



RESEARCH ARTICLE

RADIOGRAPHIC EVALUATION OF MANDIBULAR ASYMMETRY IN SKELETAL CLASS II SUBJECTS

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ABSTRACT

**Aim and Objectives:** This study is done to determine the prevalence of mandibular asymmetry in skeletal class II subjects to assess sexual dimorphism, any correlation of mandibular asymmetry with ramus length and width, length of the body of mandible and to evaluate and compare panoramic radiograph and frontal cephalogram radiograph to assess mandibular asymmetry.

**Materials and Method:** Extra oral radiographs were taken of each subjects of age group (Male 18years and above, Girls 16years and above). The lateral cephalogram of subjects were taken and evaluated for Class II skeletal pattern ANB of  $> 4^\circ$  and Beta Angle  $< 24^\circ$  and for evaluation of growth completion by CVMI staging method. (30 Males and 30 Females) samples with skeletal Class II pattern were selected. Lateral cephalograms, Orthopantomogram and Frontal cephalometric radiographs were taken using a standardised technique. The radiographs are traced on fine acetate matte tracing paper. Analysis for assessment of mandibular asymmetry and was sent for statistical analysis. The results thus obtained were subjected to Pearson's correlation coefficient, student's paired t test and independent student's t test.

**Results:** Mandibular asymmetry based on length of ramus was observed in 16.8% of the study subjects. Similarly, the incidence of mandibular asymmetry based on length of mandible, length of condyle, gonial angle and length of corpus was found to be 15.7%, 14.5%, 10.6% and 8.6% respectively. In the results for the sexual dimorphism we found that there is statistically significant results seen when we compared values of both males to females. In males we found that the mean value was increased in certain parameters when taken from OPG statistically significant and the mean value was increased in females as compared to males. When correlating the mandibular asymmetry with ramus length, width and length of the body of mandible we found that there are positive correlation in certain parameters taken, in contrast we found there are certain negative correlation seen. When comparing the panoramic radiograph (OPG) and Frontal radiograph (PA) we found that there is a significant difference in OPG and frontal cephalogram readings when comparing to length of the ramus, length of corpus and length of the mandible and gonial angle as the results showed statistically significant values, so it can be stated that the OPG and frontal cephalogram cannot be compared with each other for the measurement.

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INTRODUCTION

The word symmetry is derived from the Greek word symmetria which means 'of like measure'. Symmetry is defined as correspondence in size, shape and relative position of parts on opposite sides of a dividing line or median plane. Asymmetry is described as a lack or absence of symmetry. When applying this to the human face, it illustrates an imbalance or disproportionality between the right and left sides. A degree of asymmetry is normal and acceptable in the average face.

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It may be caused by a range of factors that affect the underlying skeletal structure or soft tissue drape. However, the importance of early diagnosis and the detection of progressive causative conditions is essential for the management of facial asymmetry (Matthew et al., 2008). The mandibular asymmetry, also known as the lower third of the face, is important because of its direct effect on facial appearance. Asymmetries of the mandible may cause not only esthetic but also functional problems because of its role in the stomatognathic system. The regions that have the highest growth potential on the mandible are the condylar cartilages. Condylar asymmetries are thought to be one of the most important causes of mandibulofacial asymmetries (Omer Said

Sezgin *et al.*, 2007). The most prominent facial features of mandibular asymmetry include a shift of the chin to the short side and prominence of the mandibular (gonion) angle on the long side. Dental features may include an open bite on the long side, shift of the mandibular midline away from the long side, cross-bite on the short side, and a tilt of the frontal occlusal plane. There are several obvious causes of mandibular asymmetry such as trauma with fracture, tumors, and congenital anomalies (Per-Lennart Westesson *et al.*, 1994). Orthopantomogram (OPG) is one of the most useful radiographs in dentistry. Panoramic radiography is frequently used in the orthodontic practice to provide important information about the teeth, their axial inclinations, maturation periods and surrounding tissues. It is also taken into consideration for assessing the condyle and symmetry of the mandible on the right and left side (Manish Batacharya and Praveen Mishra, 2012). This radiograph allows a bilateral view and adequate information on vertical measurements and asymmetry if present. (Gupta and Jain, 2012) Since the advent of cephalometric radiography, orthodontists have focused on the lateral x-ray as their primary source of patient skeletal and dentoalveolar data. However, the frontal (PA) and basilar views also contain valuable information for diagnosis and treatment planning procedures. Various dental and skeletal widths and skeletal asymmetries that are not available from the lateral cephalogram can be quantified from a frontal radiograph. (Duane *et al.*, 1987)

## MATERIALS AND METHODS

The present cephalometric study was done on untreated Orthodontic patients who visited to the OPD at Department of Orthodontics and Dentofacial Orthopaedics, Seema Dental College and Hospital. The study comprised total number of 60 non growing subjects aged between 16 years and above for girls and 18 years and above for boys with skeletal Class II pattern. On the basis of following two readings on lateral cephalogram, subjects having skeletal Class II pattern were selected for the purpose of study.

- **ANB > 4°:** - Subjects having ANB angle more than 4°
- **Beta angle < 27°:** - Subjects having Beta angle less than 27°.

### Inclusion criteria

- Subjects with skeletal Class II pattern
- ANB > 4° and Beta Angle < 27°
- Non growing adult patients
- Full complements of teeth with exception of third molars
- Subjects who have not undergone any previous orthodontic treatment.

### Exclusion criteria

- Patients undergoing orthodontic treatment.
- Patients with skeletal Class I and skeletal Class III
- Patients with any cleft.
- Patients with any syndrome.
- Patients with history of any accident, trauma.
- Patients with any tumor, cyst.

### Methodology

#### Selection criteria

The Subjects were screened at the Out Patients Department OPD of Seema Dental College and Hospital. Extra oral

radiographs were taken of each subjects of age group (Male 18years and above, Girls 16years and above). The lateral cephalogram of subjects were taken and evaluated for Class II skeletal pattern ANB of > 4° and Beta Angle < 27° (Figure I) and for evaluation of growth completion by CVMI staging method. (30 Males and 30 Females) samples with skeletal Class II pattern were selected. Lateral cephalograms, Orthopantomogram and Frontal cephalometric radiographs were taken using a standardised technique with patient in his/her natural head position, jaws in centric relation, teeth in occlusion with lips relaxed. The midsagittal plane of the patient (a vertical plane through the midline of the body divides the body into right and left halves) is parallel with the image receptor and with bilateral ear rods gently inserted into the external auditory meatus to stabilise the head position during exposure and the subject standing with the Frankfort Horizontal plane parallel to the floor. All Cephalograms were taken using Kodak 8000C Panoramic and Cephalometric unit at Tube voltage of 60-90kVp, Digital sensor CCD with 1360X1840 Pixels and magnification of 1: 1%. The Frontal cephalogram (Figure II) and Orthopantomogram cephalograms (Figure III) are traced on fine acetate matte tracing paper measuring 8X10-inch and 0.003-inch in thickness using a trans-illuminator. The data was obtained using various parameters by Grummons method and Orthopantomogram analysis for assessment of mandibular asymmetry. These are the following parameters used in the study.

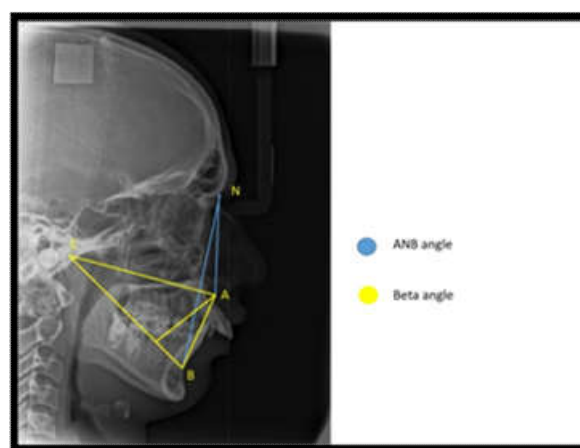


Figure 1. Parameters Used For Group Differentiation

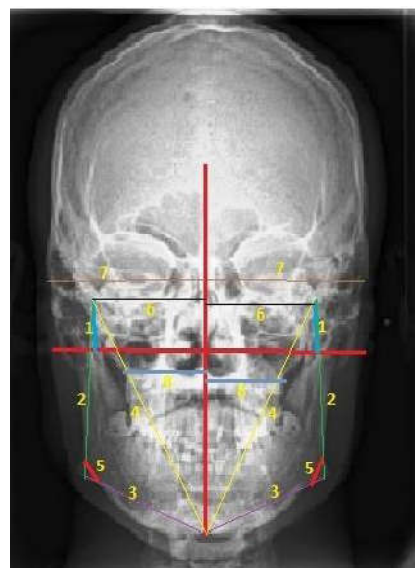


Figure 2. Parameters used in Frontal cephalogram

- Length of condyle (Co-Snp)
- Length of ramus(Co-Go)
- Length of corpus(Go-Me)
- Length of mandible(Co-Me)
- Gonial angle(Co-Go-Me)
- Co-MSR
- AZ-MSR(RIGHT) ; AZ MSR(LEFT)
- J-MSR



**Figure 3. Parameter Used for Orthopantomogram**

- Length of condyle (Co-Snp)
- Length of ramus(Co-Go)
- Length of corpus(Go-Me)
- Length of mandible(Co-Me)
- Gonial angle(Co-Go-Me)
- Length of coronoid(Cor-Snp)
- Angle between condyle and coronoid
- Width of the ramus

## RESULTS

The objective of this study was to determine the prevalence of mandibular asymmetry in skeletal Class II subjects and to assess sexual dimorphism, any correlation of mandibular asymmetry with ramus length and width, length of the body of mandible and to evaluate and compare panoramic radiograph and frontal cephalogram radiograph to assess mandibular asymmetry. The data was obtained using various parameters by Grummons method and orthopantomogram analysis for assessment of mandibular asymmetry and sent for statistical analysis. The results thus obtained were subjected to pearsons correlation coefficient, student's paired t test and independent students t test. The prevalence of mandibular asymmetry in the present study was based on different parameters inclusive of both genders and OPG and Frontal radiographs. Mandibular asymmetry based on length of ramus was observed in 16.8% of the study subjects. Similarly, the incidence of mandibular asymmetry based on length of mandible, length of condyle, gonial angle and length of corpus was found to be 15.7%, 14.5%, 10.6% and 8.6% respectively. So my results suggest that any variation in length of ramus or increase in the length of mandible on either side can be the factor of asymmetry present. In the results for the sexual dimorphism we found that there is statistically significant results seen when we compared values of both males to females. In males we found that the mean value was increased in certain parameters when taken from OPG.

### Such parameters are as follows

Length of condyle (right and left), length of ramus (right and left), length of corpus (right and left), length of mandible (right and left), length of coronoid (left and right), width of ramus(right and left).

**Table 1. Overall prevalence of mandibular asymmetry (OPG + Frontal) (male + female) (n= 60)**

Parameter	Side	Minimum	Maximum	Mean	Std. Deviation	Asymmetry
Length of Condyle	Right	9.00	23.00	16.63	3.65	14.5%
	Left	9.00	24.00	16.80	3.49	
Length of Ramus	Right	43.00	77.00	59.95	7.60	16.8%
	Left	44.00	77.00	59.56	8.01	
Length of Corpus	Right	38.00	108.00	68.97	25.23	8.6%
	Left	37.00	110.00	68.72	24.92	
Length of Mandible	Right	18.00	148.00	108.76	27.30	15.7%
	Left	38.00	147.00	108.35	25.64	
Gonial angle (in Degrees)	Right	100.00	137.00	116.67	7.61	10.6%
	Left	100.00	140.00	116.81	7.72	

**Table 2. Overall comparison of the right and left side in Orthopantomogram ( male + female)**

	N	Mean	Std. Deviation	Paired Differences		T	df	P value	
				Mean Difference	Std. Deviation				
1	OPG length of condyle (Co-Snp): right	60	16.88	3.44	0.217	2.1	0.799	59	0.427
	OPG length of condyle (Co-Snp): left	60	16.67	3.676					
2	OPG length of ramus (Co-Go): right	60	64.57	5.718	0.433	2.174	1.544	59	0.128
	OPG length of ramus (Co-Go): left	60	64.13	6.355					
3	OPG length of corpus (Go-Me): right	60	93.33	7.741	0.533	4.006	1.031	59	0.307
	OPG length of corpus (Go-Me): left	60	92.8	7.559					
4	OPG length of mandible (Co-Me): right	60	132.15	17.152	0.033	13.881	0.019	59	0.985
	OPG length of mandible (Co-Me): left	60	132.12	8.77					
5	OPG gonial angle (Co-Go-Me): right	60	114.42	5.381	0.017	3.084	0.042	59	0.967
	OPG gonial angle (Co-Go-Me): left	60	114.4	5.499					
6	OPG length of coronoid (Cor-Snp): right	60	10.13	2.92	0.117	2.518	0.359	59	0.721
	OPG length of coronoid (Cor-Snp): left	60	10.02	3.553					
7	OPG angle between condyle and coronoid: right	60	39.12	5.761	3.583	5.254	5.283	59	<0.001
	OPG angle between condyle and coronoid: left	60	35.53	4.869					
8	OPG width of ramus: right	60	31.37	3.092	0.8	2.268	2.732	59	0.008
	OPG width of ramus: left	60	30.57	3.387					

**Table 3. Overall comparison of the right and left side in Frontal cephalogram (male + female)**

	N	Mean	Std. Deviation	Paired Differences		T	Df	P value
				Mean Difference	Std. Deviation			
1	Frontal length of condyle (Co-Snp): right	60	16.72	3.575	0.117	2.436	0.371	59
	Frontal length of condyle (Co-Snp): left	60	16.6	3.669				
2	Frontal length of ramus (Co-Go): right	60	55.33	6.369	0.333	1.763	1.465	59
	Frontal length of ramus (Co-Go): left	60	55	6.827				
3	Frontal length of corpus (Go-Me): right	60	44.62	4.203	-0.033	2.792	-0.092	59
	Frontal length of corpus (Go-Me): left	60	44.65	4.145				
4	Frontal length of mandible (Co-Me): right	60	85.37	9.848	0.783	2.38	2.55	59
	frontal length of mandible (Co-Me): left	60	84.58	10.06				
5	Frontal gonial angle (Co-Go-Me): right	60	118.93	8.814	-0.283	3.179	-0.69	59
	Frontal gonial angle (Co-Go-Me): left	60	119.22	8.857				
6	Frontal Co-MSR: right	60	43.8	3.052	0.433	2.878	1.166	59
	Frontal Co-MSR: left	60	43.37	2.852				
7	Frontal AZ-MSR: right	60	57.25	4.293	0.617	4.388	1.088	59
	Frontal AZ-MSR: left	60	56.63	3.395				
8	Frontal J-MSR: right	60	26.72	2.14	-0.4	2.631	-1.178	59
	Frontal J-MSR: left	60	27.12	2.059				

**Table 4. Overall comparison of the Frontal vs OPG (Males + females)**

	N	Mean	Std. Deviation	Paired Differences		t	df	P VALUE	
				Mean Difference	Std. Deviation				
1	OPG length of condyle (Co-Snp): right	60	16.88	3.44	0.167	1.291	1	59	0.321
	frontal length of condyle (Co-Snp): right	60	16.72	3.575					
	OPG length of condyle (Co-Snp): left	60	16.67	3.676	0.067	0.516	1	59	0.321
	frontal length of condyle (Co-Snp): left	60	16.6	3.669					
2	OPG length of ramus (Co-Go): right	60	64.57	5.718	9.233	3.647	19.611	59	<0.001
	frontal length of ramus (Co-Go): right	60	55.33	6.369					
	OPG length of ramus (Co-Go): left	60	64.13	6.355	9.133	3.771	18.761	59	<0.001
	frontal length of ramus (Co-Go): left	60	55	6.827					
3	OPG length of corpus (Go-Me): right	60	93.33	7.741	48.717	8.209	45.967	59	<0.001
	frontal length of corpus (Go-Me): right	60	44.62	4.203					
	OPG length of corpus (Go-Me): left	60	92.8	7.559	48.15	7.778	47.95	59	<0.001
	frontal length of corpus (Go-Me): left	60	44.65	4.145					
4	OPG length of mandible (Co-Me): right	60	132.15	17.152	46.783	17.25	21.008	59	<0.001
	frontal length of mandible (Co-Me): right	60	85.37	9.848					
	OPG length of mandible (Co-Me): left	60	132.12	8.77	47.533	10.694	34.431	59	<0.001
	frontal length of mandible (Co-Me): left	60	84.58	10.06					
5	OPG gonial angle (Co-Go-Me): right	60	114.42	5.381	-4.517	7.769	-4.503	59	<0.001
	frontal gonial angle (Co-Go-Me): right	60	118.93	8.814					
	OPG gonial angle (Co-Go-Me): left	60	114.4	5.499	-4.817	7.95	-4.693	59	<0.001
	frontal gonial angle (Co-Go-Me): left	60	119.22	8.857					

**Table 5. Correlation of mandibular parameters using pearsons correlation coefficient in OPG**

Sno	Parameters being correlated	N	Correlation (r)	P VALUE
1	OPG length of condyle (Co-Snp): right and opg length of ramus (Co-Go): right	60	0.497	<0.001
2	OPG length of ramus (Co-Go): right and opg length of corpus (Go-Me): right	60	0.508	<0.001
3	OPG length of ramus (Co-Go): right and opg length of mandible (Co-Me): right	60	0.532	<0.001
4	OPG length of ramus (Co-Go): right and opg gonial angle (Co-Go-Me): right	60	-0.389	0.002
5	OPG length of ramus (Co-Go): right and opg length of coronoid (Cor-Snp): right	60	0.178	0.173
6	OPG length of ramus (Co-Go): right and opg angle between condyleand coronoid: right	60	-0.29	0.025
7	OPG length of ramus (Co-Go): right and opg width of ramus: right	60	0.563	<0.001
8	OPG length of condyle (Co-Snp): left and opg length of ramus (Co-Go): left	60	0.583	<0.001
9	OPG length of ramus (Co-Go): left and opg length of corpus (Go-Me): left	60	0.453	<0.001
10	OPG length of ramus (Co-Go): left and opg length of mandible (Co-Me): left	60	0.74	<0.001
11	OPG length of ramus (Co-Go): left and opg gonial angle (Co-Go-Me): left	60	-0.448	<0.001
12	OPG length of ramus (Co-Go): left and opg length of coronoid (Cor-Snp): left	60	-0.167	0.201
13	OPG length of ramus (Co-Go): left and opg angle between condyleand coronoid: left	60	0.043	0.747
14	OPG length of ramus (Co-Go): left and opg width of ramus: left	60	0.356	0.005
15	OPG length of condyle (Co-Snp): right and opg width of ramus: right	60	0.291	0.024
16	OPG length of corpus (Go-Me): right and opg width of ramus: right	60	0.486	<0.001
17	OPG length of mandible (Co-Me): right and opg width of ramus: right	60	0.192	0.142
18	OPG gonial angle (Co-Go-Me): right and opg width of ramus: right	60	-0.539	<0.001
19	OPG length of coronoid (Cor-Snp): right and opg width of ramus: right	60	0.203	0.12
20	OPG angle between condyle and coronoid: right and opg width of ramus: right	60	-0.382	0.003
21	OPG length of condyle (Co-Snp): left and opg width of ramus: left	60	0.35	0.006
22	OPG length of corpus (Go-Me): left and opg width of ramus: left	60	0.502	<0.001
23	OPG length of mandible (Co-Me): left and opg width of ramus: left	60	0.395	0.002

**Table 6 a. Comparison of OPG vs Frontal values (female)**

	N	Mean	Std. Deviation	Paired Differences		T	df	P Value	
				Mean Difference	Std. Deviation				
1	OPG length of condyle (Co-Snp): right	30	15.77a	3.319				=	
	frontal length of condyle (Co-Snp): right	30	15.77a	3.319					
	OPG length of condyle (Co-Snp): left	30	15.43	3.748	0.133	0.73	1	0.326	
	frontal length of condyle (Co-Snp): left	30	15.3	3.687					
2	OPG length of ramus (Co-Go): right	30	61	4.778	9.2	2.709	18.602	29	<0.001
	frontal length of ramus (Co-Go): right	30	51.8	5.436					
	OPG length of ramus (Co-Go): left	30	60	4.698	8.9	2.808	17.359	29	<0.001
	frontal length of ramus (Co-Go): left	30	51.1	5.628					
3	OPG length of corpus (Go-Me): right	30	88.87	7.065	45.2	7.336	33.746	29	<0.001
	frontal length of corpus (Go-Me): right	30	43.67	3.827					
	OPG length of corpus (Go-Me): left	30	88.93	6.948	44.833	6.358	38.625	29	<0.001
	frontal length of corpus (Go-Me): left	30	44.1	4.421					
4	OPG length of mandible (Co-Me): right	30	124.87	21.489	41.433	19.709	11.514	29	<0.001
	frontal length of mandible (Co-Me): right	30	83.43	7.986					
	OPG length of mandible (Co-Me): left	30	126.53	7.934	44	7.566	31.854	29	<0.001
	frontal length of mandible (Co-Me): left	30	82.53	8.382					
5	OPG gonial angle (Co-Go-Me): right	30	115.87	5.387	-5.433	7.973	-3.733	29	0.001
	frontal gonial angle (Co-Go-Me): right	30	121.3	8.619					
	OPG gonial angle (Co-Go-Me): left	30	115.83	6.12	-5.533	8.007	-3.785	29	0.001
	frontal gonial angle (Co-Go-Me): left	30	121.37	9.171					

**Table 6 b. Comparison of the OPG vs Frontal values (male)**

	N	Mean	Std. Deviation	Paired Differences		t	df	P VALUE	
				Mean Difference	Std. Deviation				
1	opg length of condyle (Co-Snp): right	30	18	3.238	0.333	1.826	1	29	0.326
	frontal length of condyle (Co-Snp): right	30	17.67	3.623					
	opg length of condyle (Co-Snp): left	30	17.90a	3.209				=	
	frontal length of condyle (Co-Snp): left	30	17.90a	3.209					
2	opg length of ramus (Co-Go): right	30	68.13	4.167	9.267	4.441	11.43	29	<0.001
	frontal length of ramus (Co-Go): right	30	58.87	5.211					
	opg length of ramus (Co-Go): left	30	68.27	4.975	9.367	4.575	11.214	29	<0.001
	frontal length of ramus (Co-Go): left	30	58.9	5.628					
3	opg length of corpus (Go-Me): right	30	97.8	5.542	52.233	7.596	37.663	29	<0.001
	frontal length of corpus (Go-Me): right	30	45.57	4.408					
	opg length of corpus (Go-Me): left	30	96.67	6.087	51.467	7.74	36.419	29	<0.001
	frontal length of corpus (Go-Me): left	30	45.2	3.845					
4.	opg length of mandible (Co-Me): right	30	139.43	5.197	52.133	12.558	22.738	29	<0.001
	frontal length of mandible (Co-Me): right	30	87.3	11.216					
	opg length of mandible (Co-Me): left	30	137.7	5.389	51.067	12.23	22.87	29	<0.001
	frontal length of mandible (Co-Me): left	30	86.63	11.266					
5	opg gonial angle (Co-Go-Me): right	30	112.97	5.055	-3.6	7.582	-2.601	29	0.014
	frontal gonial angle (Co-Go-Me): right	30	116.57	8.496					
	opg gonial angle (Co-Go-Me): left	30	112.97	4.453	-4.1	7.963	-2.82	29	0.009
	frontal gonial angle (Co-Go-Me): left	30	117.07	8.12					

**Table 7. Comparison of males vs females**

	Gender	N	Mean	Std. Deviation	T	Df	P VALUE
OPG length of condyle (Co-Snp): right	Female	30	15.77	3.319	-2.638	58	0.011
	Male	30	18	3.238			
OPG length of condyle (Co-Snp): left	Female	30	15.43	3.748	-2.738	58	0.008
	Male	30	17.9	3.209			
OPG length of ramus (Co-Go): right	Female	30	61	4.778	-6.163	58	<0.001
	Male	30	68.13	4.167			
OPG length of ramus (Co-Go): left	Female	30	60	4.698	-6.617	58	<0.001
	Male	30	68.27	4.975			
OPG length of corpus (Go-Me): right	Female	30	88.87	7.065	-5.449	58	<0.001
	Male	30	97.8	5.542			
OPG length of corpus (Go-Me): left	Female	30	88.93	6.948	-4.585	58	<0.001
	Male	30	96.67	6.087			
OPG length of mandible (Co-Me): right	Female	30	124.87	21.489	-3.609	58	0.001
	Male	30	139.43	5.197			
OPG length of mandible (Co-Me): left	Female	30	126.53	7.934	-6.377	58	<0.001
	Male	30	137.7	5.389			
OPG gonial angle (Co-Go-Me): right	Female	30	115.87	5.387	2.15	58	0.036
	Male	30	112.97	5.055			
OPG gonial angle (Co-Go-Me): left	Female	30	115.83	6.12	2.075	58	0.042
	Male	30	112.97	4.453			

Continue.....

OPG length of coronoid (Cor-Snp): right	Male	30	9.83	2.627	-0.793	58	0.431
	Female	30	10.43	3.202			
OPG length of coronoid (Cor-Snp): left	Female	30	10.2	3.199	0.397	58	0.693
	Male	30	9.83	3.922			
OPG angle between condyle and coronoid: right	Female	30	39.6	4.005	0.647	58	0.52
	Male	30	38.63	7.141			
OPG angle between condyle and coronoid: left	Female	30	35.77	4.554	0.368	58	0.714
	Male	30	35.3	5.234			
OPG width of ramus: right	Female	30	30.17	2.817	-3.239	58	0.002
	Male	30	32.57	2.921			
OPG width of ramus: left	Female	30	29.57	3.126	-2.375	58	0.021
	Male	30	31.57	3.39			
Frontal length of condyle (Co-Snp): right	Female	30	15.77	3.319	-2.118	58	0.038
	Male	30	17.67	3.623			
Frontal length of condyle (Co-Snp): left	Female	30	15.3	3.687	-2.913	58	0.005
	Male	30	17.9	3.209			
Frontal length of ramus (Co-Go): right	Female	30	51.8	5.436	-5.14	58	<0.001
	Male	30	58.87	5.211			
Frontal length of ramus (Co-Go): left	Female	30	51.1	5.628	-5.367	58	<0.001
	Male	30	58.9	5.628			
Frontal length of corpus (Go-Me): right	Female	30	43.67	3.827	-1.783	58	0.08
	Male	30	45.57	4.408			
Frontal length of corpus (Go-Me): left	Female	30	44.1	4.421	-1.028	58	0.308
	Male	30	45.2	3.845			
Frontal length of mandible (Co-Me): right	Female	30	83.43	7.986	-1.538	58	0.129
	Male	30	87.3	11.216			
Frontal length of mandible (Co-Me): left	Female	30	82.53	8.382	-1.599	58	0.115
	Male	30	86.63	11.266			
Frontal gonial angle (Co-Go-Me): right	Female	30	121.3	8.619	2.142	58	0.036
	Male	30	116.57	8.496			
Frontal gonial angle (Co-Go-Me): left	Female	30	121.37	9.171	1.923	58	0.059
	Male	30	117.07	8.12			
Frontal Co-MSR: right	Female	30	42.23	2.661	-4.608	58	<0.001
	Male	30	45.37	2.606			
Frontal Co-MSR: left	Female	30	42.2	2.797	-3.449	58	0.001
	Male	30	44.53	2.432			
Frontal AZ-MSR: right	Female	30	55.2	3.388	-4.185	58	<0.001
	Male	30	59.3	4.162			
Frontal AZ-MSR: left	Female	30	55.13	3.014	-3.791	58	<0.001
	Male	30	58.13	3.115			
Frontal J-MSR: right	Female	30	26.07	1.552	-2.451	58	0.017
	Male	30	27.37	2.456			
Frontal J-MSR: left	Female	30	26.53	2.27	-2.27	53.181	0.027
	Male	30	27.7	1.664			

In contrast we found that gonial angle (right and left) was statistically significant as the mean values was increased in females as compared to male values. When taking the values from Frontal radiograph we found that, length of condyle (right and left), length of corpus(right and left)length of mandible (right and left), Co-MSR (right and left), AZ- MSR( RIGHT AND LEFT), and J- MSR (right and left) were showing statistically significant values and the mean was increased in males as compared to females. In contrast gonial angle (right and left) was statistically significant and the mean value was increased in females as compared to males. When correlating the mandibular asymmetry with ramus length, width and length of the body of mandible we found that there are positive correlation in certain parameters taken they are as follows: -

Length of condyle and length of ramus, length of ramus and corpus length, length of ramus and length of mandible, length of ramus and length of coronoid, length of ramus and width of ramus, length of condyle and length of ramus, length of cramus and length of corpus, length of ramus and length of condyle, length of ramus and angle between condyle and coronoid, length of ramus and width of ramus, length of mandible and width of ramus, length of corpus and width of ramus, length of condyle and width of ramus, length of coronoid and width of ramus, length of condyle and width of ramus, length of corpus

length of mandible and width of ramus, length of coronoid and width of ramus. In contrast we found there are certain negative correlation seen in length of ramus and gonial angle, length of ramus and angle between condyle and coronoid, length of ramus and gonial angle, length of ramus and length of coronoid, gonial angle and width of ramus, angle between condyle and coronoid and width of ramus, gonial angle and width of ramus, angle between condyle and coronoid and width of ramus. When comparing the panoramic radiograph (OPG) and Frontal radiograph (PA) we found that there is a significant difference in OPG and frontal cephalogram readings when comparing to length of the ramus, length of corpus and length of the mandible and gonial angle as the results showed statistically significant values, so it can be stated that the OPG and frontal cephalogram cannot be compared with each other for the measurement.

## DISCUSSION

### Prevalance of mandibular asymmetry

There is little information in the literature as to the relationship between mandibular asymmetry and skeletal pattern from either the antero-posterior or vertical aspect. *Severt and Proffit*<sup>7</sup> did a retrospective study of orthognathic patients identified those with Class II skeletal pattern as being least asymmetric.

In the other study done by *sassoun et al* in his article a roentgenographic cephalometric analysis of cephalofacial relationships in 1955 stated that if there is a diversity of facial pattern in height is an outcome of distorted facial, cranial morphology affecting several bones and growth rotations of mandible. So in our study we found that the prevalence of mandibular asymmetry as shown in Table no 1 is based on different parameters inclusive of both genders, OPG and Frontal radiographs. Mandibular asymmetry based on length of ramus was observed in 16.8% of the study subjects. Similarly, the incidence of mandibular asymmetry based on length of mandible, length of condyle, gonial angle and length of corpus was found to be 15.7%, 14.5%, 10.6% and 8.6% respectively as shown in Table no 1. Thus, the results in the present study suggest that any variation in length of ramus or increase in the length of mandible on either side can be the factor of asymmetry present. So if we clinically find any asymmetry present in the subject we can consider that there may be higher chances of asymmetries present in the length of ramus followed by length of mandible and length of condyle.

### Sexual dimorphism

*Jodi Leversha et al.* found in their panoramic study that males have a statistically significant larger ramus height and bigonial width than females ( $P < 0.0001$  for both). In our study we found similar finding that the ramal height is more for male than the female (right side male  $68.13 \pm 4.167$ ; female  $61 \pm 4.78$ , left side male  $(68.27 \pm 4.975)$  female  $60 \pm 4.698$ ) which is statistically significant as shown in Table no.7. Our study shows that the width of the ramus is statistically significant more in male both right and left side as compared to female (Right side male  $32.57 \pm 2.92$ ; females  $30.17 \pm 2.81$  and left side male  $31.57 \pm 3.39$ ; female  $29.57 \pm 3.13$ ). In contrast to our study *Damera<sup>41</sup>* found insignificant (male  $31.0275$  and female  $30.5625$ ) difference. Mandibular condyle and ramus in particular are generally the most sexually dimorphic as they are the sites associated with the greatest morphological changes in size and remodeling during growth. So in our study also we have taken these parameters into consideration and found that length of mandibular condyle and ramus length is higher in males as compared to females. So it shows that there is higher prevalence of mandibular asymmetries seen in males than females. Our study is in accordance to the study done by *Noha Saleh Abu et al.* which stated that males showed statistically significant higher mean ramus linear measurements than females. His study also revealed that there is also lower mean gonial angle value in males than females which is also in accordance to our study as our study also shows decrease in the gonial angle in males than females as shown in Table no 7. The other parameters which were found more in males are length of condyle (right side male  $18 \pm 3.24$ ; female  $15.77 \pm 3.32$  while on the left side male  $17.9 \pm 3.20$ ; in female it was  $15.43 \pm 3.75$ ), length of corpus (right side male  $97.8 \pm 5.54$ ; female  $88.87 \pm 7.06$  and left side male  $96.67 \pm 6.087$ ; in female  $88.93 \pm 6.95$ ) Length of mandible (right side male  $139 \pm 5.19$ ; female  $124.87 \pm 21.49$  and left side male  $137.7 \pm 5.39$ ; in female  $126.53 \pm 7.93$ ) which were statistically significant seen in OPG radiograph. Parameters analysed using Frontal Cephalogram included most readings with increased significance in males rather than females. Length of condyle right in male was  $17.67 \pm 3.62$  and length of condyle right female  $15.77 \pm 3.32$ . Length of condyle left side male  $17.9 \pm 3.21$  whereas in female is  $15.3 \pm 3.68$ .

Similarly Length of ramus right side male  $58.87 \pm 5.21$ ; right side female  $51.8 \pm 5.44$  and left side male  $58.9 \pm 5.63$ , left in female  $51.1 \pm 5.63$ ). Length of corpus (right side male  $45.57 \pm 4.41$ ; female  $43.67 \pm 3.82$  and left side male  $45.2 \pm 3.84$ ; in female  $44.1 \pm 4.42$ ). Length of mandible (right side male  $87.3 \pm 11.23$ ; female  $83.43 \pm 7.98$  and left side male  $86.63 \pm 11.27$ ; in female  $82.53 \pm 8.38$ ). Frontal Co - MSR (right side male  $45.37 \pm 2.6$ ; female  $42.23 \pm 2.66$  and left side male  $44.53 \pm 2.43$ ; in female  $42.2 \pm 2.80$ ). Frontal AZ- MSR (right side male  $59.3 \pm 4.16$ ; female  $55.2 \pm 3.38$  and left side male  $58.13 \pm 3.11$ ; in female  $55.13 \pm 3.01$ ). Frontal J- MSR (right side male  $27.37 \pm 2.45$ ; female  $26.07 \pm 1.55$  and left side male  $27.7 \pm 1.66$ ; in female  $26.53 \pm 2.27$ ). These readings which mostly reveal increase in the value in males than females can also be due to the skull size as females have smaller skull size as compared to males.

### OPG vs Frontal Cephalometry

In our study as shown in Table no 4 we have found that there is a significant difference in OPG and frontal cephalogram readings, to compare length of the ramus, length of corpus and length of the mandible and gonial angle so it can be stated that the OPG and frontal cephalogram cannot be compared with each other for the measurement. The Possible reasons must be the variation in the measurements in both OPG and PA as all the measurements don't match due to the difference in standardization. In contrast to our study done by *Aggarwal et al<sup>11</sup>* it was found that a strong correlation exist between OPG and frontal and they have mentioned four linear namely as length of the condyle, length of the ramus and length of the corpus, and two angular as gonial angle and mandibular 1<sup>st</sup> molar angulation were found to be comparable in both PA cephalogram and OPG.

### Correlation of mandibular asymmetry with ramus length

#### Ramus length

In Table no 5, as the study shows that there is positive correlation of ramus length with length of condyle, corpus length, length of mandible, length of coronoid, width of ramus and angle between condyle and coronoid, i.e if the length of ramus length is increased, the length of the condyle will increase and vice versa i.e if length of condyle is increased the length of the ramus length will also increase. This means ramus length is directly proportional to length length of condyle. This accounts for all the positive correlations mentioned above according to our study. As shown in Table no 5, there is negative correlation between length of ramus and gonial angle i.e if the length of ramus is increased there would be decrease in the gonial angle that means according to our study the length of ramus is inversely proportional to gonial angle. Negative correlation found in the study is supported by *Bjork, A. and Palling, M. (1954)<sup>12</sup>* Adolescent age changes in sagittal jaw relation alveolar prognathism and incisal inclination, which states that increase in the length of mandibular ramus is associated with decrease in gonial angle which is always found in horizontal growth pattern. So the study done by author matches our study.

### Correlation of mandibular asymmetry with ramus width

**Ramus width:** These are the following positive correlations found in the study with regards to ramus width. Length of ramus, length of condyle, length of corpus, length of coronoid. These are the following parameters with negative correlation

with regards to ramus width: - Angle between condyle and coronoid and gonial angle.

### Correlation of mandibular asymmetry with length of body of the mandible

#### Length of mandible

The study shows that there is positive correlation of length of ramus and width of ramus. There is no negative correlation found between the parameters of the present study with regards to length of mandible.

#### Conclusion

The mandibular asymmetry, is important because of its direct effect on facial appearance and stomatognathic system. Asymmetries of the mandible may not cause only esthetic problems but also functional problems. The regions that have the highest growth potential on the mandible are the condylar cartilages. Condylar asymmetries are thought to be one of the most important causes of mandibulofacial asymmetries. (Omer Said *et al.*, 2007)

#### In the study it can be concluded that

- In the mandibular asymmetries we have found that higher prevalence is seen in the region of ramus length that is 16.8% followed by length of mandible, length of condyle, gonial angle and length of corpus which was about 15.7%, 14.5%, 10.6% and 8.6% respectively
- In the sexual dimorphism we have found that there is an increase in the prevalence of asymmetries present in males as compared to females in the condylar length, length of ramus, length of corpus and length of mandible.
- OPG and Frontal cephalogram cannot be compared as the readings suggests that there is a variation in measurements and the possible reasons is the variation in standardization.
- There is positive correlation of ramus length with length of condyle, corpus length, length of mandible, length of coronoid, width of ramus and angle between condyle and coronoid and vice-versa.
- There is positive correlation of length of mandible and width of ramus, vice versa. There is no negative correlation found between the parameters of the present study in relation to the length of mandible.
- There is positive correlation of ramus width with length of ramus, length of condyle, length of corpus, length of coronoid vice-versa and negative correlation in relation to angle between condyle and coronoid and gonial angle.

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