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Gonial and antegonial angles in different skeletal patterns (cephalometric survey)

A project submitted to College of Dentistry, Baghdad University, Department of Orthodontics in partial fulfillment of the requirement for B.D.S. degree

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Abstract

This was performed to assess the distribution of mandibular gonial and antegonial angle in different skeletal patterns, for the Iraqi adults (18-23) years of age.

The sample included 60 pretreatment digital lateral cephalometric radiographs (30 males and 30 females) collected from orthodontic department in College of Dentistry, Baghdad university, AL-Wasity hospital, Baldiat and AL-falah health center.

The sample was divided into three groups according to the skeletal classes (10 Cl I male, 10 Cl I female,10 Cl II male, 10 Cl II female,10 Cl III male and 10 Cl III female), then each group divided according toANB angle: Cl I ($2° \leq ANB \leq 4°$), CI II ($ANB > 4°$) and CI III ($ANB < 2°$) groups.

Five angular (SNA, SNB, ANB, mandibular gonial and antigonial) were digitized and recorded using AutoCAD 2014 computer program.

We found in Cl I classification:

SNA in male greater than female, SNB in male greater than female, ANB in female greater than male, go in female greater than male, ante go in male greater than female.

In Cl II classification:

SNA in female greater than male, SNB in male greater than female, ANB in female greater than male, go in male greater than female, Ante go in female greater than male.

In Cl III classification:

-SNA in male greater than female, SNB in male greater than female, ANB in malegreater than female, go in female greater than male, Ante go in male greater than female.

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List of Abbreviation

S	Sella turcica
N	Nasion
A	A point
B	B point
Me	Menton
Go	Gonion
Ar	Articular
S-N	Sella-Nasion
MP	Mandibular plane
Ar-Go-Me	Gonial Angle
Anti-Go	Antigonial angle
Cl I	Class I sketetal pattern
Cl II	Class II sketetal pattern
Cl III	Class III sketetal pattern

Introduction

A successful treatment of malocclusions often depends on appropriate orthopedic intervention to correct underlying skeletal discrepancies. The ability to predict the magnitude and direction of a patient's facial growth early in life would enable the clinician to identify those who required interceptive growth identification and to ensure that the appropriate treatment can be rendered while growth is possible, and to forego unnecessary treatment on patients with skeletal discrepancies whose growth pattern would probably lead to correction without orthopedic intervention **(Kolodziej et al, 2002**). The efficacy and timing of the treatment of malocclusions, often depends upon the pubertal growth spurt (**Garber TM, 1972; Enlow DH. 1982**). Treatment effects may be impaired or enhanced by variations in the direction, timing and duration of development in facial area (**Nahoum, 1977; Baumrind etal., 1978; Cangialosi, 1984 and Moorrees etal. 1985**); thus extensive knowledge of facial morphology and development is necessary for the successful treatment of dentofacial deformities.

Aims of the study

1-To identify the distribution of mandibular gonial and antegonial angles among genders.

2-Assessment of the measurements and relationships of gonial and antegonial angles in different skeletal patterns (CI I,II and III).

Review of Literature

1. Growth and development

The terms growth, development and maturation are often used interchangeably to describe the changes that occur throughout life. Growth usually refers to size development, progressive development (evolution, emergence, increase ,or expansion).

Development is defined as going through natural growth differentiation, or evolution by successive changes **(Bishara, 2001)**.

Development also defined as the physiological, psychological, and cognitive changes occurring over one's life span due to growth, maturation, and learning, and assumes that orderly and specific situations lead to new activities and behavior patterns **(Mandleco, 2004).**

A thorough background in craniofacial growth and development is necessary for every dentist even when not working on children (**Proffit et al, 2007**).

2. Anatomy of the mandible:

The mandible is a U-shape bone, it completes the skull and it is the only mobile bone of the facial skeleton. Since it houses the lower teeth, its motion is essential for mastication. It is formed by intramembranous ossification. The mandible is composed of 2 hemi mandibles joined at the midline by a vertical symphysis. The hemi mandibles fuse to form a single bone by age 2 years. Each hemi mandible is composed of a horizontal body with a posterior vertical extension termed the ramus **(Jahan-Parwar, 2005)**.

3.Body of the mandible:

On the anterior inferior midline region of the hemi mandibular body is a triangular thickening of bone termed the mental protuberance. The thickened inferior rim of the mental protuberance extends laterally from the midline and forms 2 rounded protrusions termed the mental tubercles. The mental foramina located lateral to the midline on the external surface that transmit the mental nerves and vessels. The rim of bone lateral to the mental tubercles extends posteriorly and ascends obliquely as the oblique line to join the anterior edge of the coronoid process. The inferior rim of the posterior body thickens and flares laterally where it attaches to the masseter muscle **(Berkovitz and Moxham, 1980 and Jahan-Parwar, 2005)**.

4.Gonial angle:

The external gonial angle is an important angle of the craniofacial complex, It is significant of the diagnosis of craniofacial disorder **(shahabi et al., 2009)**

The effect of age, gender and dental status on gonial angle size measurement of gonial angle GA is important for the growth in orthodontic researches, the degree of GA shows change during growth process , and when the growth ceases a slight sexual dimorphism appears with females having higher degree ,a study of 267 panoramic radiographs of Turkish adults with no craniomandibular disorders, orthodontic history or treatment they concluded that there were no significant difference between right and left GAs of the individuals but there was a significant difference at the left GA between genders (Gungor

Lonberg ,1951) reported a study on 2 groups with and without teeth at the age of 24 and 72 years using cephalograms .He found that in the 24 years group subjects with teeth had smaller GA than those without teeth.

Figure 1-1: genial angle (Shahabi et al., 2009).

Lin and Hang (1997) investigated the change of GA with respect to the age and gender of 1009 Chinese adult subjects (505 female and 504 male, ages ranging from 20 to 90 years) using lateral cephalometric radiographs. They concluded that the female GA was larger than the respective male .Further more in both genders no statistical difference could be found in the size of GA at different age groups.

In 1999, a study done by **Ohm and Silness** to demonstrate the variables often related to the development of the size of GA, i.e. age, degree of tooth retention and gender. The size of the GA was measured in cephalograms of 431 Norwegian adults. The average age for 20 females was 51 -6±20*6 years (range 20-90 years) and for 21 males 49-8±19-4 years (range 18-86 years). They found that the number of teeth had a decisive influence on the size of the GA.

The correlation coefficients between size of the angle and age stated that age explained approximately 8-16 % of the variation of the angle through its relation with age. Gender differences in age and size of the angle were not statistically significant in relation to degree of tooth retention during this study.

Mattila et al. In 1977 done a study to compare the size of the GA obtained from both orthopantomograms and lateral cephalograms ,601 patients aged from 5 to 20 years while the gender of the patient was not taken into consideration as only the exposure procedures were to be compared. The study demonstrated that the size of the GA could be determined from the orthopantomogram with the same degree of accuracy as from the generally used lateral cephalognun. It also showed that he right and left GAs could be quite easily determined individually from orthopantomograms thus avoiding the disturbing influence of the superimposed images found on lateral cephalograms and proved conclusively.

That the orthopantomogram is the more obvious choice for determination of the GAs.

OR comparison between lateral cephalograms and panoramic radiographs for determination of GA a study done by **Shakabi et al in (2009)** to compared the external GA of 70 adult Iranian patients(4£ females and 2 males) with Angles class 1, their age ranged from 15-30 years. They concluded that panoramic radiography could be used to determine the GA as accurately as a lateral cephalogram in addition to both right and left GAs of a patient without interferences .

Changes in the antegonial angle, antegonial depth and GA in edentate and dentate patients were found in a study done by **Yang et al. in 2009** to examine panoramic images of 312 grouped into four 10-year age groups (by decades).The youngest age group was (40-49) years and the oldest (70-79) years. They found no significant differences of GA regarding age, gender and edentulism where as the antegonial region had a restorative pattern in the edentulous mandible therefore morphology of the antegonial region was influenced by gender and dental status.

5.Antigonial angle:

The antegonial notch is the depresion along the jawline. To feel for the antegonial notch, place thumb under your ear and against the back of your jaw. Slide your thumb along the border of the jaw as if tracing the jawline from your ear to your chin. (**Qkrow 2004).**

Your thumb will slide down the back of the jawline (mandible), then turn a corner at the angle of the jaw. Just in front of this angle, your thumb will feel a slight depression; this is the antegonial notch. **(Qkrow2004**).

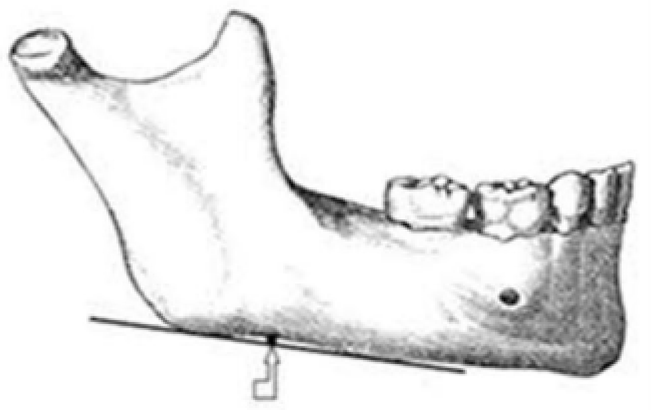


Figure 1-2: antigonial angle position(Qkrow 2004)

Assessment of craniofacial measurements

A.Direct Methods:

1. Craniometry:

It is the science of physical anthropology based on measurements of skulls found among human skeletal remains, from such skeletal material, it has been possible to piece together a great deal of knowledge about extinct populations and to get some idea of their pattern of growth by comparing on skull with another.

Craniometry has the advantage that rather precise measurements can be made on dry skulls; it has the important disadvantage for growth studies that, by necessity, all these growth data must be cross-sectional **(Proffit et al, 2007).**

Popham (1952) reported that **Leonardo DaVinci (1452-1519)** was the leader in head measurements, he used an arbitrary scale made by a vertical and horizontal lines passing near about the prominent anatomical landmarks to form a mesh scale that gives a general idea about the proportion of the face.

2. Anthropometry:

It is the measurements of skeletal dimension on living individuals **(Proffit et al, 2007).**

Anthropometry is the most basic method of analyzing dimensional changes of the soft tissues of the face with direct measurements. **Davenport (1939), Meredith (1960), and Farkas (1981)** have extensively reported on the changes in various anthropometric measurements. Limitations of the use of anthropometry include sensitivity of some of the tissues to direct measurement techniques, like the eyes. Compressibility of the soft tissues is another source of error inherent to anthropometric techniques, i.e., differences in tissue thickness and consistency. The amount of pressure exerted on the calipers during measurement further compound the problem **(Bishara et al, 1995).**

B.Indirect Methods:

1. Cephalometric Radiography:

It is scientific measurement of the dimensions of the head. It was the first method to prove of value in orthodontics, used to assess craniofacial growth and to determine treatment responses. **Pacini and Carrera (1922)** took the first x-ray picture of the skull in the standard lateral view. In subsequent years, the following authors also produced this type of radiograph for evaluation of the craniofacial measurement: **MacGowen (1923), Simpson (1923), Comte (1927), Riesner (1929)** and others. None of them gave an accurate description of the methods used to take the pictures and for their evaluation. It was not until 1931 that Hofrath and Broadbent simultaneously and independently developed standardized methods for the production of cephalometric radiographs, using special holders known as cephalostats, to permit assessment of growth and of treatment response (**Rakosi, 1982**).

Over a hundred different analyses have been developed and are differentiated into a number of ways according to the method of determination, the standards used, and the particular basis of analysis (**Rakosi, 1982**).

According to **Graber and Vanarsdall (1994),** the commonly used radiographic views are:

1. Lateral or profile cephalograms: used to study anteroposterior and vertical relationships.
2. Frontal or postero-anterior cephalograms: used to evaluate the transversal and vertical relationships in the frontal plane.
3. Submentovertex or basal cephalograms: which are used to the balance in transversal plane.

Types of Cephalometric Radiographic Views:

According to **Daskalogiannakis (2000)** the standard projections are: lateral(profile), posteroanterior (P-A), and oblique projections.

a. Lateral Cephalometric Radiograph:

It is a radiograph of the head taken with the X-ray beam perpendicular to the patient's sagittal plane. The beam most commonly enters on patient’s right side, [with the film cassette adjacent to the patient’s left side (so that the patient's head is oriented to the right on the radiograph), but the reverse convention also is used.

b. Posteranterior (P-A) Cephalometric Radiograph:

It is a radiograph of the head taken with the X-ray beam perpendicular to the patient's coronal plane with X-ray source behind the head and the film cassette in front of patient's face. P-A cephalogram are usually taken for evaluation and treatment planning of patients with facial asymmetry.

c. Oblique Cephalometric Radiograph:

It is a radiograph of the head usually taken at 45° and 135° to the patient's midsagittal plane (or at any other angular projection that is required), usually to perform direct mandibular length measurements on either side on patients with facial asymmetry.

2. Photography:

Photographic analyses are inexpensive, do not expose the patient to potentially harmful radiation, and could provide better evaluation of the harmonic relationships among external craniofacial structures, including the contribution of muscles and adipose tissue (**Cox and Vander Linden, 1971**). However, the lack of morphologic balance among different skeletal components can often be masked by compensatory soft tissue contributions (**Bittner and Pancherz, 1990; Michiels and Tourne, 1990; Yogosawa, 1990; Ferrario et al, 1993)**.

The photographic view like cephalometric tracing, not only can provide points and landmarks for measurement, but they can offer an analytic system and a complete evaluation of the unique craniofacial aspect of the person who is being investigated. **(Benson and Richmond, 1997)**.

Photocephalometry (Morphoanalysis):

A method called photocephalometry has been described for the possible evaluation of orthognathic surgery patients by superimposition of coordinated cephalograms and photographs **(Hohl et al, 1978).** The assumption behind this technique is that the photographic images can be enlarged so that metal markers placed on the patient's skin are accurately superimposed on the corresponding radiopaque images on the cephalogram. The benefits of this method would be twofold: (1) a more detailed visualization of soft tissues in the frontal and lateral views and (2) a more accurate analysis of soft to hard tissue relationships, particularly of soft tissue thickness. This additional information on soft tissue changes with orthognathic surgery would be valuable in overcoming the inability of standard cephalometric techniques to adequately quantify soft tissue alterations, especially from the frontal view (Phillips et al, 1984).

Computerized cephalometry (digital cephalogram):

Harris and Reynolds, **(1991)** demonstrated the advantages of computerized cephalometric:

1. Angles and distances can be traced, calculated or listed together with mean values for comparison.

2. Any number of copies of computerized tracing can be produced.

3. One can obtain series of superimposition of computerized tracing before and after therapy registered on different structures, such as SN line at S or SN at N.

4. The population "norm" template can be superimposed on patient tracing.

5. A prognosis tracing can be generated to demonstrate the effect of the possible procedures.

6. Stored data can be retrieved for clinical or research purposes.

The cephalogram have long been an important diagnostic procedure in orthodontic practice. The Digital cephalograms which can be defined as cephalogram using the computed radiography system is increasing in popularity in hospitals, clinics, and private practices because many land marks are easier to observe on digital than conventional film/ screen cephalogram. **(Demura et al, 2001)**

Images in digital system can be acquired by means of charged coupled device receptors, phosphors, or digitization of radiographic film.

There are some advantages of digital over film – based x- rays. Such as, instantaneous image information, less radiation burden for the patient, lack of user – sensitive and performance – sensitive chemical development processes, simplified image storage, and the option to manipulate the image for size or contrast.

Moreover, in the visual test, the digital cephalogram fares much better than the film/ screen cephalogram (visual test and receiver operating characteristic curves). On the other hand, the physical characteristic of the film/ screen cephalogram were better, and the grain size of the latter image was higher, but because grain size and resolution are not strongly related to the identification of cephalogram landmarks, the digital cephalograms were judged to be better in overall because of the ability to precisely identify landmarks compared with the film/ screen cephalogram **(Demura et al., 2001)**.

Cephalometric analysis:

It is a diagnostic tool used to determine the type and focus of therapy for an individual patient **(McNamara, 1984).**

Cephalometric analyses are used to determine the relationships of dentofacial complex. Cephalograms can also help the orthodontist to determine the changes that are associated with growth and/or orthodontic treatment **(Bishara and Fernandez, 1985).**

It is also the process of evaluating skeletal, dental and soft tissue relationships of a patient, by comparing measurements performed on the patient's cephalometric tracing with population norms for the respective measurements, so as to come to a diagnosis of the patient's orthodontic problem **(Daskalogiannakis, 2000).**

Cephalometric analysis is one of the several diagnostic aids. An orthodontic diagnosis cannot be made solely on the basis of cephalometric analysis. It is a valuable aid in diagnosis only if their findings are correctly and wisely interpreted with the help of other diagnostic aids **(Bishara, 2001)** .

Leonardi et al. (2008) described the techniques used for automatic land marking of cephalograms and highlighting the strength and weaknesses of each one and reviewing the percentage of success in locating each cephalometric points. They conclude the systems used in automatic landmarking of cephalogram are not accurate enough to allow their use for clinical purposes, and errors in landmark detection were greater than those expected with manual tracing.

The purpose of cephalometric analysis:

1- Computerized growth prediction programs can anticipate the amount and direction of growth for a given period of time (e.g. after two years). The analysis derived from previous growth studies or subsequent individual radiographs are analyzed and compared. Many growth systems had been developed. **(Bjork, 1969)**
2- Planning treatment for orthodontic and/ or surgical procedure. **(Wolford et al, 1985)**
3- Prediction of the future is formed in the absence of treatment may be attempted either from a single radiograph or from a series radiograph. **(Viazis, 1992; Aki et al., 1994)**
4- Classifying skeletal and dental abnormalities with respect to cranial base, skeletal pattern, inter and intra- arch dental relationships and soft tissue profiles **(Hanson et al., 1994)**.
5- Analyzing changes from treatment, effectiveness of different treatment modalities and comparison between pre and post treatment **(Wolf ford et al., 1985; Chua et al., 1993; Parker et al., 1995)**.
6- **Rani in 1995** reported the following purposes:

a. Study of growth and development: Cephalograms/ cephalometrics are used for longitudinal, cross- sectional and semi- longitudinal growth studies of population; like in superimposing two cephalometric x-ray taken over a period of time tells us the amount and direction of growth.

b. Diagnosis of case: We will be able to diagnose whether it is a skeletal or dental malocclusion. If skeletal we can locate the problem whether it is maxilla or mandible, like if ANB angle 2-4 degrees it is skeletal class I, less than 2 degrees it is skeletal class III, greater than 4 degrees it is skeletal class II.

c. Treatment planning.

d. Prognosis.

e. Record of patient.

f. Studying the craniofacial abnormalities: Lateral Cephalogram is not only useful for orthodontic purpose. Many other things can be diagnosed like supernumerary teeth, tonsillar and adenoid tissue, cleft lip and palate.

g. Facial type: The relation of facial components vary broadly depending on the facial type, whether a face is convex or concave, forward divergent or backward divergent.

h. For studying soft tissue morphology.

i. To differentiate between growth and treatment effect.

7-The normality of a patient is evaluated by relating the angular and distance measurements taken from the cephalograms to normative cephalometric values obtained from a sample of normal peers. The patient should belong to the same population from which the normative sample was taken. **(Bishara, 2001)**.

Methods of lateral cephalometric analysis:

Each method has its aims, advantages and limitations and one cephalometric analysis is not appropriate for all clinical needs. **(Moyers, 1988)**

Some of the most important analyses include:

1. Bjork’s analysis. (1947, 1951)
2. Down’s analysis. (1948, 1952, 1956)
3. Steinner’s analysis. (1953, 1959, 1960)
4. Rickett’s analysis. (1957, 1960, 1972, 1981, 1996)
5. Jaraback’s analysis. (1972)
6. Biggerstaff’s analysis. (1977)
7. McNamara’s analysis. (1983, 1984)

Advantages of Digital Cephalometrics:

Digital imaging and image processing have a key position in the future of dental radiography. The main advantages of the digital systems are the immediate availability of the image, the elimination of the chemical darkroom process, and a reduced radiation dose. Image contrast, brightness, magnification, and other features of the image can be adjusted right to the user's needs by digital image processing. Any number of copies of computerized tracing can be produced, and the stored data can be retrieved for clinical or research purposes. The measurement of distances and angles is facilitated **(Al-Chalabi, 2009).**

Reliability of Lateral Cephalometric Radiography:

Bjork, (1947) has described three reasons for errors of the method in cephalometric measurement studies: -

1) Differences between two films of the same individual.

2) Differences caused by variation of the positioning of the landmarks.

3) Errors in the reading process.

His analysis of errors for method of cephalometric measurements reveals large differences in precision when localizing different cranial landmarks.

Some of the landmarks used clinically are located on the outline of the cranium and are comparatively easy to identify due to the sharpness in contrast of the roentgenograms. The structures of the inner cranium are, on the other hand, often indistinct because of the summations of superimposed anatomical details. **(Midtgard and Bjork, 1974)**. According to **Savara and Takeuchi, (1979)**, errors may be caused by variation of tissue images on consecutive cephalograms resulting from changes in relative positions of bony landmarks during child growth, unclear of anatomical landmarks, and insufficient training of landmark locators. A lack of training or understanding of anatomical landmarks can result in interlocutor discrepancies. The degree of measurement error produced is directly related to the accuracy of the measuring instrument and the measuring technician.

The inter- tracer error is found to be higher than the intra-tracer error. The inter-tracer variation may be caused by variation in training and experience or by the subjective nature of landmarks identification, whereas intra-tracer variation may result from variations in lighting and image orientation. **(Odeh, 1985and Randolph et al., 1998)**.

(**Gravely and Benzies, 1973; Odeh, 1985 and Bishara, 2001)** stated that tracing errors may be caused by lack of clarity of cephalometric landmarks due to superimposition of structures, blurring of the image brought about by movement during the exposure, lack of film contact and emulsion grain.

Materials and Method

2.1.Materials:

2.1.1.The Sample:

60 samples collected form Orthodontic Departments, College of Dentistry/Baghdad, AL-Wasity hospital, Baldiaat and AL-falah health center.

The sample divided according to ANB angle to10 Cl I male,10 Cl I female, 10 Cl II male,10 Cl II female ,10 Cl III male and 10 Cl III female.

Samples were classified depended on the sagittal skeletal classification according to **Houston (1983), Foster (1985), Rani (1995), and Mitchell et al (2004):**

Skeletal Cl I: $2° \leq ANB \leq 4°$.

Skeletal Cl II: $ANB > 4°$.

Skeletal Cl III: $ANB < 2°$.

. The sample were:

1- all of Iraqi origin

2-age ranged between 18 - 23 years they possessed complete permanent dentition except the third molar **(swiergena etal , 1994)**

3- no history of abnormal habits, no history of orthodontic, orthopedic or facial and surgical treatment

2.2.The Equipment:

2.2.1.X-ray Machine:

All the radiographs were taken in the Oral Diagnosis and Orthodontic Departments, College of Dentistry, Baghdad University, AL-Wasity hospital, Baldiat and AL-falah health center., using DIMAX3 digital x-ray unit system machine (Finland). **Figure (2-1):**

Figure 2-1: DIMAX3 digital x-ray unit system machine

2.2.2.Analyzing Equipment:

1. Hardware:

- Portable computer.
- Compact disks.
- Flash 4GB

2. Software:

- AutoCAD program version 2014.

2.3.The methods:

2.3.1.The Radiographic Technique:

Lateral Cephalometric Image was done for each patient at centric occlusion, the patient head was positioned so that the x-ray beam was perpendicular to the patient’s sagittal plane. The head positioned between the two ear posts and faced the nasal positioner, the nasal positioner touched the patient's head at the Nasion point and the angle of patient's head adjusted until the Frankfort plane became horizontal.

Exposure factors were applied as recommended by the user manual of the machine.

2.3.2.Digitization:

All Lateral Cephalometric Images were analyzed by AutoCAD program (version 2014) to measure the ANB angle (represent anteroposterior position of maxilla in relation to mandible) to detect type of class (Cl I,C l II and Cl III).

Firstly, every radiograph was copied twice one for angular and one for linear measurements, then cephalometric points were located for each one and lines joined between these points to form angles and planes. figure (2-2).

The magnification was corrected by multiplying the readings by the magnification factor which was obtained as a ratio between the real distance measurements for a scale and the distance measurements for the same scale from radiographic image.

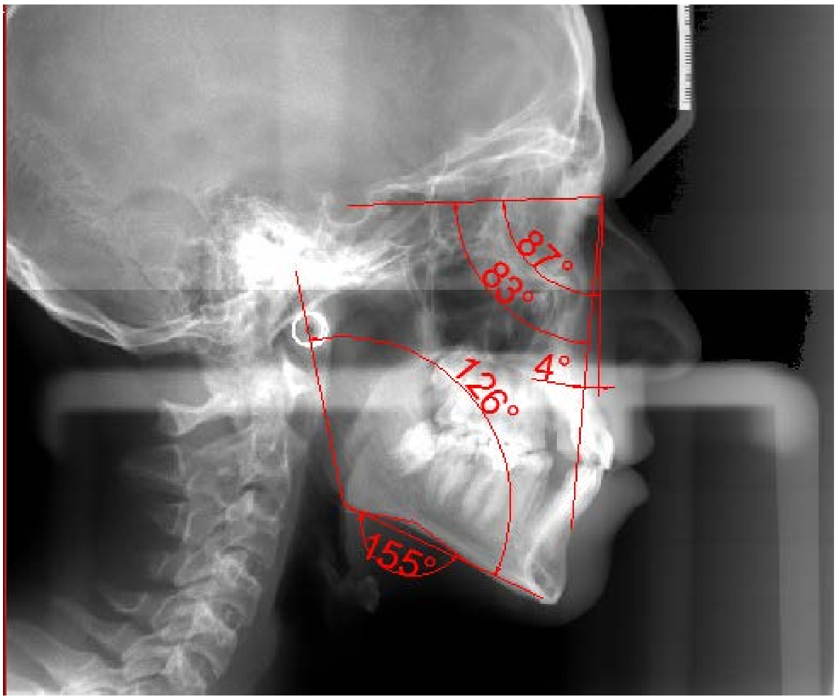


Figure (2-2): Analyzing software.

2.4.Cephalometric landmarks and measurements

2.4.1.Cephalometric bony landmarks:

The cephalometric bony landmarks, which were used in this study, include the following:-

1-Point S. (Sella): The center of the shadow of the sella turcica **(Downs,1948 and Steiner,1953).**

2-Point N. (Nasion): The most anterior point on the nasofrontal suture in the mid sagittal plane **(Downs,1948 ; Steiner,1953 andRickettes,1972).**

3- Point A (subspinale): The deepest midline point in the curved bony outline from the base to the alveolar process of the maxilla (**Rakosi, 1982; Jacobson 1995 and Bishara 2001).**

4-Point B (Supramentale): It is the most posterior point in the outer contour of the mandibular alveolar process, in the median plane (**Rakosi, 1982; Jacobson 1995 and Bishara 2001).**

5-Point Me (Menton): The most inferior point on the lower border of the mandible where the shadow of the lower border of the mandible meets the shadow of the cross section of the mandibular symphysis (**Rakosi, 1982).**

6-Point Go (Gonion): The point on the curvature of the angle of the mandible located by bisecting the angle formed by the lines tangent to the posterior ramus and inferior border of the mandible **(Rakosi, 1982**).

7- Point Ar (Articular) : The point at the junction of posterior border of ramus and the inferior border of posterior cranial base (occipital bone) (**Rakosi, 1982; Jacobson 1995).**

2.4.2.Cephalometric planes:

1. S-N plane (Sella-Nasion): It is the anterior posterior extent of anterior cranial base (**Rakosi, 1982 and Jacobson, 1995).**

2. Mandibular plane (MP): Formed by a line tangent to the lower border of the mandible extended from gonion to menton (**Rakosi, 1982).**

2.4.3.Angular measurements:

The following angles used:-

1. SNA angle: It is the anterioposterior position of maxilla relative to the anterior cranial base (**Rakosi, 1982).**

2. SNB angle: It is the anterioposterior position of mandible relative to the anterior cranial base (**Rakosi, 1982).**

3. ANB angle: It is the relative anterioposterior position of the maxilla to the mandible it represents difference between SNA and SNB angles (**Rakosi, 1982).**

4. Ar-Go-Me angle (Gonial Angle): The angle between the posterior border of the ramus (Ar-Go) and lower border of the mandibular plane (Go-ME) (**Rakosi, 1982).** From sagittal view this angle readied by drown two lines the 1st with the inferiorborder of the mandible the 2nd from the outer border of the ramus **(Mahdi A S,2013)**.

5. Antigonial angle: two lines parallel to the antigonial region that interested at the deepest point of the antigonial notch **(Mahdi A S,2013)**.

2.5.Calibration procedure:

Inter-examiner calibration was carried out by re measurements all the angular and linear measurements of the same (15) radiographs by well trained orthodontist and no significant differences were found at 5% probability level.

Table 2.1: Inter and intra calibration

NO. of example	Gonial		Antegonial	
	Inter	Intra	Inter	Intra
1	130	129	157	157
2	114	113	143	142
3	125	124	147	148
4	125	122	161	162
5	129	128	145	145
Mean	124.6	123.2	150.6	150.8

∗ Intra–examiner calibration was carried out by doing (5) angular and (5) linear measurements for (5) randomly selected radiographs from examined group(Cl I) after two week and no significant difference were found for all measured variables at(5%) probability level.

Results

3.1.Sample:

60 samples 20 Cl I, 20 Cl II ,20 Cl III and each group consist of 10 males and 10 female.

3.2.distribution of gonial and antegonial angles in males and females (Cl I):

Table 3.1: distribution of gonial and antegonial angles in males and females (Cl I)

NO.	SNA		SNB		ANB		go		Ante go	
	m	f	m	f	m	f	m	f	m	F
1	87	83	84	79	3	4	113	130	144	157
2	87	89	85	86	2	3	127	114	147	143
3	87	87	83	83	4	4	126	125	155	147
4	87	84	83	80	4	4	118	125	164	161
5	82	85	86	81	3	4	125	129	160	145
6	89	82	87	86	3	4	104	118	155	154
7	81	83	77	80	4	3	117	126	155	155
8	80	90	78	86	3	4	122	129	132	148
9	96	77	91	76	4	2	132	133	165	154
10	95	78	92	80	3	3	112	130	159	159
mean	87.1	83.8	84.6	81.7	3.3	3.5	119.6	125.9	153.6	152.3

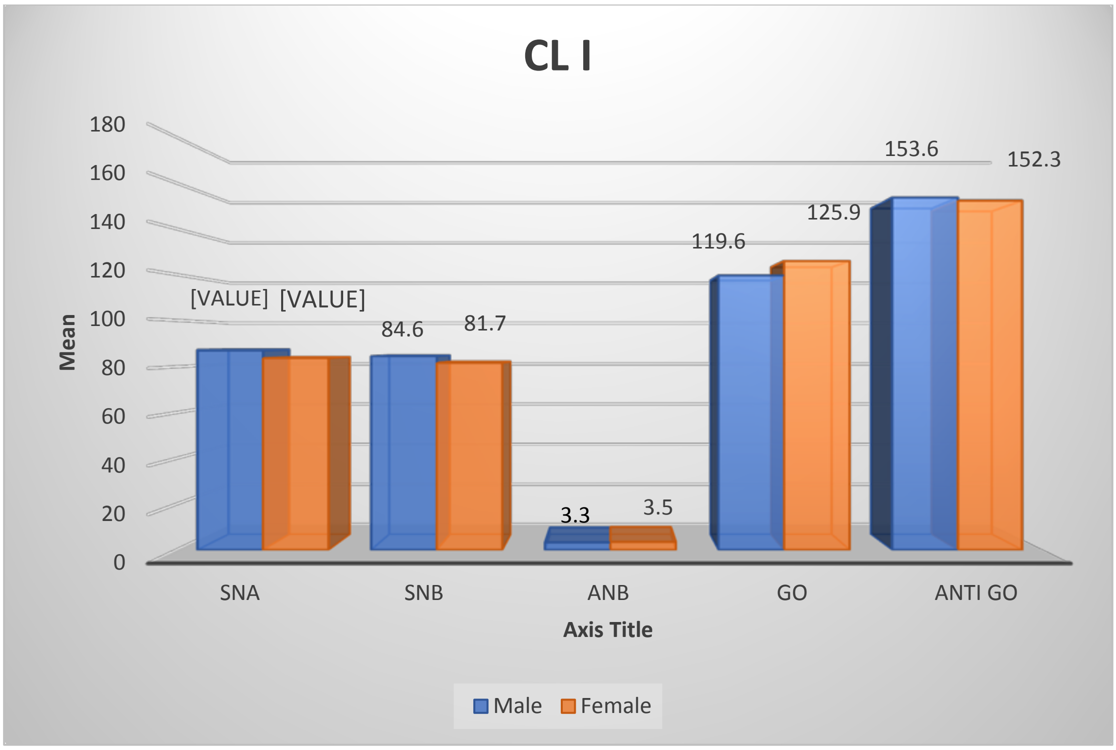
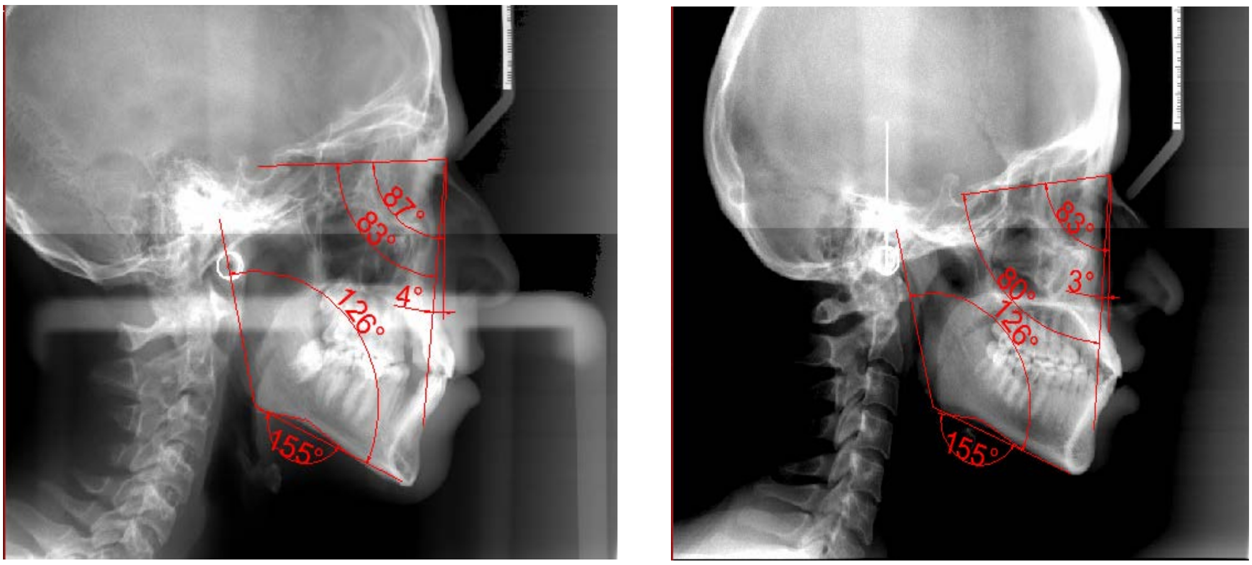


Figure 3.1: distribution of gonial and antegonial angles in males and females (Cl I)



Male Female

Figure 3.2: Male and Female

We found in Cl I the mean of gonial angle in female (125.9) greater than male (119.6) and ante gonial angle in male (153.6) greater than female(152.3).

3.3.distribution of gonial and antegonial angles in males and females (Cl II)

Table 3.2: distribution of gonial and antegonial angles in males and females (Cl II)

NO.	SNA		SNB		ANB		go		Ante go	
	m	F	m	f	m	f	m	f	m	f
1	83	94	78	86	5	8	123	129	157	149
2	84	88	78	80	6	8	118	131	162	155
3	84	78	78	71	7	7	134	141	153	154
4	86	89	79	79	9	10	139	119	147	159
5	87	97	79	89	8	9	117	118	145	166
6	82	92	73	84	5	8	138	122	160	158
7	83	77	79	69	6	8	123	119	148	158
8	|84	76	78	77	7	7	116	124	154	156
9	89	87	82	69	8	10	128	120	158	153
10	97	84	89	75	9	8	118	120	157	161
Mean	85.9	86.2	79.3	77.9	7	8.3	131.4	124.3	154.1	156.9

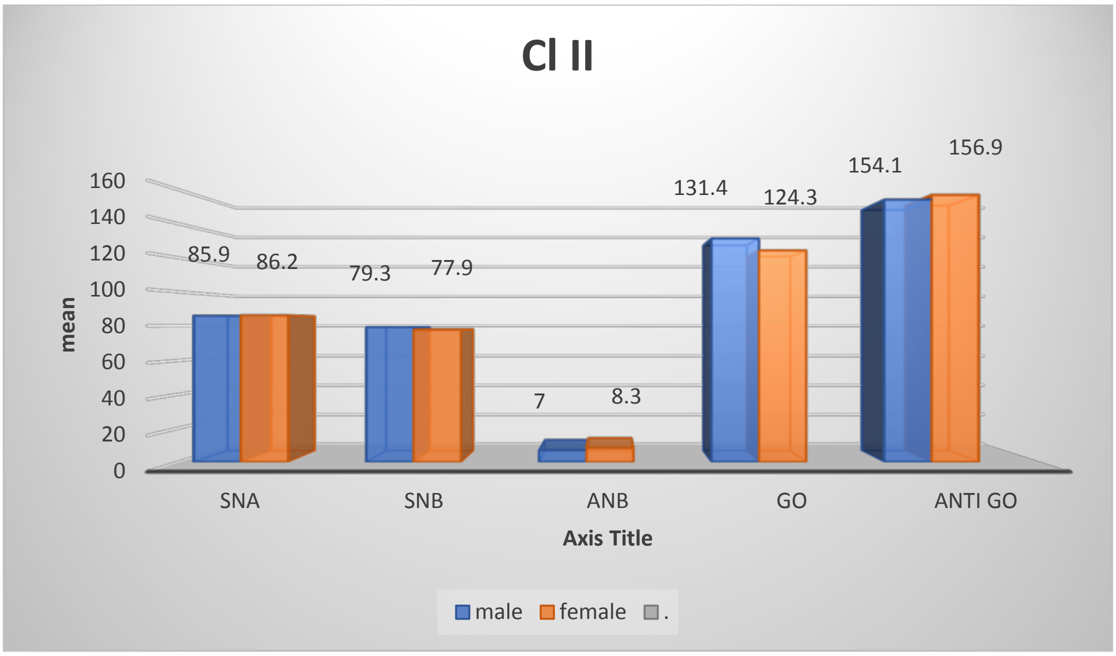
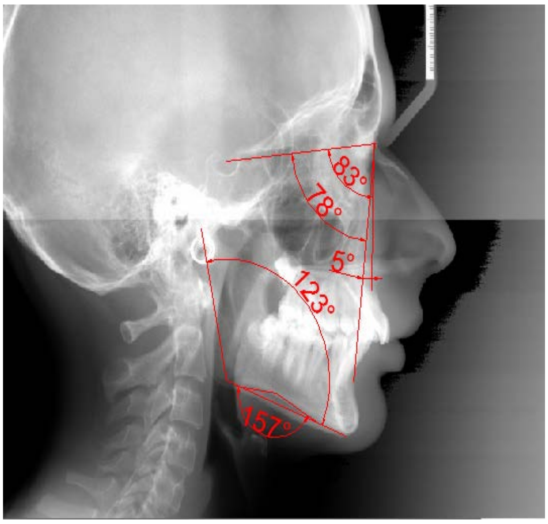
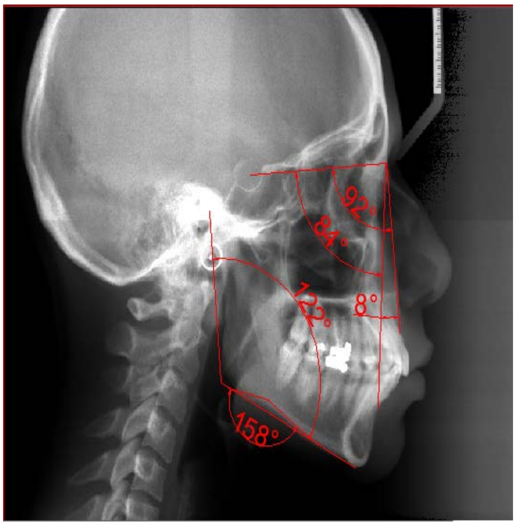


Figure 3.3: distribution of gonial and antegonial angles in males and females (Cl II)



Male



Female

Figure 3.4: Male and Female

We found in Cl II the mean of gonial angles in males (131.4) greater than females (124.3) while antegonial angles in females (156.9) greater than males (154.1).

3.4. Distributions of gonial and antegonial angles in males and females (Cl III):

Table 3.3: Distribution of gonial and antegonial angles in males and females (Cl III)

NO.	SNA		SNB		ANB		go		Anti go	
	m	F	m	f	m	f	m	f	m	f
1	84	81	84	83	1	1	118	123	163	164
2	85	86	87	84	0	0	142	123	164	153
3	79	74	87	75	1	0	124	130	158	158
4	81	70	79	72	1	1	133	143	160	160
5	77	80	78	81	0	1	125	137	161	147
6	81	84	81	86	1	1	122	122	163	158
7	85	84	83	84	1	0	127	133	162	166
8	80	81	78	83	0	1	120	130	161	168
9	92	84	91	83	1	1	124	127	157	150
10	82	78	82	78	1	0	132	130	160	149
mean	82.6	80.2	83	80.9	0.7	0.6	126.7	129.8	160.9	157.3

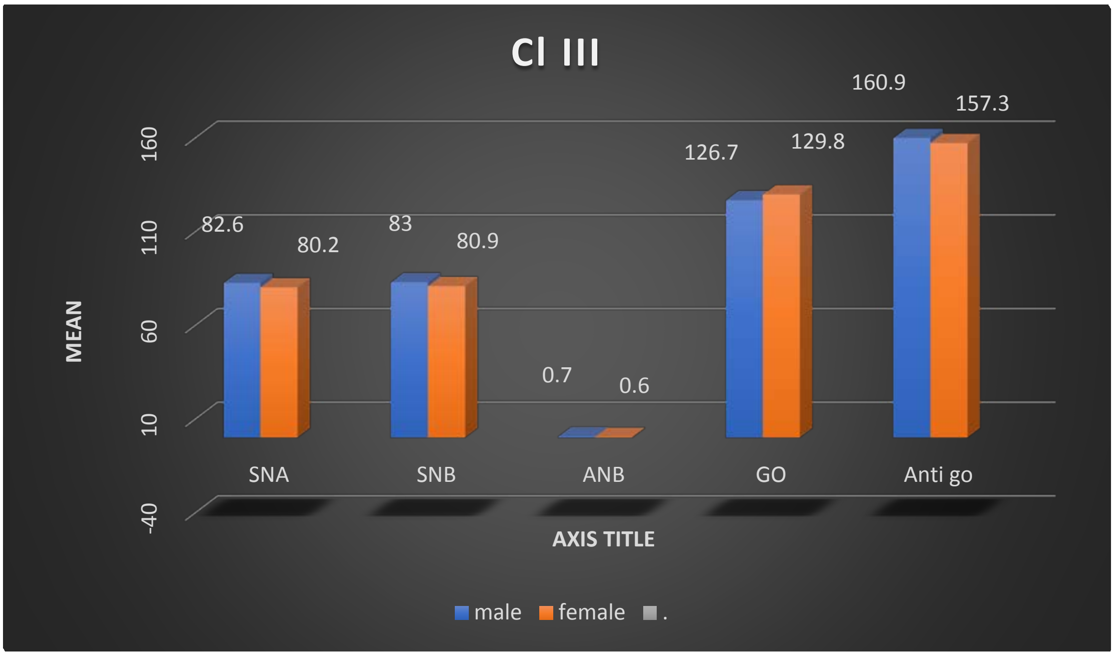
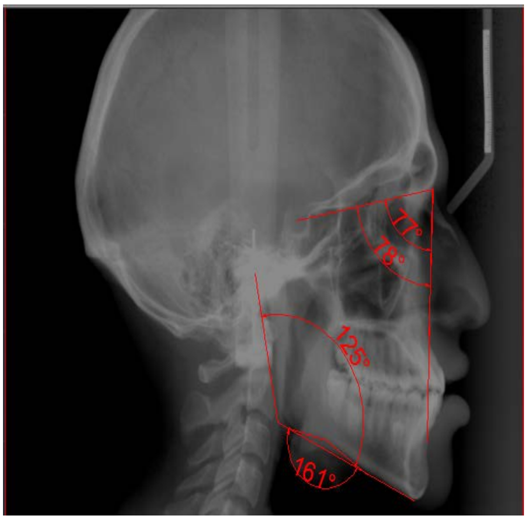
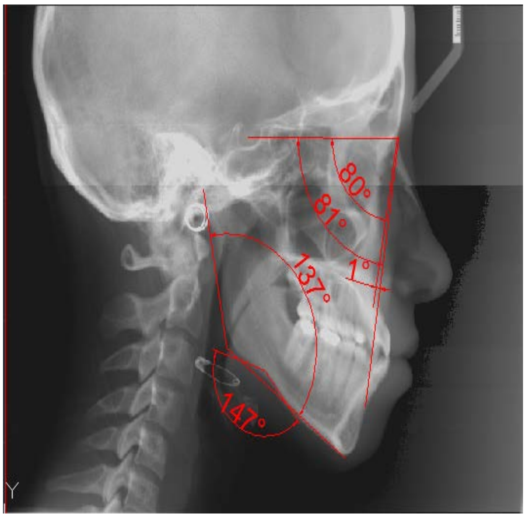


Figure 3.5: Distribution of gonial and antegonial angles in males and females (Cl III)



Male



Female

Figure 3.6: Male and Female

In Cl III we found gonial angles in female (129.8) greater than males(126.7) and antegonial angles in males (160.9) greater than females (157.3).

3.5. Relation of gonial and antegonial angles in Cl I ,Cl II and Cl III :

Table 3.4: mean of gonial and antegonial angles in Cl I ,Cl II and Cl III

	Cl I	Cl II	Cl III
Gonial	20	20	20
Mean	122.75	124.85	128.25
Antegonial	20	20	20
Mean	152.95	148.50	159.10

We notice the greater mean in gonial angle found in Cl III (128.25), smallest mean in Cl I (122.75) and the middle mean found in Cl II (124.85). While in antegonial angle the greater mean also found in Cl III (159.10), smallest mean found in Cl II (148.50) and the middle mean found in Cl I (152.95).

Discussion

4.1. The sample

The samples composed of pretreatment digital lateral cephalometric radiographs of young adults 18-23 years old, because most of growth of the craniofacial area could be considered to as complete after age of 18 years **(Graber, 1988).** The sample divided into three groups according to the skeletal classification: skeletal Cl I, Cl II and Cl III depending on the ANB angle as reported by **Houston (1983), Foster (1985), Rani (1995), and Mitchell et al (2004).**

4.2. Gonial angle

From aesthetic point of view, the gonial angle play an important role in insurance harmonious facial profile **(Claudio et al.,2005).**

Morphology of the mandible change with age consequence of tooth loos which can be expressed as widing of the gonial angle shorting of the ramus and condylar height **(humonen et al.,2010).**

- in Cl I the mean of gonial angle in female greater than male and this agree with (AL-Attar,2006) and (AL-Jarad,2009)**.** Who reported significant higher mean values of (Me-Go-Ar) in female than male.
- in Cl II the mean of gonial angles in males greater than females agree with (**Yassir abdul kadhim, 2007).**
- In Cl III we found gonial angles in female greater than males agree with **(Ali, 1988; AL-Sahaf, 1991; Nisayif, 2005) and (AL-Attar, 2006).**

4.3. Antegonial angle

Antigonial notch larger in male than female so than mean the angle is smaller in male than female as the human increased in age this angle will

increased so the notch disappeared till reached nil 180 degree due to many factors depended either
male or female. **(Dwal et al.,1980).**

In our study in general the antigonial angle and depth decreased with age increased that agree with **(Dutra et al., 2006).**

- We found in Cl I the mean of ante gonial angle in male greater than female and this agree with **(Dwal et al.,1980) and (Mahdi A S,2013)**
- in Cl II the mean of antegonial angles in females greater than males and this agree with **(Dutra et al., 2006) and (mahdi A S,2013)**
- In Cl III antegonial angles in males greater than females (no previous study)
- While in antegonial angle the greater found in Cl III, smallest mean found in Cl II and the middle mean found in Cl I (no previous study).

Conclusions

Gonil angle:

- In Cl I the mean of gonial angle in female greater than male in Cl II the mean of gonial angles in males greater than females In Cl III we found gonial angles in female greater than males
- The greater mean in gonial angle found in Cl III, smallest mean in Cl I and the middle mean found in Cl II.

Antegonial angle:

- In Cl I the mean of ante gonial angle in male greater than female in Cl II the mean of antegonial angles in females greater than males in Cl III antegonial angles in males greater than females.
- While in antegonial angle the greater found in Cl III, smallest mean found in Cl II and the middle mean found in Cl I.

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