxillary height is observed but does not have a significant influence on the position of the maxilla.

**CONCLUSION**

Nasal length was seen to be significantly positively correlated to maxillary length, and maxillary height and inclination of palatal plane. An upturned nose in an adult individual was significantly positively correlated with anti-clockwise rotation of maxilla.

**REFERENCES**

2. Proffit, WR.; White, RP.; and Sarver, DM. Contemporary Treatment of Dentofacial Deformity, Mosby, St. Louis, 2003.

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