Craniometric asymmetry assessment in class I and class II skeletal relationship patients using helical computed tomography sample aged between 18-35 years

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ABSTRACT

Background: Asymmetry assessment is an important component of orthodontic diagnosis and treatment planning. Several studies attempted to find the relationship between craniometric asymmetry and skeletal jaws relationship and many authors found some extent of asymmetry in individuals with normal jaws relationship. The use of Computed tomography (CT) allows for the assessment of asymmetry on a dimensionally accurate volumetric image, aim of the study is to determine if there are differences in craniometric asymmetry between patient with skeletal class I and patients with skeletal class II relationship using Helical CT scan.

Materials and Methods: Ninety individuals with clinically symmetrical faces were imaged with Helical CT scan, and aging 18-35 years, divided into two groups, class I group consisted of 31 individuals and class II group consisted of 59individuals. Anatomical landmarks were defined and reference planes were established to determine the variance of the landmarks using a coordinate plane system. Sagittal radiographs were used to determine the amount of the ANB angle. Asymmetry was analyzed by calculating the linear measurements and asymmetry indices of the anatomical landmarks by using coronal and axial radiographs in both classes.

Results: Clinically symmetrical faces demonstrated a computed tomographic significant asymmetry with the vertical dimensions being significantly larger than the bilateral dimensions and the amount of asymmetry was more at the level of the mandible and less at the maxillary area.

Conclusions: The craniometric structures in terms of size and shape were larger in males than in females. The amount of asymmetry was independent on gender and skeletal jaws relationship and age.

Keywords: Craniometric asymmetry, Helical CT scan. (J Bagh Coll Dentistry 2013; 25(4):60-65).

INTRODUCTION

Assessing symmetry is important in any esthetic evaluation of the craniofacial region.

Many experts consider symmetry to be of high importance in facial attractiveness [1-4]. Several studies have attempted to find a relationship between occlusion and craniofacial asymmetry, the severity of the craniofacial asymmetry was found to be independent of the severity of the malocclusion by [5,6].

A potentially way to assess the importance of symmetry is by mirroring skeletal landmarks on both sides of the face and comparing this new face to the original. In these types of studies, the new symmetrical face is found to be more attractive than the original in studies of both male and female faces [2,7]

The first CT scanner was invented in 1972 by Godfrey Hounsfield, since then these machines have gained greater sophistication and are being utilized in a wider array of clinical applications.

In the modern medical CT, the x-ray source rotates within the gantry chamber that houses the x-ray tube and detector, while the patient is moved through the gantry on the bed. This method of CT scanning is known as helical CT and is the most widely used [8].

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The aim of this study was to determine if there are differences in craniometric asymmetries between patients with a skeletal class I ANB angle compared to patients who have a skeletal class II using CT images.

MATERIALS AND METHODS

The study was accomplished in the Institute of X-Ray in Baghdad Hospital. The study sample consisted of ninety patients attended the Institute of X-Ray for different diagnostic purposes.

The patients were consecutively selected and fit inclusion criteria. Mirroring technique was used to exclude patients with markedly asymmetric faces by comparing the right and left sides. The age ranged between 18-35 years. The subjects were divided into two groups according to the value of the ANB angle.

Group 1

Those with a class I skeletal relationship and clinically had normal, pleasant symmetrical faces, the value of ANB angle 2-4º, it include 18 males and 13 females [9-11].

Group 2

Those with a class II skeletal relationship and clinically had normal, pleasant symmetrical faces, the value of ANB angle 4º to 5º. It included 35 males and 24 females. Each subject was extra-orally examined by inspection to check for obvious facial asymmetry. Mirroring technique was used to exclude patients with markedly asymmetric faces by comparing the right and left sides. The landmarks Sella , Nasion and Odontoid process of epistropheus (Dent) were used to create the two reference planes that were used to measure linear distances from the landmarks (Orbitale, Condyle, and Gonion) by calculating the distance of each of these landmarks from the reference planes in millimeters for the right and left sides of each patient.

Statistical analysis

All the data of the sample were subjected to computerized statistical analysis using. Computer program. The statistical analysis included: Descriptive statistics: Including means, standard deviation, statistical tables and figures, Inferential statistics: Independent samples t-test: for comparison between classes and genders, Paired sample t-test: to assess the asymmetry of right and left measurements for both genders and both classes, Cohen's d: to estimate the sample size and as a measure of the effect size in which the values (0 to 0.3) represent a small effect size ,(0.3 to 0.6) represent a moderate effect size and the values larger than 0.6 represent a large effect size.

RESULTS

1. Craniometric Linear Measurements and Indices for both Classes

Results in table (1) reveal that in class II all linear measurements of the gonion and the condyle landmarks were larger than those in class I with asymmetry indices more in class II than in class I, while the linear measurements of the orbitale were larger in class I than in class II with asymmetry index less in class II than in class I.

Table 1: Classes Differences

	Skeletal class			
	Class-I (n=31)	Class-II (n=59)	P (t-test)	Cohen's d
Condyle-distance from transverse plane (mm)-mean RL			0.35[NS]	0.21
Range	(14.9 to 28.9)	(11.3 to 37)		
Mean	21.22	22.25		
SD	4.18	5.25		
SE	0.75	0.68		
Gonion-distance from transverse plane (mm)-mean RL			0.43[NS]	0.18
Range	(66.8 to 105.5)	(56.2 to 124.1)		
Mean	89.06	90.98		
SD	10.29	11.18		
SE	1.85	1.46		
Orbitale-percent lateral displacement			0.018	-0.54
Range	(0 to 42.4)	(0 to 42.2)		
Mean	14.95	10.42		
SD	9.19	8.04		

2. Age Differences in the Craniometric Linear Measurements and Indices for both Classes

The linear measurements of the anatomical landmarks for both age groups, showed a non significant differences between the two age groups, for class I, and the same results were obtained for class II concerning the linear measurements of the anatomical landmarks for both age groups (table 2).

3. Gender Differences in the Craniometric Linear Measurements and Indices for both Classes

Both class I and class II the linear measurements of the anatomical landmarks showed non significant differences between males and females with craniometric linear measurements of the anatomical landmarks were mostly larger in males than in females (table 3).

Table 2: Age group differences

	Age group (years)			
For skeletal Class-I subjects	**<30 (n=16)**	**30-40 (n=15)**	**P (t-test)**	**Cohen's d**
Condyle-vertical distance between Right and Left side				
Range	(0.6 to 7.2)	(0.4 to 5.5)	0.17[NS]	-0.5
Mean	3.38	2.42		
SD	2.24	1.48		
Gonion-distance from transverse plane (mm)-mean RL				
Range	(77 to 105.5)	(66.8 to 100.4)	0.11[NS]	-0.59
Mean	91.93	85.99		
SD	9.23	10.77		
SE	2.31	2.78		
Orbitale-vertical distance between Right and Left side				
Range	(0 to 7.3)	(0.4 to 4.3)	0.49[NS]	-0.25
Mean	2.38	1.91		
SD	2.29	1.29		
SE	0.57	0.33		

	Age group (years)			
For skeletal Class-II subjects	**<30 (n=35)**	**30-40 (n=24)**	**P (t-test)**	**Cohen's d**
Condyle-vertical distance between Right and Left side				
Range	(0 to 8.6)	(0.3 to 8.1)	0.43[NS]	-0.21
Mean	3.64	3.14		
SD	2.49	2.15		
SE	0.42	0.44		
Gonion-distance from transverse plane (mm)-mean RL				
Range	(67.3 to 109)	(56.2 to 124.1)	0.2[NS]	0.34
Mean	89.42	93.25		
SD	9.52	13.12		
SE	1.61	2.68		
Orbitale-distance from transverse plane (mm)-mean RL				
Range	(20 to 61)	(22 to 52.8)	0.85[NS]	0.05
Mean	32.09	32.5		
SD	8.52	7.86		
SE	1.44	1.6		

Discriminant Analysis

The mandibular-asymmetry index was ranked as the most important index among the other craniometric linear measurements and indices, while the Gonia-distance from sagittal plane (mm)-Left side was ranked the last one in this table which means that it has the least importance of effect between the two classes (table 4).

Table 3: Gender differences

For Skeletal Class-I subjects	Female (n=13)	Male (n=18)	P (t-test)	Cohen's d
Condyle-distance from transverse plane (mm)-mean RL			0.21[NS]	-0.47
Range	(16.1 to 28.9)	(14.9 to 27.3)		
Mean	22.35	20.41		
SD	4.24	4.05		
SE	1.18	0.96		
Gonion-vertical distance between Right and Left side			0.41[NS]	-0.3
Range	(0.1 to 9.4)	(0 to 7.5)		
Mean	3.98	3.1		
SD	3.01	2.82		
SE	0.83	0.67		
Orbitale-vertical distance between Right and Left side			0.79[NS]	0.1
Range	(0 to 7.3)	(0.4 to 5.6)		
Mean	2.05	2.23		
SD	2.03	1.78		
SE	0.56	0.42		
For Skeletal Class-II subjects	**Female (n=13)**	**Male (n=18)**	**P (t-test)**	**Cohen's d**
Condyle-distance from transverse plane (mm)-mean RL			0.72[NS]	0.09
Range	(11.8 to 32.6)	(11.3 to 37)		
Mean	21.97	22.46		
SD	5.12	5.41		
SE	1	0.94		
Gonion-distance from transverse plane (mm)-mean RL			0.2[NS]	0.34
Range	(68.8 to 109.4)	(56.2 to 124.1)		
Mean	88.88	92.63		
SD	10.32	11.7		
SE	2.02	2.04		
Orbitale-distance from transverse plane (mm)-mean RL			0.8[NS]	0.07
Range	(21.7 to 44.7)	(20 to 61)		
Mean	31.95	32.5		
SD	5.73	9.78		
SE	1.12	1.7		

Table 4: Discriminant Analysis

Discriminant Model for 29 Selected Measurements when used to discriminate between Class-I and Class-II.

	Rank according to importance (discriminating power)
Mandibular-asymmetry index	1
Orbitale-lateral displacement (difference between Right and Left side horizontal distance from midline)	2
Condyle-distance from transverse plane (mm)-Left side	3
Gonion-distance from sagital plane (mm)-Left side	4

P (Model) < 0.001
Overall predictive accuracy = 73.3%
Wilks' Lambda = 0.73

D = -0.123 + (0.107 x Condyle-distance from transverse plane (mm)-Left side) + (-0.081 x Gonia-distance from sagital plane (mm)-Left side) - (-0.291 x Orbitale-lateral displacement (difference between Right and Left side horizontal distance from midline)) + (0.481 x Mandibular-asymmetry index)

Cut-off value = 0.197
Class-II ≥ cut-off value, Class-I < cut-off value

DISCUSSION

Classes differences

From the mentioned tables it was obvious that all the linear measurements and the asymmetry indices of the condyle and the gonion were larger in class II than in class I, while for the orbitale all the linear measurements and the asymmetry indices were larger in class I than in class II.

These findings indicate that the linear measurements and the asymmetry indices were larger at the level of the mandibular area, this can be explained by knowing that head is a complex of different parts, each one of which serves different functions [(12)].

Growth of the mandible occurs essentially at the condyle, the growth at the condyle usually does not occur in the direction of ramus, but slightly forward. Individual variation in the direction of growth at the condyles is large and, in the adolescent period, has been found to vary by almost 45 degrees. Growth is not always linear in direction but usually curves slightly forward even backward [(13, 14)] described the mandibular growth pattern as racial in nature. Enlow [(15)] has shown growth of the maxilla to be under the influence of the cranial base, which in turn is influenced by growth of the brain. The mandible, by virtue of its remoteness from the region, acts in a more independent way although its articulation at the glenoid fossa does provide potential for influence from the cranial base.

Age Groups Differences

The results of this study showed a non significant difference between the two age groups for class I for all landmarks, the same findings were in class II with some increase in the linear measurements of the condyle at the young age group, and an increase in the measurements of the goinion and orbitale at the older age group.This indicates that the amount of craniometric asymmetry in both classes was independent on the age; this is because the majority of the facial growth is usually completed by 16 -17 years of age [(16)].

Gender Differences

Generally, most of the linear measurements and asymmetry indices values showed insignificant differences between males and females in both class I and class II. This indicates that the degree of craniometric asymmetry was independent on gender in our study. This finding comes in agreement with [(17-26)].

The results of this study also showed that some of the linear measurements values were larger in males than in females for both classes. These findings indicate that craniometric structures in terms of size and shape are larger in males than in females.

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