Evaluation of skeletal asymmetry in aesthetically symmetric faces

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Abstract
Aims: To evaluate the extent and nature of facial asymmetry in aesthetically symmetric faces seen in the Rajasthan population and to analyze the gender wise difference in asymmetry. Methods: The present study was carried out among 50 adult subjects (25 males and 25 females) aged 12-25 years. All the subjects were taken from the daily out patients of the Department of orthodontics and Dentofacial Orthopedics, Darshan Dental College, Udaipur, Rajasthan. A Posteroanterior (PA) cephalogram was obtained with each subject in centric occlusion. Skeletal asymmetry was determined from three bilateral landmarks as defined by Sassouni: Laterosuperior orbit (LO); Lateral zygoma (Zyg) and Gonion (Go). Results: The results indicate less asymmetry and more dimensional stability as the cranium is approached and mandibular region shows the asymmetries of higher magnitude. A tendency toward right side dominance was statistically significant. Conclusions: Even in the aesthetically symmetric faces skeletal asymmetry was common and soft tissue masking is invariably seen in all the asymmetric cases.

Key words: PA Cephalometry; Aesthetics; Asymmetry.

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Introduction

In 1907 Angle (1) said, “The study of orthodontia is indissolubly connected with that of art as related to the human face” and Berendt (2) considered that “Aesthetic problems are... of decisive importance in orthodontics”. Therefore the subject of the symmetry or lack of symmetry of the human face is of considerable interest, particularly in the field of orthodontics (3).

Facial esthetics in terms of symmetry and balance is referred to the state of facial equilibrium, the correspondence in size, form and arrangement of facial features on the opposite sides of the median sagittal plane (4). The ideal craniofacial complex should have the right and left halves each consisting of the identical structures (5). McCoy (6) regarded absolute symmetry as a normal condition so that one side of the face mirrors the other side.

Each individual shares many characteristics with the rest of population but still unique in his own sense. This uniqueness is exhibited due to variations in size, shape and relationship of skeletal, dental and soft tissue facial structures. These variations may also exist within the same individual on the opposite side of median sagittal plane of face.

Asymmetry of the craniofacial region was first recorded by an artist ‘Hasse’ (7). His investigation of early Greek statuary revealed that sculptors of the classic era duplicated nature which showed slight to moderate asymmetry in the creation of artistic works. Human craniofacial investigations was not confined to present era, studies were carried out in the past by many anthropologists (8-11), who showed varying degrees of asymmetry within the material studied. Earlier cephalometric and radiographic studies (12-16) have also shown presence of asymmetry in the normal facial features. If this were true, then it would be reasonable to believe that a pleasing, normal, symmetrical face would present a certain degree of asymmetry in the bony face.

Gross asymmetry of soft tissue can be detected directly on the living face using the soft tissue nasion and pogonion as landmarks for construction of the central line (3). An alternative approach is to use standardized full face photographs of the subject.

A more precise method is to use radiographs of the subjects. Asymmetry of the craniofacial bones can be quantified by X-ray techniques only. The most common view used is the Postero-Anterior with different reference points for construction of the midline of the face. Postero-Anterior films are most useful to better define a problem when a rather specific area of deformity exists clinically. Recently, studies on the asymmetry evaluation have not been reported and in particular no such studies could be traced among the Rajasthan population. Thus, the present study was conducted to evaluate the extent and nature of facial asymmetry in aesthetically symmetric faces in a sample of Rajasthan population and to analyze the gender wise difference in asymmetry.

Material and methods

Study population

The sample consisted of 50 adult subjects (25 male and 25 female) aged 12-25 years. All the subjects were randomly recruited from the patients attending Department of orthodontics and Dentofacial Orthopedics, Darshan Dental College, Udaipur, Rajasthan during the period of January to March 2010.

Intraoral malocclusion type and severity was not taken into consideration. Inclusion criteria for selection of the subjects were: 1) Clinically acceptable facial harmony and symmetry, 2) Full complement of teeth, and the exclusion criteria were: 1) Past history of orthodontic treatment and gross deformity
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of facial skeleton 2) Functional displacement of mandible during opening and closing.
To minimize the subjective error in selection, each person was examined by a panel of three orthodontists and was included in the study. All aspects of the study were explained to each subject and verbal as well as signed consent was taken from the same. Ethical approval for the study was taken from the ethical committee of Darshan Dental College and Hospital, Udaipur, Rajasthan.

Methods
Each subject was made to stand in the cephalostat for standardization of X-ray and a Posteroanterior (PA) cephalogram was obtained with subject positioned in centric occlusion. Tracing was done on acetate paper with the use of 0.5 mm pencil and a midskeletofacial reference line was then constructed on each cephalogram. Shore (13) method was used to generate a mid-facial reference line as shown in figure 1. In this method, two midface points are generated and a line connecting both the points is taken as mid-facial reference line. Point 1 is defined as the point of bisection between the medial aspects of the orbits at the level of planum sphenoid and point 2 is determined from the anatomic structure of the nose (projections of lines tangent to the lateral border of the nasal wall and perpendicular to the horizontal axis of the cephalostate are made. These two projections are intersected by a line drawn tangent to the most inferior point of each of the nasal cavity. The distance between the intersections is bisected to form Point 2).

Skeletal asymmetry was determined from three bilateral landmarks as defined by Sassouni (18) (Figure 1): Laterosuperior orbit (LO), Lateral zygoma (Zyg) and Gonion (Go).

Data collection was done in the following manner: the distance between each landmark, left and right, and the midskeletofacial line was recorded in millimetres. The difference between each pair of measurements was also recorded in millimetres as left side minus right side; in this way sidedness in facial asymmetry could be evaluated. The total width between the bilateral landmarks (sum of left and right side) was also calculated.

The intra examiner variability was determined by randomly selecting a sample of 10 PA cephalograms for retracing within period of one week. The error was found to be 0.5 mm, which was within normal limits.

The absolute value of the left and right difference was used to compute the mean absolute asymmetry for each of the three dimensions studied. Separate computation was made to test for left or right side dominance within the sample. Positive (+) sign for the left side and negative (-) sign for the right side were used to indicate sidedness.

Figure 1: Landmarks and Mid Skeleton-Facial Reference Line.
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Statistical analysis
The data was tabulated and descriptive statistical analysis was done. Statistical Package for Social Sciences (SPSS, 15.0) was used to perform the statistical analysis. Paired t test was performed to determine the significance of facial sidedness towards the right while unpaired t test was executed to assess the significance of difference between the genders for absolute asymmetry.

Correlation were calculated among the three dimensions measured using pearson’s correlation coefficient two-tailed test.

Results
All the subjects examined showed asymmetries in one or more of the dimensions measured.
Table 1 shows the mean absolute asymmetry and sidedness in male and female study sample for the three bilateral craniofacial dimensions investigated. The highest asymmetry was observed at Go (3.82) followed by the Zyg (3.20) and the LO (2.14), which showed least asymmetry in males and similar observations were found for the females, Go (1.86), Zyg (1.80) and LO (1.04) respectively.

In all the parameters measured, males showed greater asymmetry compared to females, in which LO and Go were statistically significant (p<0.05). In the evaluation of sidedness, the mean asymmetries for all the three dimensions showed right side dominance in males where as Zyg (-2.40) showed statistically significant right sidedness.

Table 1 : Gender wise skeleto-facial asymmetry: mean absolute value and sidedness

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Male (N=25)</th>
<th>Female (N=25)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Absolute values</td>
<td>Sidedness</td>
</tr>
<tr>
<td></td>
<td>X [d]</td>
<td>SD</td>
</tr>
<tr>
<td>LO</td>
<td>2.14†</td>
<td>1.64</td>
</tr>
<tr>
<td>Zyg</td>
<td>3.20</td>
<td>3.55</td>
</tr>
<tr>
<td>Go</td>
<td>3.82†</td>
<td>3.15</td>
</tr>
</tbody>
</table>

Paired t test; †Unpaired t test, p<0.05

Though insignificant, among females Go (0.50) showed left sidedness and other two parameters showed right sidedness.

The mean absolute asymmetry and sidedness of total study population investigated is shown in table 2. Greatest asymmetry was exhibited at Go (2.82) followed by the Zyg (2.50) data and the LO (1.59) data. All the three parameters showed right side dominance in which only Zyg (-1.60) showed statistically significant right sidedness.

Table 2 : Total skeleto-facial asymmetry: mean absolute value and sidedness

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Absolute values</th>
<th>Sidedness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X [d]</td>
<td>SD</td>
</tr>
<tr>
<td>LO</td>
<td>1.59</td>
<td>1.42</td>
</tr>
<tr>
<td>Zyg</td>
<td>2.50</td>
<td>2.75</td>
</tr>
<tr>
<td>Go</td>
<td>2.84</td>
<td>2.64</td>
</tr>
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</table>

Paired t test

Table 3: Correlation between Transverse parameters

<table>
<thead>
<tr>
<th>Transverse Parameters</th>
<th>LO</th>
<th>Zyg</th>
<th>Go</th>
</tr>
</thead>
<tbody>
<tr>
<td>LO Pearson Correlation</td>
<td>1</td>
<td>0.480**</td>
<td>0.423**</td>
</tr>
<tr>
<td>P value</td>
<td>0.000</td>
<td>0.002</td>
<td></td>
</tr>
<tr>
<td>Zyg Pearson Correlation</td>
<td>0.480**</td>
<td>1</td>
<td>0.666**</td>
</tr>
<tr>
<td>P value</td>
<td>0.000</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>Go Pearson Correlation</td>
<td>0.423**</td>
<td>0.666**</td>
<td>1</td>
</tr>
<tr>
<td>P value</td>
<td>0.002</td>
<td>0.000</td>
<td></td>
</tr>
</tbody>
</table>

**Correlation is significant at the 0.01 level.

The correlation between all three parameters was highly significant in the present study (Table 3).
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Discussion

Knowledge of facial asymmetry can be helpful in diagnosis and treatment planning in Orthodontics. In the present study, the mean absolute asymmetry values obtained reveal presence of skeletal asymmetries in aesthetically symmetric faces. The mean absolute asymmetry recorded at the level of the laterosuperior orbit was less compared to lateral zygoma and gonion in both males and females. This data suggests that the craniofacial complex exhibits less asymmetry and greater dimensional stability as the cranium is approached, which is in accordance to the study done by Peck and Peck in 1991 (17).

Males had greater values of asymmetry in comparison to females in all three parameters evaluated. The mean absolute asymmetry values at LO and Go in males were almost twice the amount of asymmetry among the females which was statistically significant.

It was interesting to note that all the three parameters showed right side dominance and Zyg showed statistically significant right sidedness which is similar to studies done by Shah and Joshi in 1978 (5), Farkas and Cheuing (19), Peck et al (17) and Ferrario et al in 1994 (20). Woo (10) has suggested that right craniofacial dominance may be naturally favoured for neuroanatomic developmental reasons. However, other studies (15,16,21) have found a tendency towards left side dominance.

Compared to the study done on white adults (17), present study showed higher rates of asymmetry at LO and Zyg, whereas at Go former study observed higher rates of asymmetry. This indicates that the present sample of Rajasthan population had more asymmetry at Lo and Zyg compared to White adults, however the white adults exhibited more asymmetry at Go in contrast to the present study population. A common observation in both the studies was the sidedness which demonstrated right side dominance.

In the present study, among the esthetically well balanced faces, correlations between all the three parameters were highly significant.

Conclusions

In the present study an attempt was made to quantify skeletal asymmetries in aesthetically symmetric faces. From the study, following conclusions can be drawn which could be attributed to the present study population

- Males showed higher rates of asymmetries compared to females.
- There was a right side dominance of facial asymmetry.
- The craniofacial complex exhibited less asymmetry as the cranium was approached

References

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