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Assessment and Comparison of Facial Asymmetry by Photograph and Radiographic Methods

Naheeda [aω*], Mrinal Bidri [b#], Sameena Sultana [c†], Shaik Mohammed Asif [d‡] and Saeed Abdullah Arem [d]

[a] Department of Periodontology, Tirumala Dental College, Nizamabad, Telangana, India.
[b] Orchids Dental Implants and Orofacial Pain Centre, Hanamkonda, Telangana, India.
[c] Department of Oral and Preventive Care, Sri Surya College of Nursing, Hyderabad, Telangana, India.
[d] Department of Diagnostic Science and Oral Biology, College of Dentistry, King Khalid University, Abha, Kingdom of Saudi Arabia.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: An identical craniofacial complex must have symmetrical structures on right and left side. However, asymmetries are quite common and have been a matter of concern for orthodontic therapy. Asymmetries of face are often associated with dental asymmetries which are of clinical importance for treatment of malocclusion.
Aim: This present study was conducted to assess and Compare facial asymmetry of Deccan population by using photographic and radiographic Methods.
Methods: Hundred college students of Deccan population between age group of 15-30 years of age with harmonious and symmetrical face were selected for study. Radiographs were taken using Cephalostat (Kodak 8000 & Kodak 8000C system manufactured by care stream health Inc., USA). Exposure was standardized for subjects were 85Kvp; 12 mA for 0.1 second exposure time with magnification factor of 1.27% (±10) Photographs were taken with Single Lens Reflex (SLR) digital camera (Nikon D3200; Nikon Corporation, Tokyo, Japan) and a macro lens (Macro-Nikkon 105mm; Nikon Corporation). Facial asymmetry was evaluated by using three cephalometric analysis (Grummon's, Rickett's and Hewitt's) and a photographic analysis. Paired t test was used

[ω] Lecturer;
[#] Consultant Orthodontist;
[†] Professor;
[‡] Assistant Professor;
**Corresponding author: Email: dr.naheeda@gmail.com;*

for comparison of asymmetry on left and right sides. A p-value of 0.05 or less was considered statistically significant.

Results: In Grummons analysis, left side was more in size than right but not statistically significant in all measurements except distance between the Mid Facial Line to Condylion point (MFL-Co). In Hewitts analysis, results indicated that total facial area was more on left than right. However, cranial base region, Middle Maxillary region, Lower Maxillary Region and dental region indicated that right side was more in area than left side but not statistically significant. In Ricketts Analysis, result have shown that maxillary width and mandibular width were more on right when compared to left but not statistically significant. In photographic analysis left hemi face was greater in size than right. Total facial structures in Deccan population was found larger on left side when compared to right, was not statistically significant.

Conclusion: Normal pleasing and symmetrical faces do exhibit some skeletal asymmetry. Asymmetry of face might be present even when teeth are in excellent occlusal position.

Keywords: Facial asymmetry; radiograph; photograph; analysis.

1. INTRODUCTION

"Variation in size, shape and relationship of dental, skeletal and soft tissue facial structures are important in providing each individual with his or her own identity" [1]. "Asymmetry in craniofacial regions can be recognized as a difference in size or form of individual bones or it can be recognized as a difference in positional relationship of a bone or bones in the cranium or face" [2]. "Etiology of these differences involves many factors, one of which is probably difference in growth rates of right and left side. Difference in growth-rate could be due to genetic, environmental or both" [3]. Asymmetries are quite common, highest number of asymmetries (69.2%) are seen at age group of 18 years in males on upper third of the face. Very few (18%) are noticed on Orbito-Tragial region at the age of 6years. Generally, right side is more likely to be longer than left [4]. Measurements of craniofacial skeleton are done either directly from living subjects, dry skulls or cephalometric radiographs of face, jaws and dentition [5]. "As the demand for improved facial esthetics is increasing, more patients are complaining of development or progression of facial asymmetry during or after orthodontic treatment" [6]. "Facial asymmetry is an imbalance that occur between homologous parts of face affecting proportion of these parts to one another with regard to size, form and position on opposite sides of a plane, line, or point. As facial asymmetries are very often present with dental asymmetries, they are of clinical importance in treatment of malocclusion" [7]. "Significant facial asymmetry causes both functional as well as esthetic problems" [8]. Therefore, this present study was conducted to assess and Compare facial asymmetry of Deccan population by using photographic and radiographic Methods.

2. MATERIALS AND METHODS

The study was done to assess asymmetry, correlate the magnitude of asymmetry in Deccan population by photographic and radiographic methods and to know the degree of asymmetry in craniofacial skeleton in Deccan population. Facial asymmetry was evaluated by using three cephalometric analysis (Grummon's, Rickett's and Hewitt's) and a photographic analysis. Hundred college students of Deccan population were selected for the study. Subjects between age group of 15-30 years of age with harmonious and symmetrical face, who did not have deviation of mandible on closing and opening mouth with no previous history of orthodontic treatment were included in the study. Patients with severe facial asymmetry, congenital anomalies, patients who had received orthodontic treatment before were excluded from the study.

2.1 Methodology

Posteroanterior radiographs were taken for all subjects in standing position. These radiographs were taken in natural head position by making subject look straight at their eye level. To minimize subjective error, a panel of three Orthodontic post graduate students selected subjects. If any subject was not able to maintain a natural head position then, observer corrected it by checking Frankfort horizontal plane parallel to the floor. Radiographs were taken with patient in Cephalometer looking straight ahead into the Cephalostat (Kodak 8000 & Kodak 8000C system manufactured by care stream health Inc., USA). Radiograph settings used for each subject

were 85Kvp; 12 mA for 0.1 second exposure time with magnification rate for the cephalographic machine was 1.27% (±10). Photographs were taken with head fixed using ear rods with Frankfort horizontal plane parallel to ground in physiologic rest position. Frankfurt horizontal level was checked parallel to the floor by observer to minimize the errors during projection. All subjects were made to stand at a distance of 150cm and a tripod was used to take photographs of subject which was used for Photographic analysis. A ring strobe was employed as a light source. For standardization for photography a line of 150 cm was drawn from position of subject to center of tripod and position of tripod was also marked with a permanent marker for maintaining a constant distance between subject and camera. Photographs were taken with an SLR digital camera (Nikon D3200; Nikon Corporation, Tokyo, Japan) and a macro lens (Macro-Nikkon 105mm; Nikon Corporation). Few points taken in the study were "err, erl and Me", which stands for ear rod right, ear rod left and Menton respectively (Fig. 1). Points err and erl were defined as points on the patient's right and left sides where a line connecting the centers of the ear rods intersects the outer contour of the face. Facial midline was defined as the perpendicular bisector of the line between the centers of the right and the left pupils (p). Differences in distance between err to the facial midline and from erl to the facial midline were defined as dFW. Soft-tissue Menton (Me), was defined as the lowest point of outer contour of face on standardized facial photographs. Horizontal distance between Menton (me) and facial midline was defined as dME. Each photograph was analyzed with a software programme (Adobe photo shop CS5 extended version 12.0 x32). For all posteroanterior cephalograms tracing was done manually. Furthermore, all measurements were undertaken by the same examiner. Linear measurements were carried out with the metal scale and angular measurements were made by means of a protractor. For all 100 posteroanterior cephalograms cephalometric analysis was done for evaluation of asymmetry. The following posteroanterior cephalometric analyses were done a) Rickett's analysis b) Grummon's analysis and c) Hewitt's analysis.

Rickett's analysis (1972) incorporates the following measurements (Fig. 2)

1) Nasal cavity width - measured from NC to NC (widest points in nasal capsule).
2) Mandibular width - measured from Ag to Ag (at trihedral eminence above notch).
3) Maxillary width - two frontal lines, left and right, are constructed from the medial margins of the zygomatico frontal sutures to Ag points and the maxillary width is evaluated on left and right sides separately by relating J point or point jugale (defined as the crossing of the outline of the tuberosity with that of the jugal process) to these lines. In this way the maxillary width is evaluated in relation to the mandible.
4) "Symmetry - a midsagittal plane is constructed by dropping a line through the top of the nasal septum or crista galli, perpendicular to the line connecting the centers of the zygomatic arches (CSP). Asymmetry is evaluated by relating point ANS and pogonion to this midsagittal plane" [9].

Grummon's analysis (1987) had a practical procedure which included the following steps: A midsagittal reference line (MSR) is constructed from crista galli (Cg) through anterior nasal spine (ANS) to chin area. An alternative way of constructing the MSR line, if anatomical variations in upper and middle facial regions exist, is to draw a line from the midpoint of Z-plane either through ANS or through the midpoint of both foramina rotundum (Fr-Fr line). Mandibular morphology analysis–left sided and right sided triangles are formed between head of the condyle (Co) to the antigonial notch (Ag) and menton (Me). A vertical line from ANS to Me visualizes midsagittal plane in the lower face. The following measurements are taken

1. Condylion-Menton distance (in mm),
2. Antegonion-Menton distance (in mm) ,
3. Condylion-Antegonion distance (in mm),
4. Angle at Condylion in ΔCo-Ag-Me (in degrees),
5. Angle at Antegonion in ΔCo-Ag-Me (in degrees),
6. Angle at Menton in ΔCo-Ag-Me (in degrees),

Linear asymmetry assessment: linear distance to MSR and difference in vertical dimension of the perpendicular projections of bilateral landmarks to MSR are calculated for landmarks Co, NC, J, Ag, and Me. Left and right values and vertical discrepancies between bilateral

landmarks are listed [10]. Following measurements are taken

7. Jugal process-Mid Facial Line distance (in mm),
8. Antegonion-Mid Facial Line distance (in mm),
9. Condylion-Mid Facial Line distance (in mm),
10. Nasal cavity-Mid Facial Line distance (in mm).

According to Hewitt's analysis (1975), craniofacial asymmetry is performed by dividing craniofacial complex in constructed triangles, so-called triangulation of the face. Different angles, triangles and component areas can be compared for both left side and right side. Regions can be described as following (Fig. 3).

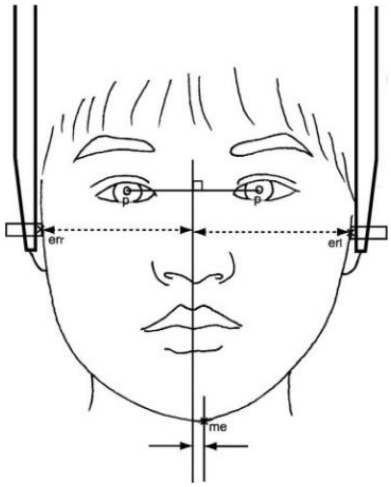

Fig. 1. Schematic illustration of reference points and linear measurements used on facial photograph

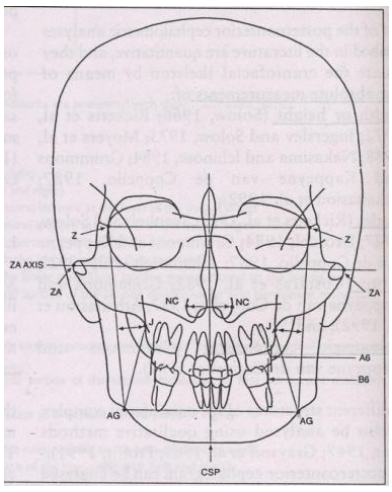

Fig. 2. Rickett's Analysis

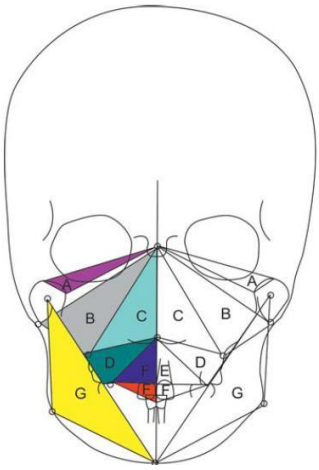

Fig. 3. Hewitt's Analysis

Cranial base region: triangle drawn between the extreme upper extent of the head of the condyle, extreme mesial extent of the head of the condyle and sella.

Lateral maxillary region: triangle drawn between sella, mastoidale and root of zygoma.

Upper maxillary region: triangle drawn between sella, root of zygoma and anterior nasal spine.

Middle maxillary region: triangle drawn between root of zygoma, upper molar points and the anterior nasal spine.

Lower maxillary region: triangle drawn between anterior nasal spine, upper molar points and the point of intersection of a line drawn between the bilateral upper molar points and the arbitrary anatomical axis.

Dental region: triangle drawn between upper molar points, upper incisor point and the point of intersection of a line joining the upper molar points and the anatomical axis.

Mandibular region: triangle drawn between the gonion, condylar and menton points.

Total facial region: the sum of all the above triangles on one side of the face are compared with the opposite side [5]. To reduce method error in defining the measuring points and reference structures, all radiographs were analyzed twice by the same investigator with a week interval between the recordings. All cephalograms were hand traced by one investigator and landmarks verified by other. Mean values of the two recordings were used as the final measuring value. Paired t test was used

for the comparison of asymmetry on left and right sides. A p-value of 0.05 or less was considered for the results to be statistically significant.

3. RESULTS

Present study was conducted to compare and assess skeletal and craniofacial asymmetry on one side of face to that of other side in patients by using posteroanterior cephalometric radiographs and frontal facial photograph.

3.1 Hewitt's Analysis

3.1.1 Cranial base region (triangle A)

Mean value of triangle 'A' on right side was 221.1200 and on left side it was 217.1350 with a mean difference of 3.98500 and a standard deviation of 32.78430 (Table 1). Though there was a minor difference between left and right sides of face in terms of mean region 'A. however, it was not statistically significant (p>0.05).

3.1.2 Lateral maxillary region & Upper maxillary region (triangle B & C)

Mean value of triangle 'B' on right side was 511.3650 and on left side it was 520.1700 with a mean difference of 8.80500 and a standard deviation of 95.98826 (Table 1). Though there was a minor difference between the left and right sides of the face in terms of mean region 'B' measure, it was not statistically significant. (p>0.05). Mean value of triangle 'C' on right side was 591.6450 and on the left side it was 597.9700 with a mean difference of 6.32500 and a standard deviation of 45.95927 This result implies that the right side of the face showed greater mean region 'C' measure as compared to left side, but was not statistically significant (p>0.05).

3.1.3 Middle maxillary region & Lower Maxillary Region (triangle D & E)

There was a minor difference between left and right sides of face in terms of mean region 'D & E' measures. However, it was not found to be statistically significant (Table 1).

3.1.4 Dental region & Mandibular region (triangle F & G)

Mean value of the area triangle 'F' was 63.0750 on right side and on left side it was 61.8700 and with a mean difference of 1.20500 and a standard deviation of 21.45210. Though the result implies that right side of face was bigger in size than left it was not statistically significant. There was a minor difference between left and right sides of the face in terms of mean region 'G' measure, which was not statistically significant (p>0.05) (Table 1).

3.1.5 Total facial region (sum of all triangles)

There was a minor difference between the left and right sides of the face in terms of mean 'Total Area', which was not statistically significant (Table 1).

3.1.6 Comparison of males and females

Mean value on right side for males was 2781.0729 with a standard deviation of 231.85643 and for the females it was 2535.7981 with a standard deviation of 245.66726 with t-value of 0.461 and p-value of <0.001 which indicated that magnitude of difference on right when compared between males and females was greater in males and shown a statistically significant difference. (Table 2).

Mean value on left for males was 2828.5313 with a standard deviation of 258.71687 and for the females was 2511.5481 with a standard deviation of 248.43343 when computed with t-value of 0.929 and p-value of <0.001 which indicated that the magnitude of difference on left when compared between males and females was greater in the males and shown a statistically significant difference (Table 2).

3.2 Grummon's Analysis

3.2.1 Condylion-Menton distance, Antegonion-Menton distance & Condylion-Antegonion distance

Though there was a minor difference between left and right side of face in terms of mean Co-Me, Ag-Me &Co-Ag measures it was not found to be statistically significant (Table 3).

3.2.2 Angle at condylion in ΔCo-Ag-Me, Angle at antegonion in ΔCo-Ag-Me & angle at menton in ΔCo-Ag-Me

There was a minor difference between left and right sides of face in terms of Co-Ag-Me triangle, Co-Ag-Me triangle at antegonian and Menton angle. It was not statistically significant (Table 3).

3.2.3 Jugal process-Mid facial line distance

There was a minor difference between left and right side of face in terms of mean 'J-MFL' measure, which was found to be statistically significant. This result implies that the right side of the face showed greater mean 'J-MFL' measure as compared to the left side. There was no statistical difference between left and right side of face for Antegonion-Mid facial line distance, Condylion-Mid facial line distance, Nasal cavity-mid facial distance (Table 3).

3.3 Rickett's Analysis

There was no statistical difference between left and right side of face for Nasal cavity width, mandibular width, and maxillary width (Table 4).

3.4 Photographic Analysis

There was a minor difference between the left and right sides of face in terms of mean ear rod measure, which was not found to be statistically significant (Table 5). For dMe the minimum value was zero and maximum value was 2.00 with a mean value of 0.04 and a standard deviation of 0.28141 indicated that the deviation of menton shown a maximum value of 2.00. For dFW the minimum value was zero and maximum value was 10.00 with a Mean value of 3.05 and a standard deviation of 2.18061 which indicated that the difference value between left and right sides has shown a maximum of 10.00 (Table 6).

Table 1. Mean, mean difference, SD, SD error and p-value - Hewitt's analysis

Measurement	Mean (in mm^2)	Mean difference	Standard deviation	Error	p value
Triangle A - Cranial base region right	221.1200	3.98500	32.78430	3.27843	0.227
Triangle A - Cranial base region left	217.1350				
Triangle B - Lateral maxillary region right	511.3650	8.80500	95.98826	9.59883	0.361
Triangle B - Lateral maxillary region left	520.1700				
Triangle C - Upper maxillary region right	591.6450	6.32500	45.95927	4.59593	0.172
Triangle C - Upper maxillary region left	597.9700				
Triangle D - Middle maxillary region right	182.6350	2.74500	25.32331	2.53233	0.281
Triangle D - Middle maxillary region left	179.8900				
Triangle E - Lower maxillary region right	166.4750	4.20000	24.46178	2.44618	0.089
Triangle E - Lower maxillary region left	162.2750				
Triangle F - Dental region right	63.0750	1.20500	21.45210	2.14521	0.576
Triangle F - Dental region left	61.8700				
Triangle G - Mandibular region right	909.5800	13.91500	88.03136	8.80314	0.117
Triangle G - Mandibular region left	923.4950				
Total facial surface area right	2653.5300	10.17000	283.04256	2.83042	0.322
Total facial surface area left	2663.7000				

**Statistically significant if p value is ≤ 0.05*

Table 2. Male and female values for total area

Group statistics						
	Gender	**N**	**Mean (in mm^2)**	**Standard deviation**	**t**	**p value**
Total right	Male	50	2781.0729	231.85643	0.461	<0.001*
	Female	50	2535.7981	245.66726		
Total left	Male	50	2828.5313	258.71687	0.929	<0.001*
	Female	50	2511.5481	248.43343		

**Statistically significant if p value is ≤ 0.05*

Table 3. Mean, mean difference, SD, SD error and p-value - Grummon's analysis

Measurement	**Mean**	**Mean difference**	**Standard deviation**	**Error**	**p value**
Condylion-Menton right (in mm)	84.6000	0.090	3.0087	0.30087	0.765
Condylion-Menton left (in mm)	84.6900				
Antegonian-Menton right (in mm)	41.0600	0.280	3.47307	0.34731	0.422
Antegonian-Menton left (in mm)	40.7800				
Condylion-Antegonian right (in mm)	55.5400	0.170	3.30917	0.33092	0.609
Condylion-Antegonian left (in mm)	55.7100				
Angle at Condylion in ΔCo-Ag-Me right (in degrees)	24.6000	0.130	3.52668	0.35267	0.713
Angle at Condylionin ΔCo-Ag-Me left (in degrees)	24.4700				
Angle at Antegonion in Δ Co-Ag-Me right (in degrees)	121.2700	0.270	4.10925	0.41093	0.513
Angle at Antegonion in Δ Co-Ag-Me left (in degrees)	121.0000				
Angle at Menton in Δ Co-Ag-Me right (in degrees)	34.0500	0.750	4.61306	0.46131	0.107
Angle at Menton in Δ Co-Ag-Me left (in degrees)	34.8000				
Jugal process-Mid facial line right (in mm)	28.2900	0.48000	2.11526	0.21153	0.025
Jugal process-Mid facial line Left (in mm)	27.8100				
Antegonion-Mid facial line right (in mm)	35.9600	0.02000	2.94385	0.29439	0.946
Antegonion-Mid facial line left (in mm)	35.9800				
Condylion-Mid facial line right (in mm)	45.4200	0.34000	3.65762	0.36576	0.355
Condylion-Mid facial line left (in mm)	45.0800				
Nasal Cavity-Mid facial line right (in mm)	12.4600	0.20000	1.52422	0.15242	0.193
Nasal Cavity-Mid facial line left (in mm)	12.6600				

**Statistically significant if p value is ≤ 0.05*

Table 4. Mean, mean difference, SD, SD error and p-value - Rickett's analysis

Measurement	Mean (in mm)	Mean difference	Standard deviation	Error	p value
Nasal cavity width right Nasal cavitywidth left	12.6700 12.7900	0.12000	1.51944	0.15194	0.432
Mandibular width right Mandibular width left	35.9700 35.7000	0.27000	2.77017	0.27702	0.332
Maxillary width right Maxillary width left	11.3200 11.2800	0.04000	2.87420	0.28742	0.890

**statistically significant if p value is ≤ 0.05*

Table 5. Photographic analysis

	Mean	N	Std. deviation	Std. error mean	T	p value
ER Right	46.4700	100	3.96055	.39606	0.965	0.337
ER Left	46.8300	100	4.70773	.47077		

Table 6. Descriptive Statistics for dMe and dFW

	N	Minimum	Maximum	Mean	Std. Deviation
dMe	100	.00	2.00	.0400	.28141
dFW	100	.00	10.00	3.0500	2.18061
Valid N (listwise)	100				

4. DISCUSSION

"Symmetry or asymmetry of human face is of considerable interest in field of Orthodontics" [4]. "Perception of asymmetry is influenced by level of asymmetry and profession of the observer. Both 3D and 2D images are useful for understanding asymmetrical structures. Most patients with facial asymmetry are well diagnosed by using cephalometric radiographs" [6]. "Normal pleasing and symmetrical faces do exhibit skeletal asymmetry, this suggests that soft tissue tries to minimize underlying asymmetry. Asymmetry of face might be present even when teeth are in good occlusal contact, maximally interdigitated and with coinciding upper and lower midlines" [11]. According to James F. Mulick [3] heredity is not considered as causative factor for craniofacial asymmetry (excluding hereditary syndromes). Edler R, David Wertheim and Darrel Greenhill (2003) measured mandibular asymmetry by using radiographic and photographic methods. Their results showed a significant relationship for area (p=0.002), compactness (p<0.001) and moment ratios (p=0.004) measured through photographs and posteroanterior cephalographs, but not for perimeter ratio (p=0.078) [12]. In present study facial asymmetry was assessed which showed similar results in both photographs (p=0.337) and radiographs (p>0.05). Sarah Good et al. [13] (2006) conducted a study to investigate relationship between mandibular outline asymmetry and skeletal discrepancy among orthodontic patients in anteroposterior and vertical planes. A statistically significant relationship was found between mandibular outline asymmetry (p=0.051). In present study facial asymmetry was evaluated across the sagittal plane showed similar results both in photographs (p=0.337) and radiographs (P>0.05) However, results were not statistically significant. James F. Mulick (1965) conducted a study to investigate craniofacial asymmetry using serial twin-study method and they concluded that heredity is not a controlling agent in production of craniofacial asymmetry (except hereditary syndromes) and their cross-sectional evaluation showed that there are differences in the amount of asymmetry of various craniofacial regions and landmarks [3]. Similar findings were noticed in our present study. Sheldon Peck, Leena Peck and Mattikateja (1990) conducted a study on skeletal asymmetry in esthetically pleasing faces to quantify subclinical asymmetries in clinically symmetrical faces. Their results showed dominant values on the right, but was not statistically significant) with that of left side [14]. however, present study showed a dominance on left side (p>0.05).Gerald M. Letzer and Joseph H. Kronman (1967) conducted a study by using posteroanterior cephalogram to explore

relationship between presence or absence of mandibular and anterior cranial base asymmetry in frontal plane. Their results revealed no statistical evidences existed between occlusion of teeth and asymmetry of face, they also stated that asymmetry is a common finding in normal population [15]. VK Taneja.et.al (2012) undertook a study to assess the craniofacial asymmetry in south Indian population using posteroanterior cephalogram by Hewitt's method. Results revealed that area of cranial base region had shown a mean value of 201.4 on right and 244.5 on the left side whereas in present study mean values were 221.120 on right and 217.135 on left side. Area of lateral maxillary region showed a mean value of 943.4 on right and 919.1 on left side whereas in present study mean value were 511.365 on right and 520.170 on left side. Area of upper maxillary region showed a mean value of 837.6 on right side and 819.5 on left side. Whereas in present study mean value were 591.640 on right and 597.970 on left side. Area of middle maxillary region showed a mean value of 229.9 on right and 227.7 on left side. In present study mean values were 182.635 on right and 179.890 on left side. Area of lower maxillary region showed a mean value of 253.1 on right and 267.5 on left side whereas in present study mean value were 166.470 on right and 162.270 on left side. Area of dental region showed a mean value of 70.8 on right and 72.4 on left side whereas in present study mean value were 63.075 on right side and 61.870 on left side. The area of mandibular region showed a mean value of 1605.4 on right and 1634.8 on left Side. Whereas in present study mean values were 909.58 on right and 923.49 on left side. Total facial surface area showed a mean value of 4141.6 on right side and 4185.6 on the left side whereas in present study the mean value was 2653.50 on right and 2663.70 left side (Table 1). Differences in the areas when compared to present study could be due to change in the population and also cephalometric machine used for the study. Total facial structures in the South Indian population were larger on the left side ($p>0.05$) [16]. Results of present study had shown similar results indicating a larger left side however, they were not statistically significant ($p>0.05$). Ranjith Haridas Kamble et al. [17] (2011) conducted a study to evaluate facial asymmetry by using facial photography and radiographs. They concluded that there is a significant correlation between photographs and radiographs ($p<0.005$). Similar findings were observed in our study. Peter Claes et al. [18] (2012) conducted a study to investigate sexual dimorphism using 3D facial symmetric analysis. Magnitude of facial asymmetry was significantly larger in males than in the females ($p<0.05$). Present study also found similar results showing a greater and significant magnitude of asymmetry in males than in females ($p<0.001$). Leslie G. Farkas and Gwaynne Cheung [4] (1981) conducted a study on normal children to evaluate degree of asymmetry that can be expected in normal population. Asymmetry was found to be very common and average difference between right and left measurements were mild (3 mm or 3%), with right side being more asymmetrical. Present study showed that left side is greater in size compared to right side however, it was not statistically significant ($p>0.05$). Yoshitaka Iguchi and Kenji Takada [19] (2008) investigated asymmetry of human face by examining differences in relation to sex, growth stage and skeletal classification. There results showed a wider right hemi face, while chin deviated more towards left-side but it was not statistically significant ($p>0.01$). Results of present study showed a wider left hemi face with no chin deviation ($p=0.337$). Paul W. Major and Karen L. Hesse [20] (1994) conducted a study to quantify intra examiner and inter examiner reliability of 52 commonly used posteroanterior cephalograms. Their results showed inter examiner landmark identification error were significantly larger than intra examiner error for many landmarks ($p<0.05$). In present study to reduce error, measuring points and reference structures, all radiographs were analyzed twice by same investigator within a week. Paul W. Major.et.al [21] (1996) conducted a study to know effect of head orientation on posterior anterior cephalometric landmark identification. Their results have shown that rotation around vertical axis did not affect relationship of landmarks for horizontal line but did affect their relationship for vertical line. In present study to reduce these errors all radiographs were taken in natural head position and each member in the sample was observed from side to ensure that pupil was in middle of eye and, head was repositioned if there was even a slight discrepancy. Bilateral head support in transverse plane was achieved by ear rods. A E. Athanasiou, R. R. Miethke and A. J. W. Van Der Meij [22]. (1999) performed a study to know random errors in localization of landmarks in posteroanterior cephalograms and gave the following conclusions. Each posteroanterior cephalogram landmark has its own characteristic envelope (distribution of localization random errors). Bilateral landmarks exhibit very similar (mirror image) envelopes. To

reduce these errors in localization of landmarks in present study, all radiographs were analyzed twice by same investigator within a week. Samir E. Bishara made a review on dental and facial asymmetries in which he stated that asymmetry of face and dentition is a naturally occurring phenomenon [1]. Present study has also shown asymmetry as a natural finding. Grainne Mc. Avinchey.et.al [23] (2014) investigated perception of facial asymmetry in young adults to identify the amount of chin asymmetry that can be regarded as normal and may benefit from correction by three dimensional (3D) images. Perception of asymmetry is affected by amount of asymmetry and observer group, with orthodontists being more critical. Therefore, in our study patients with severe facial asymmetries were excluded. Hence, each subject was examined for facial asymmetry by standing in front and keeping his/her eyes at the level of subject's head. It was made sure that patient's head did not tilt or tip. To minimize theses subjective error in selection, a panel of three Orthodontic post graduate students examined each person, and subjects were selected when three agreed.

5. CONCLUSION

In Grummons analysis, results indicated that left side is more in size than right but not statistically significant in all measurements except distance between the Mid Facial Line to Condylion point (MFL-Co). In Hewitts analysis, results indicated that total facial area is more on left than right. Lateral Maxillary region, Upper Maxillary region and Mandibular region also indicated that left side is more in area than right. However, cranial base region, Middle Maxillary region, Lower Maxillary Region and dental region indicated that right side is more in area than left side but not statistically significant. In Ricketts Analysis, result have shown that maxillary width and mandibular width is more on right when compared to left but not statistically significant. In photographic analysis, results indicated that left hemi face is greater in size than right. Normal pleasing and symmetrical faces do exhibits some skeletal asymmetry. This suggests that soft tissue of face tries to minimize underlying asymmetry. Though the total facial structures in Deccan population was found larger on left side when compared to right it was not statistically significant. Asymmetry of face might be present even when teeth are in excellent occlusal contact, maximally interdigitated, with coinciding upper and lower midlines.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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