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An Assessment of Sexual Dimorphism in Relation to Facial Asymmetry in Esthetically Pleasing Faces

Yagnesh Rajpara[1], Tarulatha R. Shyagali[2]

[1]Department of Orthodontics and Dentofacial Orthopedics, Goneka Research Institute of Dental Sciences, Gandhinagar, Gujarat, India.
[2]Department of Orthodontics and Dentofacial Orthopedics, Darshan Dental College and Hospital, Udaipur, Rajasthan, India.

Corresponding author: Dr. Tarulatha R Shyagali. Staff quarter No: 6, Darshan Dental College Campus, Ranakpur Road, Loyara, Udaipur, Rajasthan, India. Mobile No: 07742129768. E –mail: drtarulatha@gmail.com,

ABSTRACT

Objective: The aim of the study is to detect gender-wise difference in the skeletal asymmetry in the esthetically pleasing faces. **Materials and methods:** a cross sectional study was conducted on 25 females and 25 males of age 18 -25 years using the posterior-anterior cephalograms. The selected part of grummon's frontal analysis for analyzing the vertical skeletal asymmetries, mandibular morphology, transverse asymmetry and mandibular deviation was used. The obtained data was subjected to independent student's 't' test for comparing the difference between males and females. **Results:** there was statistically significant difference between the males and females for the measurements like Gonion-Menton length for the mandibular morphology and for the transverse parameters like zygomatico frontal suture length, jular length and antegonial notch length. There was no significant difference for the sidedness of asymmetry for the males and females. **Conclusion:** frontal facial asymmetry showed sexual dimorphism with males showing greater asymmetric values than the females. The asymmetry showed right sided prominence for both the males and females. This knowledge can be utilized for planning facial reconstruction and remodeling surgeries.

Key words: Asymmetry, Grummon's Analysis, posterior-anterior cephalogram, Sexual Dimorphism

1. INTRODUCTION

One of the prime component in evaluation of the face is the detection of facial asymmetry (1). Facial Asymmetry is considered to be unaesthetic and has bearing on the selection of the partner (2) and the social wellbeing of the person (3). Apart from this symmetry faces are considered to be healthy and genetically bestow a good quality assurance (4, 5, 6). Certain conditions like clefts of face, tooth size asymmetries, using right sided organs over the left side by humans, all show the tendency for asymmetry in day to day life (7, 8). This asymmetry is not only is pertaining to the human face but also to other entities like micro blood supply and function (9, 10).

Finding the perfectly well balanced face is a myth as some amount of asymmetry is bound to be there in all the individuals (11). This point has been proven by the mirror image photographs or the composite photographs (12, 13), where it was evaluated that the right and the left side of face were non identical and the right side composite photographs were more preferred than the left side (14). The role of genetics and the embryonic encoding in the central nervous system can also be cited for these asymmetries (15).

The trend behind measuring the asymmetry is not new to the field of biological science, but locating and the quantifying the asymmetry is required for the face authentication and reorganization, for diagnose the pathologies in orthodontics and orthopedic field, for the reconstruction surgery planning and for detecting the psychological imbalances in the individuals (16). The past literature survey showed the presence of asymmetry in perfectly symmetrical faces (17, 18, 19), but the sexual dimorphism existing for the asymmetry has been explored to the lesser extent. The present article was aimed to evaluate and compare the extent of skeletal facial asymmetry in otherwise symmetric faces of male and female subjects of Indian origin.

2. MATERIALS AND METHODS

Simple random sampling was executed to select an initial sample of 80 subjects aged between 18 to 25yrs, who walked in to the department of oral diagnosis for the routine check-up. The samples were evaluated for the clinically acceptable facial symmetry, full complement of teeth, and absence of functional deviation of the mandible by a single examiner. The selected sample than was evaluated by the panel of three expert orthodontist for all the above said parameters again. The unison decision of the judges was taken into consideration and the final sample included 25 females and 25 males. Posterior anterior cephalograms (P-A ceph) of all the subjects were taken
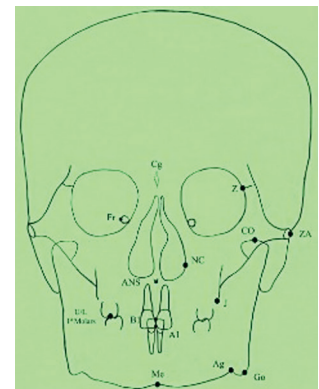

Figure 1. *Anatomic Landmarks. Legend: Cg – Crista Galli, Z – Zygomatico–Frontal Suture, ZA – Zygomatic Arch, CO – Condylion, ANS – Anterior Nasal Spine, NC – Nasal Cavvity at widest point, J – Jugal Process, Go – Gonion, Ag – Antegonial notch, Me – Menton, A1 – Upper central incisor edge, B1 – Lower central incisor edge, U/L 1st Molars – Upper & Lower 1st Molars, Fr – Foramen Rotundum*
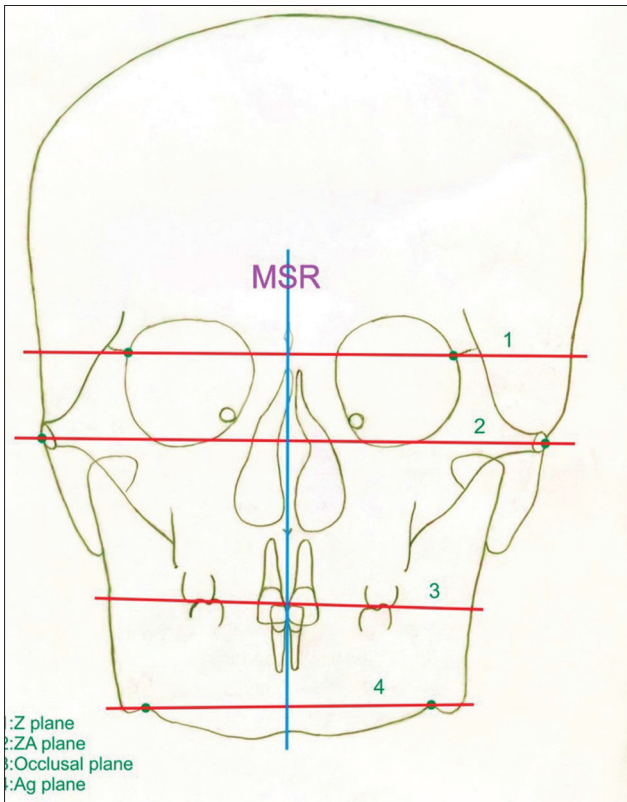
Figure 2. *Mid Sagittal Reference line & Horizontal Planes*

in natural head position with the plumb line and fluid level device to guide the head position. The frank-fort horizontal plane was parallel to the floor and the teeth were in centric occlusion during the exposure.

The purpose and procedures of the study was explained to all the 50 subjects and the written consent was obtained for willingness to participate in the study. The ethical clearance
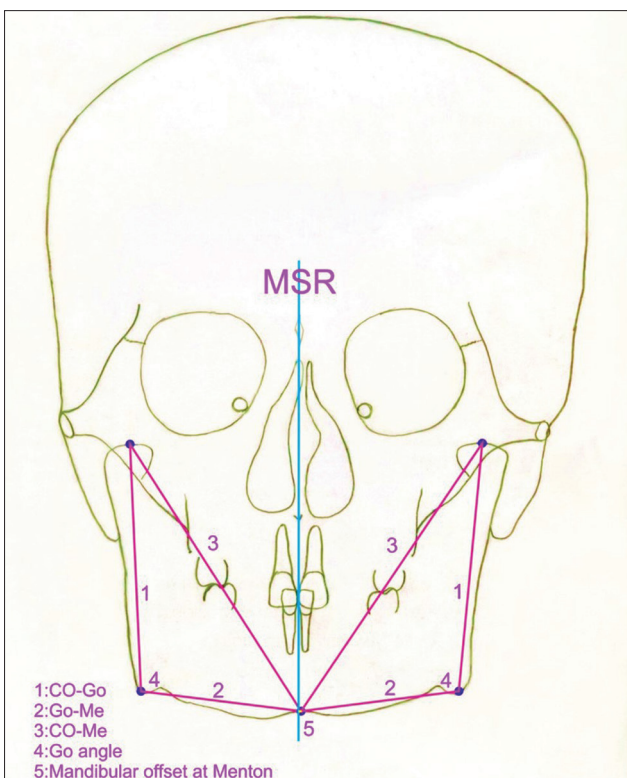

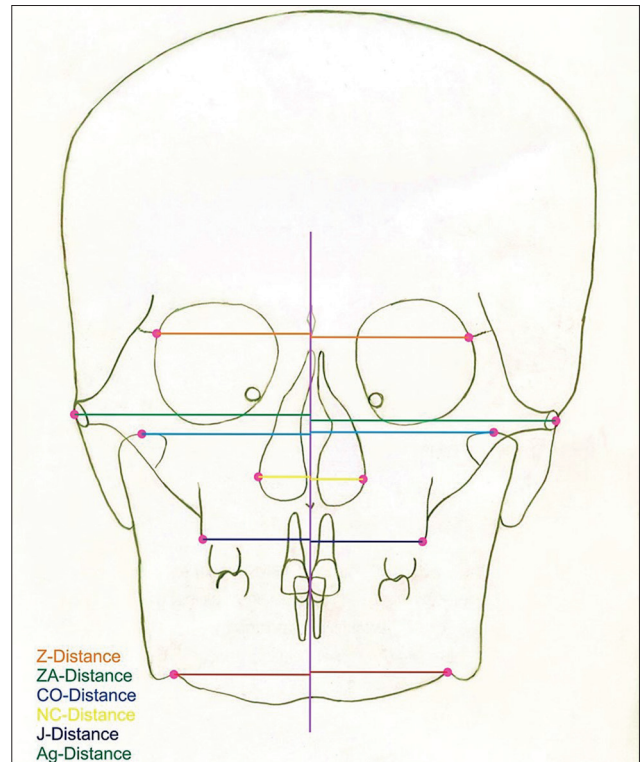Figure 3. *Mandibular morphology & Mandibular deviation*

Figure 4. *Transverse parameters*

was obtained by the ethical committee of Darshan dental college and hospital, Udaipur.

The obtained frontal cephlograms were traced on the 0.003 inches thick matte acetate paper using 0.5mm pencil for the relevant anatomical landmark (Figure 1). To assess the asymmetry, the selected parts Grummon's analysis (20) was used (Table 1, Figure 2, 3, 4). To evaluate the intraexaminer variability, ten cephalgrams were retraced and the subjected to statistical test (t test). The error was found to be 0.5 mm, which was within normal limits.

To discriminate the asymmetry from right and left side positive and negative signs were allotted for the measurements; positive indicating left sided asymmetry and the negative indicating the right sided asymmetry. To compute the mean absolute asymmetry for each of the dimensions studied the absolute value of the left and right difference $(_{|d|})$ was used.

The measured values were tabulated and were subjected to statistical analysis using the soft wear SPSS 15. The independent 't' test was used to detect the sex-wise difference in the facial asymmetry.

3. RESULTS

The asymmetry was evaluated in different dimension and the results for each dimension is as follows.

The Graph 1 shows the vertical asymmetry for the male and females. There was no statistical significant difference for the vertical asymmetries noted for the male and females.

Table 1 depicts the gender wise mean absolute value and sidedness (in degree and millimeter) for the mandibular morphology. In both males and females the highest absolute asymmetry value was noted for Go-Me Length, but the difference between the male and females was significant for the same measurement.

In all the linear measurements of mandibular morphology
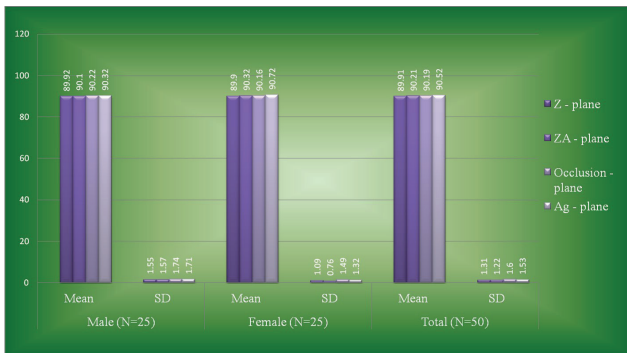
Graph 1. *Vertical Asymmetry measurements for the males and females*

Sl.No	Dimensions/areas of measurements	Parameters of measurements	Measurement procedure
A.	Mid sagittal reference plane (Vertical Asymmetry)	Construction of Mid Sagittal Reference line (MSR)	MSR was constructed by running a vertical line from Cg to the chin area passing through the ANS
B.	Horizontal Planes	1. Z plane 2. ZA plane 3. Occlusal plane 4. Ag plane	A superior outside angle is measured in degree between each plane to MSR for the assessment of parallelism
C.	Mandibular morphology	1. CO – Go Distance 2. Go – Me Distance 3. CO – Me Distance 4. The angle Go (CO-Go to Go-Me)	The linear measurements for all the three sides of the triangles were also recorded for left and right side Measured, separately for both the sides
D.	Mandibular deviation	Me-MSR	linear distance between the Menton (Me) point and the point where MSR joins the lower border of mandible i.e., mandibular offset at Me point
E.	Linear transverse asymmetry	1. Z – Distance 2. ZA – Distance 3. CO – Distance 4. NC – Distance 5. J – Distance 6. Ag – Distance	linear distances were measured from MSR to assess the asymmetry in the cranial base and the lower facial region

Table 1. *Different Parameters used for measuring the asymmetry on Posterior-Anterior Cephalograms.*

males showed higher rate of asymmetry compare to females, and at Go-Me length males have almost double the asymmetry in comparison to females which is statistically significant. In the sidedness, at Go angle both the males and females show right sidedness which is statistically not significant. Males show left sidedness at Co-Go, whereas at Go-Me and Co-Me they shows right sidedness which are statistically significant. In females all the lengths shows right sidedness, but only Go-Me and Co-Me are statistically significant (Table 2).

Gender wise skeletal asymmetry in transverse direction, mean absolute value and sidedness (in millimeter) is depicted in table 3. Males show higher rate of asymmetry compared to females in all the parameters but only Z, J and Ag are statistically significant among them. In the sidedness males show right side bias at Z, ZA, NC and Co, but only ZA and Co are statistically significant. In females only ZA and Co shows right side bias which are statistically not significant, whereas Z, NC, J and Ag shows left side bias, but only J and Ag are statistically significant. But there was no statistically significant difference for the sidedness for the males and females.

Table 4 shows mandibular deviation, their mean absolute value and sidedness (in millimeters) in males and females. In the investigation of mandibular deviation, mean absolute asymmetry was recorded for the mandibular offset at menton. Males show higher mandibular deviation (2.56 mm) compared to female (1.59 mm). In the sidedness both the males and females show left side dominance, which is statistically significant

4. DISCUSSION

The facial symmetry and asymmetry is quite interesting topic for the professionals like artists, plastic and cosmetic surgeons, anthropologist, psychologists and orthodontist. When Peck et al studied the frontal cephalograms of esthetically pleasing faces, they found all the subject who were examined had asymmetry in one or the other measurements (17). Thus, finding some amount of skeletal asymmetry in esthetically pleasing faces is a normal thing, but the question to ponder in this case is whether this hidden skeletal asymmetry is distributed similarly in both the genders and if no, to what extent it is different. With this as a basis, the present study was done to determine the gender-wise difference in the skeletal asymmetry in esthetically pleasing faces.

The posterior-anterior cephalometric for studying the facial asymmetry is considered as an ideal tool because, the right and left sides are located at relatively equal distance from the film and X-ray source, this ensures the minimizing of unequal enlargement by diverging rays and reducing the possible distortion. Thus, making the comparison between sides more accurate (21).

The vertical skeletal asymmetry was measured for the four planes (figure 3) and there existed no significant difference between male and females for these measurements. This indicates that all the four planes were almost parallel to each other. Similar results were reported by the earlier study for

Dimension	Absolute values ($\overline{X}_{|d|}$)					Sidedness ($\overline{X}_{d}$)						
	Male (N=25)		Female (N=25)			Male (N=25)			Female (N=25)			
	$\overline{X}_{|d|}$	SD	$\overline{X}_{|d|}$	SD	P value	$\overline{X}_{d}$	SD	P value	$\overline{X}_{d}$	SD	P value	P value
Go - Angle	2.92°	2.48°	1.98°	1.53°	0.114	-1.08°	3.71°	0.159	-0.22°	2.52°	0.668	0.344
Co-Go Length	2.76	2.42	1.70	1.25	0.058	1.80	3.23	0.010*	-0.10	2.13	0.817	0.018*
Go-Me Length	5.10	3.25	2.82	2.65	0.009*	-4.02	4.56	0.000*	-2.06	3.30	0.005*	0.089
Co-Me Length	2.94	2.61	2.18	1.74	0.232	-1.82	3.51	0.016*	-1.58	2.32	0.002*	0.777

Table 2. *Gender wise mean absolute value and sidedness (in degree and millimeter) for the Mandibular morphology.* * = *Significant, p<0.05*

Dimension	Absolute values ($\overline{X}_{|d|}$)					Sidedness ($\overline{X}_d$)						
	Male (N=25)		Female (N=25)		P value	**Male (N=25)**			Female (N=25)			P value
	$\overline{X}_{|d|}$	SD	$\overline{X}_{|d|}$	SD		$\overline{X}_d$	SD	**P value**	$\overline{X}_d$	SD	**P value**	
Z -Distance	1.60	1.62	0.54	0.76	0.005*	-0.04	2.30	0.932	0.34	0.87	0.064	0.445
ZA -Distance	3.20	3.55	1.80	1.35	0.072	-2.40	4.15	0.008*	-0.80	2.13	0.073	0.093
NC -Distance	1.38	1.26	1.44	1.01	0.854	-0.26	1.87	0.494	0.04	1.78	0.912	0.565
Co -Distance	3.84	3.23	3.08	2.56	0.362	-2.00	4.65	0.042*	-0.72	3.99	0.376	0.302
J -Distance	1.74	1.44	0.94	0.88	0.022*	0.46	2.24	0.315	0.58	1.16	0.020*	0.813
Ag -Distance	3.32	2.37	1.92	1.11	0.010*	0.52	4.10	0.532	1.40	1.74	0.001*	0.329

Table 3. *Gender wise skeletal asymmetry in transverse direction, mean absolute value and sidedness (in millimeter).* ⋆ = *Significant, p<0.05*

Dimension	Absolute values ($\overline{X}_{|d|}$)					Sidedness ($\overline{X}_d$)						
	Male (N=25)		Female (N=25)		P value	**Male (N=25)**			Female (N=25)			P value
	$\overline{X}_{|d|}$	SD	$\overline{X}_{|d|}$	SD		$\overline{X}_d$	SD	**P value**	$\overline{X}_d$	SD	**P value**	
Mandibular offset at mention	2.56	1.59	1.82	1.51	0.099	1.20	2.80	0.043*	1.18	2.07	0.009*	0.977

Table 4. *Gender wise Mandibular deviation: mean absolute value and sidedness (in millimeters).* ⋆ = *Significant, p<0.05*

different horizontal planes (22).

In mandibular morphology males show higher rate of asymmetry at Go angle compared to females, which is the angle formed by the plane Condylion to Gonion and Gonion to Menton (Co-Go and Go-Me). In the linear measurements of mandibular morphology, measurements in between two points were directly recorded. In all the linear measurements of mandibular morphology males show higher rate of asymmetry compare to females, and at Go-Me length males had almost double the asymmetry than the females which is statistically significant. In accordance to our study in a published thesis it was reported that the male showed greater amount of asymmetry than the females (23). In contrast to this Ercan et al report that the significant asymmetry was noted for the female subjects than the male subjects. They also comment that the left side of the face was most commonly dominate in both the sexes (24). It is been mentioned in the previous literature that the facial symmetry matters more in judging the female attractiveness than their counter part (25). But, both the above said studies were done on the human face photographs directly and not on the p-a cephalometric, which is concern for the bias in comparing. Comparison of our results with the previous studies is done in generalized manner as the samples and the data obtaining processes were entirely different in different studies, but for the further understanding of the subject comparison becomes necessary.

In the sidedness, at Go angle both the males and females show right sidedness, which is in accordance with the study done by Shah and Joshi (26) and Sumant Goel (22). Both the studies used the same parameters for evaluation of mandibular morphology, for which three lines Co-Go, Go-Me and Co-Me were constructed, they measured Gonial angle and all three lines were recorded in millimeters. Ferrario et al studied the age related and sex related soft tissue asymmetry digitally and reported there existed no significant age related or sex related difference existed for the soft tissue asymmetry, however they comment that maximum normal asymmetry was detected in females when compared to the males (27).

In the linear measurements of mandibular morphology, at Co-Go length males show left side bias but females show right side bias and the difference is statistically significant. Both the males and females group show statistically significant right sidedness, at Go-Me and Co-Me length.

Males showed higher rate of asymmetry compared to females in all the parameters but only Z, J and Ag are statistically significant among them. In the sidedness males showed right side bias at Z, ZA, NC and Co, but only ZA and Co are statistically significant. In females only ZA and Co showed right side bias which are statistically not significant, whereas Z, NC, J and Ag showed left side bias, but only J and Ag are statistically significant. In one of the previous article by Ravi et al who studied the facial asymmetry in the long face subjects, report that the right sided dominance was noted for both the sexes and male dominance for asymmetry was statistically significant (28). In one of the previous studies on photographic analysis for asymmetry it was noted the males were left faced and females were right faced and authors attribute this difference to the differential muscular development of two sides (29). Further, it is reported that the laterality in facial asymmetry is normal in humans, and it is more due to heritability than acquired (30).

5. CONCLUSION

The results of the study suggests that asymmetries are the common findings in the aesthetically pleasing faces. The gender wise difference was noted with the males showing increased amount of asymmetry. The hemispheric asymmetry was also detected with right side dominance in whole sample. This knowledge can be utilized during the facial reconstruction surgeries and other minor cosmetic remodeling procedures.

CONFLICT OF INTEREST: NONE DECLARED.

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