Evaluation of the Novel Midsagittal line for diagnosis of craniofacial asymmetry

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ABSTRACT

The purpose of this study was the determination of midsagittal reference line (MSL) for craniofacial asymmetry assessment by drawing a line from Crista gali parallel to the true vertical line in PA cephalometry using Natural Head Position (NHP) technique. 60 samples (30 males and 30 females, within the age range of 9 to 13 years old Iranian population) were selected with normal class I occlusion without any history of orthodontic or jaw surgery treatments. Patients had no supernumerary or missing teeth and any skeletal anomaly. Postero Antero cephalometry radiographs (PA Cephalograph) were taken from all samples with NHP technique. The midsagittal line was also traced parallel to the hanging chain from the intracranial reference point (Crista gali). This line is a true vertical line. True horizontal lines were traced perpendicular to the hanging chain from Crista gali (Cg). We can assess craniofacial symmetry with linear, angular and trigonometrical measurements in PA cephalometric radiographs by NHP technique, using true vertical and horizontal lines. The mean differences of the aforementioned measurements in left and right sides were analyzed by T-test. Each variable was measured independently; then, the mean values and standard deviation calculated separately. Also, transverse ratios were prepared in our samples (age range of 9 to 13 years). All patients were from Iranian decent. For midsagittal line (MSL) validity, the ANS (Anterior Nasal Spine) distance in the middle third and Me (Menton) distance in lower third from Midsagittal line (MSL) was measured. Findings of this study showed that PA cephalometry with NHP technique could assess the facial symmetry with the rate 96% confidence interval. Therefore, the introduced midsagittal line using NHP technique could prove the ability for diagnosis of facial asymmetries.

Key words: Natural head position (NHP), midsagittal line, facial asymmetry, true vertical line, true horizontal line, crista gali, maxillofacial surgery, orthodontics, radiology.

INTRODUCTION

Different methods with versatile features are proposed for diagnosis of facial asymmetries. By using these methods, clinicians can identify location and the amount of skeletal deformities causative of asymmetries (Fong et al., 2010; Grummons and Dappsyne, 1987; Betts et al., 1995; Aoshia, 1990; Grayson and McCarthy, 1983-1984).

Conventional methods for assessment of asymmetry are based on intracranial tow landmarks. Researchers such as Betts et al. (1995), Grayson and McCarthy (1983-1984) and Mongini et al. (1991) used two intracranial landmarks introducing conventional midsagittal line as a reference for diagnosing facial symmetry. However, credibility of this reference line depends on the landmarks which can be affected by asymmetries (Fong et al., 2010; Madsen et al., 2008). As such, validity of this reference line is questionable.

Due to controversies and statistical differences in previous studies, it became necessary proposing a new
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Figure 1. The film, chain and patient’s position for taking PA cephalogram with NHP technique (A: posterior view and B: lateral view)

The aim of this study was evaluation of midsagittal reference line for assessment of maxillofacial asymmetry in maxillofacial surgery, orthodontics and maxillofacial radiology fields. This is accomplished by using an intracranial landmark of Crista Gali with the true vertical line (a hanging chain near the patient’s face), while patient look into mirror to his/her own eyes (Chen et al., 2008).

The benefit of using this new reference line (MSL) is its independency from inconsistent intracranial structures (Cuccia and Carola, 2009).

MATERIALS AND METHODS

60 orthodontic samples (30 males and 30 females) were selected with normal occlusion. Patients were 9 to 13 years old and had no skeletal discrepancy, supernumerary, missing tooth, any past history of orthodontic treatment or jaw surgery. PA cephalometry radiographs were taken with NHP technique (in standing position), while patients looked at front mirror to his/her eyes (Mirror designed on the cassette by a special stick and against the wall in front of the patient) and hanging a chain near the face from all samples (Figure 1a and b), then, midsagittal line was traced parallel to the hanging chain from Crista Gali (Figure 2).

This midsagittal line is the true vertical line, the line drawn from Crista Gali parallel to hanging chain. The true horizontal line was traced perpendicular to the midsagittal line (true vertical line). Accordingly, the craniofacial symmetry was assessed on the basis of linear and angular measurements as well as, triangular ratios. Finally, this technique was tested so as to determine the standard transverse dimension for Iranian children.

PA cephalometry with NHP technique has specific value for assessing symmetry of a face (Figure 2); the mean differences of the aforementioned measurements in left and right sides were analyzed by T-test. Three determinant points were initially considered for evaluating facial symmetry in this study namely: A) reference points in the upper third of face; B) reference points in the middle third of face and C) reference points in lower third of face. PA cephalogram tracings was done by one person using Canson 224 × 210 dimension tracing paper with a black pencil (diameter 0.5 mm).

RESULTS AND DISCUSSION

As was mentioned earlier, linear variables, transverse, angular and triangular ratios were used for symmetric assessment. According to these linear variables, we assessed transverse ratios based upon the defined left and right of craniofacial landmarks (Tables 1 and 2).

Furthermore, according to the distance ratio from the midsagittal line in left and right sides of PA cephalometry radiograph, we assessed symmetry of face by true vertical
Figure 2. Postero-anterior cephalogram in NHP technique.

Table 1. Mean and S.D. of dentofacial linear variables in 9 to 13 years Iranian children.

<table>
<thead>
<tr>
<th>Linear variable</th>
<th>Mean</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lo-Lo</td>
<td>92.2</td>
<td>3.2</td>
</tr>
<tr>
<td>Pt-Pt</td>
<td>51.3</td>
<td>6.2</td>
</tr>
<tr>
<td>Es-Es</td>
<td>93.8</td>
<td>4</td>
</tr>
<tr>
<td>J-J</td>
<td>63.6</td>
<td>3.4</td>
</tr>
<tr>
<td>Zg-Zg</td>
<td>123.5</td>
<td>5.2</td>
</tr>
<tr>
<td>Ma-Ma</td>
<td>108.8</td>
<td>5.8</td>
</tr>
<tr>
<td>Um-Um</td>
<td>59.6</td>
<td>3.7</td>
</tr>
<tr>
<td>Ag-Ag</td>
<td>82</td>
<td>3.8</td>
</tr>
<tr>
<td>Lm-Lm</td>
<td>59.6</td>
<td>4</td>
</tr>
<tr>
<td>Co-Co</td>
<td>98</td>
<td>2.5</td>
</tr>
</tbody>
</table>

Lo = Latero-Orbital; Pt = Petrous; Es = Sphenoid; J = Jugale; Zg = Zygoma; Ma = Mastoid, Um = Maxillary molar; Ag = Antegonion; Lm = Mandibular and Co = Condylion.
and horizontal line. Each variable was measured independently and transverse ratios were prepared in all samples and then, their mean and standard deviation was calculated.

For midsagittal line (MSL) validity assessment, in middle third, the ANS distance and in lower third, the Me (Menton) distance from symmetry line was measured. The mean and standard deviation of these distances from MSL was calculated for all images. Obviously, if ANS and Me adapted on MSL, their distances were considered as zero; the differences of mean values were analyzed by T-test.

All previous studies (Fong et al., 2010; Grayson and McCarthy, 1983-1984; Athanasiou et al., 1992) for asymmetry assessment were based upon conventional PA cephalometry method, but in this study, PA cephalometry used NHP method. As such, many shortcomings of previous studies were carefully observed.

With this method, an extra-cranial landmark was used and each variable was measured, independently. In addition, this landmark has the advantage of high reproducibility. As opposed, the other intracranial anatomic landmarks are highly variable in different samples (Madsen et al., 2008). Transverse ratios in our samples were prepared. Also, personal errors and difficulties in symmetry assessment due to head movements and rotations were eliminated during the process of preparing PA cephalogram (Araujo and Wilhelm, 1994).

As discussed, reference line for dentofacial landmarks assessment is traced according to extra-cranial landmark (true horizontal and vertical lines) and by the fixed point (Crista Gali). Thus, difficulties and errors in conventional methods due to determining different intracranial landmarks by different operators were reduced significantly (Chen et al., 2008; Cuccia and Caradonna, 2009).

Reported methods by other researchers can assess only dental and skeletal landmarks according to median axis of face, except computer based method of Mongini which needs a sophisticated software component (Mongini et al., 1991). Transverse ratio analysis used in this study eliminated errors due to magnification. Since the age range of samples was limited to 9 to 13 years old Iranian children, the results of transverse ratio can be observed as a valuable reference for transverse dentofacial measurements. This range was different compared to the study of Athanasiou et al. (1992).

In the NHP method, in addition to reproducibility of X-ray procedures using extra-cranial landmarks, symmetry assessment is true and predictable up to 96%, which was similar to the report of Madsen et al. (2008).

### Conclusions

In postero-anterior cephalometry radiographs analysis with NHP method, Crista Gali, an extra-cranial landmark, is reliable for assessment of facial symmetry with minimum errors and maximum validity in the skull region, highly reproducible and up to 96% times symmetries or asymmetries were detectible.

Findings of this study showed that PA cephalometry with NHP technique could assess the facial symmetry at the rate of 96% confidence interval. Therefore, the introduced midsagittal line using NHP technique could prove the ability for diagnosis of facial asymmetries.

### REFERENCES


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