ORIGINAL ARTICLE

Evaluation of facial asymmetry in esthetically pleasing faces

Yagnesh Rajpara, Tarulatha R. Shyagali[1], Kalyani Trivedi[2], Prabhuraj Kambalyal[1], Tapan Sha[1], Varun Jain[1]

Departments of Orthodontics and Dentofacial Orthopaedics, Goneka Research Institute of Dental Sciences, Gandhinagar, [2]Karnavati School of Dentistry, Ahmedabad, Gujarat, [1]Darshan Dental College and Hospital, Udaipur, Rajasthan, India

ABSTRACT

Aims: The aim of the following study is to assess the extent of facial skeletal symmetry or asymmetry in individuals who had no visible facial asymmetry. **Materials and Methods:** Posterior-anterior cephalographs of 50 esthetically pleasing faces were taken and traced for the Grummon's facial asymmetry analysis. Parameters such as the horizontal planes, mandibular morphology, mandibular deviation and the transverse asymmetry were measured. To find the difference between different parameters Student's *t*-test was performed. **Results:** There existed a significant difference between the mandibular morphology measurements such as condylar-gonion distance, gonion-menton distance and the condylar-menton distance. Moreover the mandible showed the left side deviation. There was highly significant correlation between the zygomatic arch and the measurements like nasal cavity distance, condylar distance and the jugular process distance to the mid-sagittal plane. **Conclusion:** Skeletal asymmetries are a common finding even in individuals who have normal facial features. Right sided dominance of the mandible was more and there was also tendency for the craniocaudal increase in the rate of the asymmetry.

Key words: Esthetics, asymmetry, mandibular deviation, skeletal asymmetry, transverse skeletal asymmetry

Introduction

Facial symmetry and asymmetry are of prime importance in judging the face to be attractive or unattractive. Facial symmetry is considered attractive in women[1] and women are less attracted to men with asymmetrical faces and symmetrical faces correlate with long term mental performance.[2] The art of facial beauty, the symmetry and the asymmetry related to it are of considerable interested in the field of the art, plastic surgery, orthognathic surgery, orthodontics and psychology.

The facial symmetry is considered as the prime requisite for the esthetically pleasing faces and facial esthetics in terms of symmetry and balance is termed as state of facial equilibrium. The left and right side of the face should correspond to each other in size, shape and volume with respect to the mid-sagittal plane if the face is symmetrical. Asymmetry is supposed to be seen in the face where the bilateral structures are not equidistance from the mid-sagittal plane.[3]

Access this article online	
Quick Response Code:	Website: www.jorthodr.org
	DOI: 10.4103/2321-3825.131118

The usual scenario of the asymmetry measurement is the qualitative analysis of the asymmetry through visualization which is followed by the quantitative measurements,[4] either directly taking the measurement on the face i.e., anthropometry or indirectly by measuring on the photographs in case of extra oral facial asymmetry. Whereas, the skeletal asymmetries are supposed to be measured by using different radiographic views like the lateral cephalograms, the panoramic radiographs, sub mental vertex view, the posterior-anterior cephalogram and the latest the computer tomographic view.[4-11]

The facial asymmetries are the common findings in otherwise normal looking faces, and the same was proven by using the composite photographs of the individuals,[12,13] where by using the image technology the right and the left halves of the faces are separated

Address for correspondence: Dr. Tarulatha R. Shyagali, Staff Quarter No. 6, Darshan Dental College Campus, Ranakpur Road, Loyara, Udaipur, Rajasthan, India. E-mail: drtarulatha@gmail.com

and by joining the similar side picture a composite photograph was created and both the photographs looked different. The underlying cause for this asymmetry in normal looking people is the issue to be addressed. Many studies have evaluated the facial asymmetries,[4-12,14,15] but very few have addressed the skeletal asymmetry in normal pleasing face[16,17] and the present article will analyze the extent of skeletal asymmetry in otherwise normal looking faces using the posterior-anterior cephalograms.

Materials and Methods

A cross-sectional study was conducted on a sample of 50 adult subjects (25 male and 25 female). Simple random sampling was executed for the sample selection. All the subjects were taken from the daily out patients of the Department of Oral Medicine and Radiology, Darshan Dental College, Loyara, Udaipur, Rajasthan. The subjects were selected irrespective of intraoral occlusion/malocclusion. Criteria for selection of the subjects were:

1. Clinically acceptable facial harmony and symmetry.
2. Full complement of teeth.
3. No history of orthodontic treatment and gross deformity of the facial skeleton.
4. No functional displacement of mandible during opening and closing.

To minimize the subjective error in the selection, each person was examined by a panel of three orthodontists and the subjects were selected when all the three agreed. A total of 85 patients were examined and out of which 50 met the selection criteria. The subject was made to stand in the cephalostat and the target to source distance of five feet was maintained [Figure 1]. All the cephalograms were taken by the same machine (Gendex Orthoralix Panoramic/Cephalogram combination unit X-ray machine) and by the same radiographer. Each film was exposed for 0.80 s at 78 kVp and 10 mA setting and they were developed for 30 s and fixed for 60 s and dried. The radiographs were taken with the teeth in centric occlusion. Head position was fixed using a fluid level device and the plumb line. The purpose of the study was explained to the subject and the informed consent was obtained for participating in the study. The ethical clearance was obtained by the ethical committee of the Darshan Dental College and Hospital, Udaipur.

Tracing was done on acetate matte tracing paper (0.003 inches thick) using 0.5 mm pencil. The analysis for assessment of transverse frontal facial asymmetry was done by using parts of the frontal asymmetry analysis suggested by Grummons.[18] All the measurements which are taken are shown in Figures 2-5.

Figure 1: Individual positioned within the cephalostat for PA cephalogram

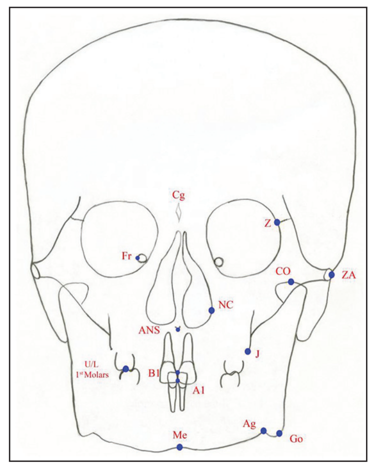

Figure 2: Anatomic Landmarks. Cg: Crista Galli, Z: Zygomatico-frontal suture, ZA: Zygomatic arch, CO: Condylion, ANS: Anterior nasal spine, NC: Nasal cavity at widest point, J: Jugal process, Go: Gonion, Ag: Antegonial notch, Me: Menton, A1: Upper central incisor edge, B1: Lower central incisor edge, U/L 1st Molars: Upper and lower 1st Molars, Fr: Foramen rotundum

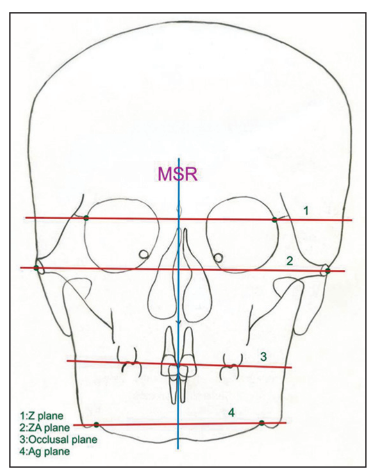

Figure 3: Mid-sagittal reference line and horizontal planes

The intra examiner variability was determined by randomly selecting a sample of 10 PA cephalograms for retracing within a period of 1 week. Kappa statistics was performed for the same and it account for the 0.92 (κ = 0.92).

The absolute value of the left and right difference (|d|) was used to compute the mean absolute asymmetry for each of the 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.

Statistical Analysis

The statistical analysis was performed to find out the parameter which was least variable and thus most reliable for the determination of skeletal asymmetry and sidedness. Statistical analysis was also applied to find out the correlation among various parameters.

Data collected by the investigator were first entered to Excel (Microsoft Office Excel 2007). All data were visually screened for any missing data or outliners and for validity of distribution assumptions. Though we have checked for the outliners, they were not encountered in this particular set of data (if it all they are present one should measure the particular data again and rectify the same). The data were collected, tabulated, and statistically analyzed using the SPSS 15.0 programme (IBM, New York, US) statistical analysis package software. Independent *t*-test was used to find the differences between different measurements. The data was checked for the normal distribution using *t*-statistics and then the correlation coefficients between the various parameters were calculated using Pearson's correlation to determine which combination would produce a higher value.

Results

All the subjects examined showed asymmetries in one or more of the measured dimensions. Table 1 shows the vertical asymmetry for the four planes investigated. The mandibular morphology in the form mean absolute value and the sidedness is depicted in Table 2. The present population showed 2.45° of asymmetry at Go angle. The Co-Go shows least and Go-Me shows highest rate of asymmetry of 2.23 mm and 3.96 mm respectively. In the sidedness, Go angle shows right sidedness. Both the Go-Me and Co-Me shows right sidedness, but Co-Go shows left sidedness which is statistically significant [Table 2].

Description of skeletofacial asymmetry in the transverse direction, their mean absolute value and sidedness (in

Table 1: Mean absolute value for the vertical asymmetries (in degree)

Angle	Male (*N* = 25)		Female (*N* = 25)		*P* value	Total (*N* = 50)	
	Mean $\bar{X}$	SD	Mean $\bar{X}$	SD		Mean $\bar{X}$	SD
Z – plane	89.92°	1.55°	89.9°	1.09°		89.91°	1.33°
ZA – plane	90.1°	1.57°	90.32°	0.76°		90.21°	1.22°
Occlusion – plane	90.22°	1.74°	90.16°	1.49°		90.19°	1.60°
Ag – plane	90.32°	1.71°	90.72°	1.32°		90.52°	1.53°

*Significant, *P* < 0.05. SD: Standard deviation

Table 2: Total mean absolute value and sidedness (in degree and millimeter) for the mandibular morphology

Dimension	Absolute values		Sidedness		
	$\bar{X}_{\lvert d \rvert}$	SD	$\bar{X}_d$	SD	*P* value
Go – angle	2.45°	2.09°	−0.65	3.17°	0.154
Co – Go length	2.23	1.98	0.85	2.87	0.042*
Go – Me length	3.96	3.15	−3.04	4.06	0.000*
Co – Me length	2.56	2.23	−1.70	2.95	0.000*

*Significant, *P* < 0.05. SD: Standard deviation

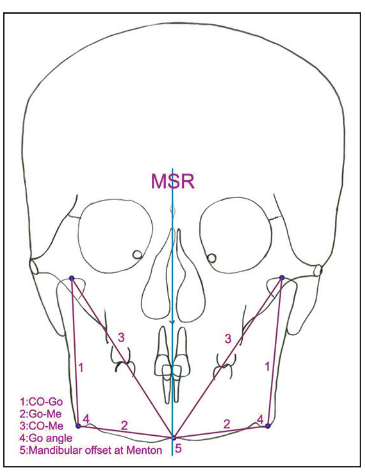

Figure 4: Mandibular morphology and mandibular deviation

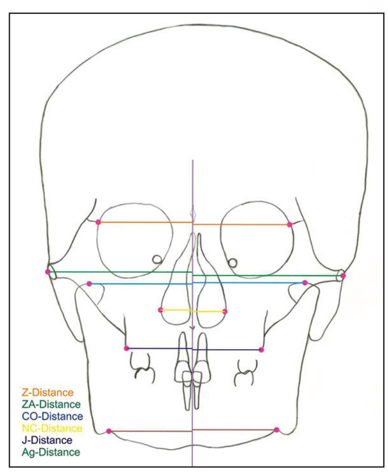

Figure 5: Transverse parameters

millimeters) in Table 3. Co shows highest (3.46 mm) and Z shows lowest (1.07 mm) rate of asymmetry. In the sidedness ZA, NC and Co shows the right side bias, in which ZA and Co are statistically significant. But Z, J and Ag shows the left side bias, in which J and Ag are statistically significant [Table 3].

Table 4 shows mandibular deviation, their mean absolute value and sidedness (in millimeters). 2.19 mm of mandibular deviation with the left side dominance was seen and same was statistically significant [Table 4].

Calculation of correlation among all the transverse parameters is presented in Table 5. It shows reasonable association between ZA and NC, ZA and Co, ZA and J, including Co and NC. All the correlations are statistically significant, but ZA and NC, and ZA and Co are highly significant among them [Table 5].

Table 3: Total skeletal asymmetry in transverse direction, mean absolute value and sidedness (in millimeter)

Dimension	Absolute values		Sidedness		
	$\bar{X}_{\lvert d \rvert}$	SD	$\bar{X}_d$	SD	*P* value
Z − distance	1.07	1.36	0.15	1.73	0.544
ZA − distance	2.50	2.75	−1.60	3.36	0.002*
NC − distance	1.41	1.13	−0.11	1.81	0.670
Co − distance	3.46	2.91	−1.36	4.33	0.031*
J − distance	1.34	1.25	0.52	1.76	0.043*
Ag − distance	2.62	1.96	0.96	3.15	0.036*

*Significant, $P < 0.05$. SD: Standard deviation

Table 4: Total mandibular deviation: Mean absolute value and sidedness (in millimeters)

Dimension	Absolute values		Sidedness		
	$\bar{X}_{\lvert d \rvert}$	SD	$\bar{X}_d$	SD	*P* value
Mandibular offset at mention	2.19	1.58	1.19	2.44	0.001*

*Significant, $P < 0.05$. SD: Standard deviation

Table 5: Correlations between transverse parameters (*N* = 50)

Transverse parameters	Z	ZA	NC	Co	J	Ag
Z						
Pearson correlation	1	0.183	−0.088	0.053	−0.032	0.141
P value		0.203	0.543	0.713	0.825	0.329
ZA						
Pearson correlation	0.183	1	0.486**	0.693**	0.360*	0.250
P value	0.203		0.000	0.000	0.010	0.080
NC						
Pearson correlation	−0.088	0.486**	1	0.322*	0.198	0.275
P value	0.543	0.000		0.023	0.167	0.053
Co						
Pearson correlation	0.053	0.693**	0.322*	1	0.194	0.094
P value	0.713	0.000	0.023		0.177	0.515
J						
Pearson correlation	−0.032	0.360*	0.198	0.194	1	0.482**
P value	0.825	0.010	0.167	0.177		0.000
Ag						
Pearson correlation	0.141	0.250	0.275	0.094	0.482**	1
P value	0.329	0.080	0.053	0.515	0.000	

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

Discussion

The present study was done to detect the skeletal asymmetry in otherwise normally looking individuals.

Parallelism of the facial structures in the cranial base and the lower facial region was assessed and there existed no significant difference for the different asymmetries measurements. Results indicated that the facial structures were more or less parallel to each other and no gross canting was seen in the present study and the findings are in agreement with the earlier study.[15,16]

The mandibular morphology evaluation using various measurements showed a significant difference for the mean sidedness and absolute values for condylion-gonion length, gonion-menton length and the condylion-menton length, with later two showing the left sidedness. Gonial angle in the present study showed right sidedness and same is in accordance to the results of previous study.[15,16]

When the mean absolute and the sidedness values were compared in transverse dimension there existed a significant difference between zygomatic distance, condylar distance, jugular distance and the antegonial notch distance, with zygomatic arch distance and the condylar distance showing right sidedness. Whereas left sidedness was appreciated for the jugular process distance and the antegonial notch distance, which is in contrary to earlier reports.

The mandibular offset at the menton was 2.19 mm and this deviation is less compared to the study done by Goel *et al*.[15] This is in agreement with Severt and Proffit[18] who found incidence of 74% of chin deviations. This high incidence of chin deviation may be due to the asymmetries of mandibular length, which also showed high incidence. Chin deviation in the present study showed left sidedness which is in agreement with findings of earlier studies.[15,17]

There existed highly significant correlation between the zygomatic arch and the measurements like nasal cavity distance, condylar distance and the jugular process distance to the mid-sagittal plane. Cranial base and all other structures which are correlated are situated in the mid-face region that might be the reason behind the highly significant correlation. Similarly, jugular process distance and the antegonial notch distance shared a highly significant correlation. The reason might be the vicinity of their location. J shows left sidedness and NC shows right sidedness which is opposite to the results of previous study.[15]

More than 50% of the examined subjects in the present study showed asymmetry of 2 mm or more in the cranial region. In addition the results are in a similar line with results of the previous studies.[11,15,17,19]

The findings for the sidedness for the different parameters were variable and the most of measurements pertaining to the mandibular morphology showed right sidedness. Sleeping habits and other environmental influences may play a role in the difference between left and right sidedness. However, Lear[20] described a method for graphic and metric appraisal of the arch and palate form. He concluded that there was a marked asymmetry in the arch form where the subject spent equal positions at night with the right and the left cheeks pillowed. Nevertheless most of the earlier studies reported right side of the cranial structures to be greater in dimension then the left.[21]

When we considered the asymmetries from hair line to chin, we found that the asymmetries decrease in magnitude as we approach higher in craniofacial region and mandibular region showed the asymmetries of higher magnitude. This finding is in agreement with the results of Peck *et al*.,[17] and Goel *et al*.[15]

Chierici *et al*.[22] have described with their animal experiments that asymmetry of the face is related to functional demands of the masticatory apparatus and the musculo-skeletal systems, and skeletal asymmetry reflects onto the soft-tissue of the face, this is in contrast to the present study where mild skeletal asymmetry does not reflects onto the soft-tissue of the face.

Clinical Relevance

Skeletal asymmetries are the common findings in otherwise normal looking faces and are not supposed to be treated unless there are any occlusal disturbances.

Conclusion

Following conclusion can be drawn from the present study:
1. Asymmetries are common finding in human beings.
2. The asymmetries decrease in magnitude as we approach higher in craniofacial regions and mandibular region shows the asymmetries of higher magnitude.
3. Right side dominance of mandibular asymmetry was appreciated.

References

1. Fink B, Penton-Voak IS. Evolutionary psychology of facial attractiveness. Curr Dir Psychol Sci 2002;11:154-8.
2. Feng C. Looking good: The psychology and biology of beauty. Journal of Young Investigators 2002; 6. Stanford University.
3. Peck H, Peck S. A concept of facial esthetics. Angle Orthod 1970;40:284-318.
4. Marmary Y, Zilberman Y, Mirsky Y. Use of foramina spinosa to determine skull midlines. Angle Orthod 1979;49:263-8.
5. Ras F, Habets LL, van Ginkel FC, Prahl-Andersen B. Method for quantifying facial asymmetry in three dimensions using stereophotogrammetry. Angle Orthod 1995;65:233-9.
6. Arnold TG, Anderson GC, Liljemark WF. Cephalometric norms for craniofacial asymmetry using submental-vertical radiographs. Am J Orthod Dentofacial Orthop 1994;106:250-6.
7. Major PW, Johnson DE, Hesse KL, Glover KE. Landmark identification error in posterior anterior cephalometrics. Angle Orthod 1994;64:447-54.
8. El-Mangoury NH, Shaheen SI, Mostafa YA. Landmark identification in computerized posteroanterior cephalometrics. Am J Orthod Dentofacial Orthop 1987;91:57-61.
9. Grayson BH, McCarthy JG, Bookstein F. Analysis of craniofacial asymmetry by multiplane cephalometry. Am J Orthod 1983;84:217-24.
10. Forsberg CT, Burstone CJ, Hanley KJ. Diagnosis and treatment planning of skeletal asymmetry with the submental-vertical radiograph. Am J Orthod 1984;85:224-37.
11. Letzer GM, Kronman JH. A posteroanterior cephalometric evaluation of craniofacial asymmetry. Angle Orthod 1967;37:205-11.
12. Cheong YW, Lo LJ. Facial asymmetry: Etiology, evaluation, and management. Chang Gung Med J 2011;34:341-51.
13. Rhodes G, Peters M, Lee K, Morrone MC, Burr D. Higher-level mechanisms detect facial symmetry. Proceedings of the Royal Society B: Biological Sciences 2005;272:1379-84.
14. Vig PS, Hewitt AB. Asymmetry of the human facial skeleton. Angle Orthod 1975;45:125-9.
15. Goel S, Ambedkar A, Darda M, Sonar S. An assessment of facial asymmetry in Karnataka population. J Indian Orthod Soc 2003;36:30-8.
16. Shah SM, Joshi MR. An assessment of asymmetry in the normal craniofacial complex. Angle Orthod 1978;48:141-8.
17. Peck S, Peck L, Kataja M. Skeletal asymmetry in esthetically pleasing faces. Angle Orthod 1991;61:43-8.
18. Severt TR, Proffit WR. The prevalence of facial asymmetry in the dentofacial deformities population at the University of North Carolina. Int J Adult Orthodon Orthognath Surg 1997;12:171-6.
19. Alavi DG, BeGole EA, Schneider BJ. Facial and dental arch asymmetries in Class II subdivision malocclusion. Am J Orthod Dentofacial Orthop 1988;93:38-46.
20. Lear CS. Symmetry analyses of the palate and maxillary dental arch. Angle Orthod 1968;38:56-62.

21. Bjoerk A, Bjoerk L. Artificial deformation and cranio-facial asymmetry in ancient peruvians. J Dent Res 1964;43:353-62.
22. Chierici G, Harvold EP, Dawson WJ. Primate experiments on facial asymmetry. J Dent Res 1970;49:847-51.

How to cite this article: Rajpara Y, Shyagali TR, Trivedi K, Kambalyal P, Sha T, Jain V. Evaluation of facial asymmetry in esthetically pleasing faces. J Orthod Res 2014;2:79-84.

Source of Support: Nil. **Conflict of Interest:** None declared.