Angular Relationship between Frankfort Horizontal Plane and Sella-Nasion Plane in Nepalese Orthodontic Patients: A Cephalometric Study

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ABSTRACT

Introduction: The angle between Frankfort horizontal (FH) plane and Sella-Nasion (SN) plane is considered to be 7°. Various studies have shown that the FH-SN angulations could vary; which can affect cephalometric diagnosis.

Objective: To determine average FH-SN angle for a group of Nepalese orthodontic patients. The secondary objectives were to assess whether the FH-SN angle exhibits sexual dimorphism and to evaluate the FH-SN angle in different skeletal relationships.

Materials & Method: Lateral cephalograms of 238 orthodontic patients were hand traced and the angle between the FH and SN plane was measured and recorded. The cephalograms were also classified as skeletal Class I, II or III cases using Wits appraisal.

Result: The average FH-SN angle was 6.71° ± 3.13°. FH-SN angle was greater in female samples compared to males. However, the difference was not statistically significant. Similarly, the ANOVA analysis revealed no significant difference between FH-SN angles in different skeletal relationships.

Conclusion: The average FH-SN angle for a group of Nepalese orthodontic patients was 6.71° ± 3.13°. There was no statistically significant difference in FH-SN angle between skeletal Class I, II and III relationships.

Keywords: Frankfort horizontal plane, lateral cephalometry, Sella-Nasion plane

INTRODUCTION

Cephalometric analysis has been a mainstay of orthodontic diagnosis using different reference planes drawn by various investigators. Two of these reference planes which have passed the test of time are Frankfort horizontal plane (FH) and Sella-Nasion plane (SN plane). FH plane is constructed by joining the inferior most point in bony orbit called orbitale (Or) with the superior most point on external auditory meatus called porion (Po). SN plane is constructed by joining the mid-point of sella tursica (S) with nasion (N). Commonly used cephalometric analyses utilize these two planes. Though all cephalometric planes show some variations, SN plane followed by FH plane have been found to be relatively stable. Any variation in the FH-SN angulation can affect the cephalometric diagnosis. However various studies have shown that the FH-SN angulation is not always 7°. Hence, assessment of FH-SN angle is imperative before drawing any cephalometric conclusion.

The primary objective of this study was to determine an average FH-SN angle for a group of Nepalese orthodontic patients. The secondary objectives were to assess whether the FH-SN angle exhibits sexual dimorphism and to evaluate FH-SN angle in different skeletal relationships.

MATERIALS AND METHOD

Two hundred and thirty-eight lateral cephalograms of patients undergoing orthodontic treatment were randomly retrieved from Department of Orthodontics, BP Koirala Institute of Health Sciences, Dharan, Nepal. The radiographs were taken between January 2013 and December 2015 by a single technician using same cephalometric machine. The study was conducted after obtaining ethical clearance from the institutional review board of BPKIHS. Radiographs with unclear landmarks and magnified image were excluded from the study.

The lateral cephalograms were hand traced on 0.003 inch matte acetate tracing paper using sharp 3H
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Errors during cephalometric analysis. After 2 weeks of initial measurement, 60 lateral cephalograms (25% of the samples) were randomly selected and measured again to ensure the intra-observer variability.

Normal distribution of data was assessed using Kolmogorov-Smirnov and Shapiro Wilk tests. Mean and standard deviation of FH-SN angle of the samples were calculated. Intraclass correlation coefficient (ICC) was calculated to assess the intraexaminer reliability. Relationship between the gender of the samples and FH-SN angle was evaluated using independent samples t-test. One-way analysis of variance (ANOVA) was used for assessing the relationship between skeletal Class I, II and III malocclusion and FH-SN angle. SPSS software version 11.0 was used for data analysis.

RESULT

The average age of the samples was 19.19 ± 6.12 years. The values of Kolmogorov-Smirnov and Shapiro Wilk tests were above 0.05; which suggest the normal distribution of the data. The mean FH-SN angle was 6.71° ± 3.13°. FH-SN angle was greater in female samples compared to males (Table 1); however, the difference was not statistically significant (Table 2).

Out of 238 samples; 117 had skeletal Class I relationship, 79 had skeletal Class II relationship and 42 had skeletal Class III relationship. When the mean FH-SN angles of 3 different skeletal relationships were compared using ANOVA analysis, it was found that there was not statistically significant difference between the groups (Table 3). Intraclass correlation coefficient (ICC) demonstrated excellent intraexaminer reliability (ICC = 0.91).

Table 1: Age and FH-SN angle of the samples

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Number of samples</th>
<th>Mean age (years)</th>
<th>Mean FH-SN angle (degrees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>111</td>
<td>18.42 ± 5.22</td>
<td>6.36 ± 2.76</td>
</tr>
<tr>
<td>Female</td>
<td>127</td>
<td>19.87 ± 6.77</td>
<td>7.01 ± 3.4</td>
</tr>
</tbody>
</table>

Table 2: T-test statistics comparing FH-SN angle between gender groups

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Male</th>
<th>Female</th>
<th>t-Value</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>FH-SN angle (degrees)</td>
<td>Mean = 6.36</td>
<td>Mean = 7.01</td>
<td>-1.624</td>
<td>0.106 (NS)</td>
</tr>
<tr>
<td></td>
<td>SD = 2.76</td>
<td>SD = 3.4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3: ANOVA results comparing FH-SN angle between skeletal Class I, II and III

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>49.993</td>
<td>2</td>
<td>24.997</td>
<td>2.578</td>
<td>0.078 (NS)</td>
</tr>
<tr>
<td>Within Groups</td>
<td>2278.542</td>
<td>235</td>
<td>9.696</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2328.535</td>
<td>237</td>
<td>-</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NS: Not significant
DISCUSSION

The present cephalometric study was conducted to determine an average FH-SN angle for a group of Nepalese orthodontic patients. The average FH-SN angle was found to be 6.71° ± 3.13°. This value is near to the generally accepted 7° angulation between FH and SN planes. But, there are studies which have reported FH-SN angle greater than 7° as well.7,10,11,14 This discrepancy in FH-SN angle could be attributed to the racial variation that exist between the samples of those studies.

The mean FH-SN angle of female samples of the present study was slightly greater than that of the male samples with 0.6° greater on average. Huh et al14 had also reported similar finding. However, this difference was not found to be statistically significant. Moreover, any cephalometric difference less than 2° is considered clinically insignificant.15 Hence, we can infer that the FH-SN angle does not exhibit a significant statistical or clinical gender dimorphism.

Another objective of this study was to evaluate the FH-SN angle in different skeletal relationships namely: Class I, II and III. The ANOVA analysis revealed that there was not a statistically significant difference between the FH-SN angles in different skeletal relationships. This finding is not in agreement with Alves et al16 who found that FH-SN angle was greater in skeletal Class II relationship compared to skeletal Class III. A possible explanation for this discrepancy might be the difference in method used for classifying skeletal relationship. Alves et al16 had used ANB angle for classifying skeletal relationship. Presence of landmark Nasion (N) in both ANB angle and FH-SN angle could lead to confounding bias. Hence, it might be more prudent to use Wits appraisal to classify skeletal relationship, as done in this study because it eliminates the role of Nasion (N) in classification of skeletal relationship.

It is evident that FH-SN angle displays inter-individual variability. Intra-individual variability of FH-SN angle is still debated; though it is accepted that this angle remains nearly constant (7°) throughout an individual’s life. There are studies which have reported an increase in FH-SN angle with age.7,14 The present study cannot answer this question whether the FH-SN angle changes with age because of its cross-sectional design. Hence, further longitudinal studies with adequate sample size are needed to assess the age-related changes in FH-SN angle.

Variation in FH-SN angle affects cephalometric diagnosis of an orthodontic case. According to Moore,8 an increase in FH-SN angle is associated with decrease in SNA and SNB values. Variation in FH-SN angle could be due to the change in inclination of SN line, FH line or both. Hence, it is imperative to evaluate the FH-SN angle before making a cephalometric diagnosis. If the variation of FH-SN angle is due to variation in SN line, cephalometric parameters which use FH line alone should be used for making cephalometric diagnosis; however cephalometric reference planes tend to be highly variable and poorly related. Hence, cephalometric analysis should be performed using more than one reference plane.17 Alternatively, perpendiculars to FH and SN lines could be used to reach the diagnosis.18

CONCLUSION

The average FH-SN angle for a group of Nepalese orthodontic patients was found to be 6.71° ± 3.13°. There was no statistically significant difference in FH-SN angle between skeletal Class I, II and III relationships. Similarly, gender dimorphism of FH-SN angle could not be established statistically.
REFERENCES