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Sudan University of Science and Technology

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Study of Mandible Features in Sudanese using Digital Orthopantomography

دراسة خصائص الفك السفلي لدى السودانيين باستخدام التصوير المقطعي الطبقي الكلي الرقمي للاسنان

Thesis Submitted for Partial Fulfillment of the Requirement of M.Sc. Degree in Diagnostic Radiologic Technology

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الآيـة

بسْمِ اللّهِ الرّحْمَـنِ الرّحِيمِ

قال تعالى:

{يأَيّهَا النّاسُ اتّقُواْ رَبّكُمُ الّذِي خَلَقَكُمْ مّن نّفْسٍ وَاحِدَةٍ وَخَلَقَ مِنْهَا زَوْجَهَا وَبَثّ مِنْهُمَا رِجَالاً كَثِيراً وَنِسَآءً وَاتّقُواْ اللّهَ الّذِي تَسَآءَلُونَ بِهِ وَالأرْحَامَ إنّ اللّهَ كَانَ عَلَيْكُمْ رقيَباً}

صدق الله العظيم

سورة النساء، ألأية (1)

Dedication

To every one whom lightened a dark spot in my mind…

to my family and friends.

Acknowledgment

First of all thanks to Allah for giving me the strength to complete these work.

I would like to express my great thanks and tribute to everyone who support me in my work; especially who helped me in the family of dental teaching hospital.

Full regardness for my supervisor Dr . Huseein Ahmed who gave aperfect advice and ideas, in such way that he motivated me to complete the work in success.

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List of abbreviations

DPR: Dental panoramic radiography

L: Left

Max: Maximum

Min: Minimum

MM: Millimetres

OPG: Orthopantomgraphy

OPT: Orthopantomography

PAN: Panorax

PAN: Pantogram

PSP: Photostimulable phosphor plate

R: Right

Sig: Significance

SPSS: Statstical package for social sciencs

STD: Standard deviation

TMJ: Tempromandibular joint

Abstract English

Mandible being largest and strongest bone of skull having various morphological features may show changes with reference to age and sex . It very important bone to find out sex of the body remains in anthropological practice .The study amid to study mandible features and their relationship to age and gender. In present study 100 mandibles (55 females and 45 males) underwent OPG in Khartoum dental teaching hospital , by using of panoramic digital machine (vatech) .during period of September2016 to January2017. Dental subjects age group from18 to 70 years (females mean 36.55_+14.325std and males mean38.07_+15.44std) participated in this study.

The measurements of condyle height , coronoid height , minimum and maximum ramus width (on both sides), are taken also observe the shape of mandiblular eroded cortex, and ccount the number of teeth on mandible . The data were obtained from panoramic radiographs :ramus width , ramus height (on both sides) were measured digitally for each subject (by using of special soft ware) . The means _+ std values of the right and left ramus height of condyle and coronoid of females was (61.627273 _+ 3.7950482) ,(60.341818 _+ 4.5602425), (54.230909_+ 6.3160253), (52.844 4.8223) respectivly. The means -+ std of right and left ramus height (condyle and coronoid) on males was (67.14444 _+ 5.2016412), (65.806667 _+4.4366449), (60.217778 _+ 4.7209537), (58.777778 _+ 4.3690486) respectively . The mean_+ std of maximum and minimum ramus width on right and left sides on female was (28.798182 _+ 3.7982691), (26.724 _+ 2.7532), (24.994545 _+2.5921833), (23.429091 _+ 2.4432577) respectivly. the mean _+ std of minimum and maximum ramus width on right and left side on males was (29.62000 3.1339490), (27.960000 3.808946),(25.68000 2.7147409), (23.962222 3.2981599) respsctivly. The mean _+ std of number of teeth on mandible on females was(14.64 _+ 1.840) and on males was(14.67 _+ 2.153) . T cortical

shape of mandible distribution was 49% was normal cortex,29% midly to modratly eroded cortex and 22.22% severely eroded cortex. The mean values were calculated and compared between male and female subjects and between different age groups using SPSS. The result of study showed that males had higher values of parameters compared to females .ramus hight and width increased with increasing age. The morphology of mandible changed as a consequence of age and between genders, which can be expressed as increase of the ramus height and width. The number of mandibular teeth decreased by age and there was a direct relationship betwwe eroded of mandible cortex and age and there was no differences between males and females on number of mandible teeth.

Therefore conclusion of this study the mandible features change by age and gender.

Abstract Arabic

يعتبر الفك السفلي اكبر واقوي عظمة في عظام الجمجمة وله عدة اشكال وملامح تتغير علي حسب العمر والجنس . وايضا يعتبر اهم جزء من بقايا العظام البشرية التي فحصها لتحديد الجنس في مجالات العلوم الانسانية والطب الجنائي . الهدف من الدراسة هو معرفة خصائص الفك السفلي والتغيرات التي تحدث فيه وعلاقتها بالعمر والجنس.

في الدراسة المقدمة تم فحص 100 فك سفلي (55ذكور و45اناث) اعمار العينة تراوحت ما بين 18الي 70سنة متوسط اعمار الاناث كان (14.325+_36.55) بينما كان متوسط الذكور (15.44+_38.07) (المتوسط زائد او ناقص معامل التصحيح الانحرافي) .جمعت هذه العينات من مستشفي الخرطوم التعليمي للاسنان وذلك باستخدام جهاز الاشعة المقطعية الطبقية الكلية الرقمية (Vatech) وهويعطي منظر شامل للفك السفلي .قمنا بقياس ارتفاع الفك السفلي من منطقة اللقمة (condyle) ومن منطقة الاكليلاني (coronoid) من الجهتين اليمني واليسري لكل واحد منهما وكذلك تم قياس اقل واكبر عرض للفك السفلي من الجهتين ايضا ، وتم ملاحظة مدي تآ كل قشرة الفك السفلي .

البيانات التي تم جمعها من الصور الرقمية كانت عبارة عن ارتفاع وعرض الفك السفلي من الجهتين تم قياس كل منها علي حدة رقميا بواسطة برمجيات معينة.وجد ان متوسط القيم والانحراف المعياري للجهتين اليمني واليسري لارتفاع الفك السفلي في منطقة اللقمة ومنطقة الاكليلاني بالنسبة للاناث كانت كما يلي بالترتيب(3.7954+_61.627273)، (6.3160253+_54.230909)، (4.5602425+60.341818)، (43.8223+-52.844) .وبالنسبة للذكور كانت كما يلي: (5.216412+-67.1444)، (4.43690486+_65.806667)، (4.7209537+_60.21777)، (4.3690486+_58.7778) . وكذلك وجد ان المتوسط الحسابي والانحراف المعياري لأعلي واقل عرض للفك السفلي من الجهتين اليمني واليسري عند الاناث كانت كما يلي بالترتيب : (-28.79818 3.798269+) ، (2.4432577+_26.724)، (2.5921833+_24. 994545) (- 23.42909 2.4432577+) .وبالنسبة للذكور كانت النتائج كما يلي : (3.133490+_29.62000) ، (3.808946+_27.96000)، (2.71409+_25.6800)، (3.298159+_23.9622) .ووجد ان الوسط الحسابي والانحراف المعياري بالنسبة لعدد الاسنان في الفك السفلي عند الاناث كانت (1.84+_14.64) وعند الذكور(2.153_+14.67) .ونسبة تاكل قشرة الفك السفلي كانت كما يلي : 49% تاكل بالمعدل الطبيعي و 29% تاكل متوسط الي خفيف و22% تاكل زائد عن المعدل الطبيعي .

تم حساب متوسط القيم ومقارنتها بين الذكور والاناث بعد تصنيفها علي ثلاث وحدات عمرية معينة وذلك باستخدام برنامج التحليل الاحصائي الاجتماعي(SPSS) اظهرت نتيجة الدراسة ان الذكور كانت لهم قيم مرتفعة مقارنة بالاناث ووجد ان الفك السفلي للذكور اطول واعرض عند الذكور مقارنة بالاناث ، وان طول الفك السفلي يزداد مع التقدم في العمر .وان هناك علاقة طردية بين نسبة تاكل قشرة الفك السفلي والعمر.

لذا فان شكل الفك السفلي يتغير بتغير العمر والجنس، ويظهر ذلك في شكل زيادة في الطول والعرض اما بالنسبة لعدد اسنان الفك السفلي وجد انها تقل بالتقدم في العمر.

لذا فان ملخص هذه الدراسة هو ان ملامح وشكل الفك السفلي تتغير بتغير العمر والجنس.

Chapter one

Introduction

Chapter one
Introductions

1-1 Introduction:

The mandible is the largest and strongest bone in the face with a horizontally curved body that is convex forwards with two broad rami ,which ascend from the posterior end of the body .The rami bears the coronoid and codyloid processes. The mandible is considered suitable for study as it is the most durable bone of the facial skeleton and retains it is shape better than other bones. (Taleb ,et al 2005)

The need for such type of research is due to the increased incidents of violence in specific population groups ,both qualitative and quantitative criteria can be identified and used in combination to distinguish sex ,age, and ethnicity.(Vodanovic et al 2006).

Jaws and teeth used since olden times to ascertain the sex of an individual, because they show sexual dimorphism in morphological feature but these are likely to be subjected to variation depending upon the experience of worker, therefore some morphometric critera need to be put in place which can be used as a reference for sex and age determination when combined with some other features.(Hegde, et al2013).

Various studies have clearly indicated that the skeletal characters vary by population ,and there is a need to lay down population specific standards.

To evaluate the morphology of the human condyles, variation in human mandibuler condyle shapes was noted by previous researchers anormal variation of condyler morphology occurs with age ,gender, facial type, occlusal force, and between right and left sides, the most prevalent morphological changes are detected in the TMJ of elderly person due to the onset of joint degeneration.

Mandibular ramus can differentiate between sexes, as the stage of mandibular development , growth rate and duration are distinctly different in both sexes.

In addition masticatory forces exerted are different for males and females, which infuence the shape and size of the mandibular ramus .moreover,the morphological change of the mandible are through to be influenced by the occlusal status and age of the subject where longitudinal studies have shown that remodeling of the mandibular bone occurs with age despite the varying anatomical landmark , numerous studies have performed using differernt ramus metric measurement for sex and age estimation.(Poongodi, et al, 2014). Skeletal characteristics differ in each population emphasizing the need for population – specific osteometric standards for sex estimation there is no published studies were conducted on the sudanes population using the human mandible.

In present study we are going to use digital OPGs and special software to measure the width and hieght of ramus of mandible ,observation of different mandibular cortical shapes ,and account the number of mandible teeth in order to investigate the mandibular feature in sudanes population which come in Khartoum dental teaching hospital.

Panoramic x-ray technology is commonly accessible and using in daily clinical routine to assess mandibular vital structures bilaterally. Some studies had concluded that the most reliable panoramic measurement obtained from linear objects in the horizontal plane . moreover, other studies had shown that the vertical measurement had acceptable accuracy and reproducibility when a software-based calibrated measurement tool was used. (Hegde, et al , 2013)

In forensic anthropology, comparison of antemortem and postponortem radiographs is one of the cornerstones of positive identification of human remains. So, antemortem orthopantomograms may be of great value in the idinentification of humans The presence of plenty of panoramic radiographs provides a great a pportunity to study the mandibular feature of individuals in a certain population. This was behind the idea of using panoramic images for mandibular ramus assessment, condyler height measurement, account of

mandibular teeth number , and observation of different shapes of mandibular cortical in the current work . (Kumar, 2015.

1-2. Problem of study:

By using of the clinical , histological and biochemical method its difficult to study the mandibular feature , which are very important to determinate of age, gender and some pathological conditions.

1-3-1.General objective of study:

To study the mandible feature in sudanese population by using digital orthopantomography(OPG) .

1-3 2. specific objectives

To measure the breadth and width of ramus of the mandible,

To investigate different cortical shapes of mandible.

To measure the height of coronoid and condyle process.

Comparing between males and females mandibular feature.

To ccount the number of teeth on the mandible

1-4 significant of the study :

This study will enhance the measurement of mandibular feature by using digital OPG in order to detect age ,gender and mandibular morphology .

So as to be useful in different purpose and diagnose, although there is a lot of methods can be used to determination of age and gender like clinical, histological and chemical but the radiological analysis is the superior one .and give clear detail about mandibular feature.

1-6 overview of the study

The study will fall into five chapters , chapter one consist of introduction that about the mandible anatomy and pathology, objectives ,significant of the study , chapter two includes the literature review, chapter three detailed materials and methods , chapter four includes presentation of the result and finally chapter five include discussions , conclusion, recommendations and references.

Chapter two

Literature Review and previous studies

Chapter two
Literature Review

2-1Anatomy

The mandible, lower jaw or jawbone (from Latin *mandibula*, "jawbone") is the largest, strongest and lowest bone in the face. It forms the lower jaw and holds the lower teeth in place. In the midline on the anterior surface of the mandible is a faint ridge, an indication of the mandibular symphysis, where the bone is formed by the fusion of right and left processes during development. Like other symphyses in the body, this is a midline articulation where the bones are joined by fibrocartilage, but this articulation fuses together in early childhood.(http:// www.wikipedia.com\ mandible-Anatomy).

2-1-1 Structure of mandible:

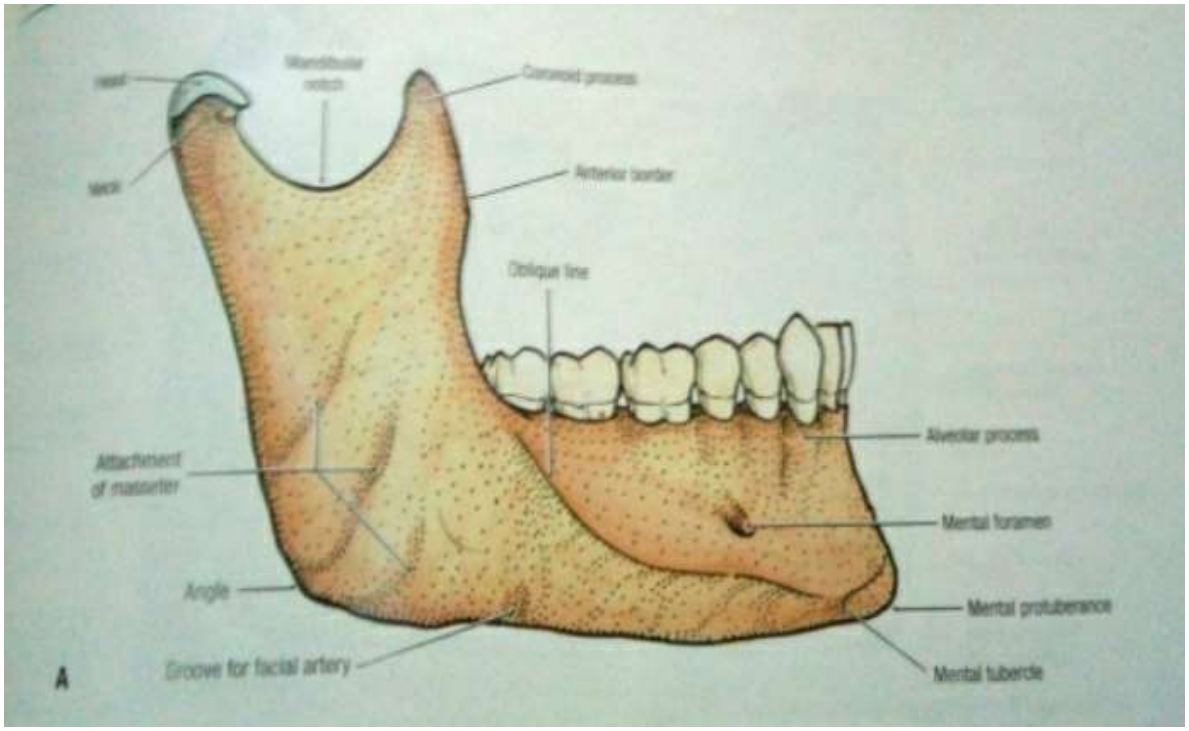


Fig.(2-1) Mandible. Lateral view, External surface. (Anne, et al,1999).

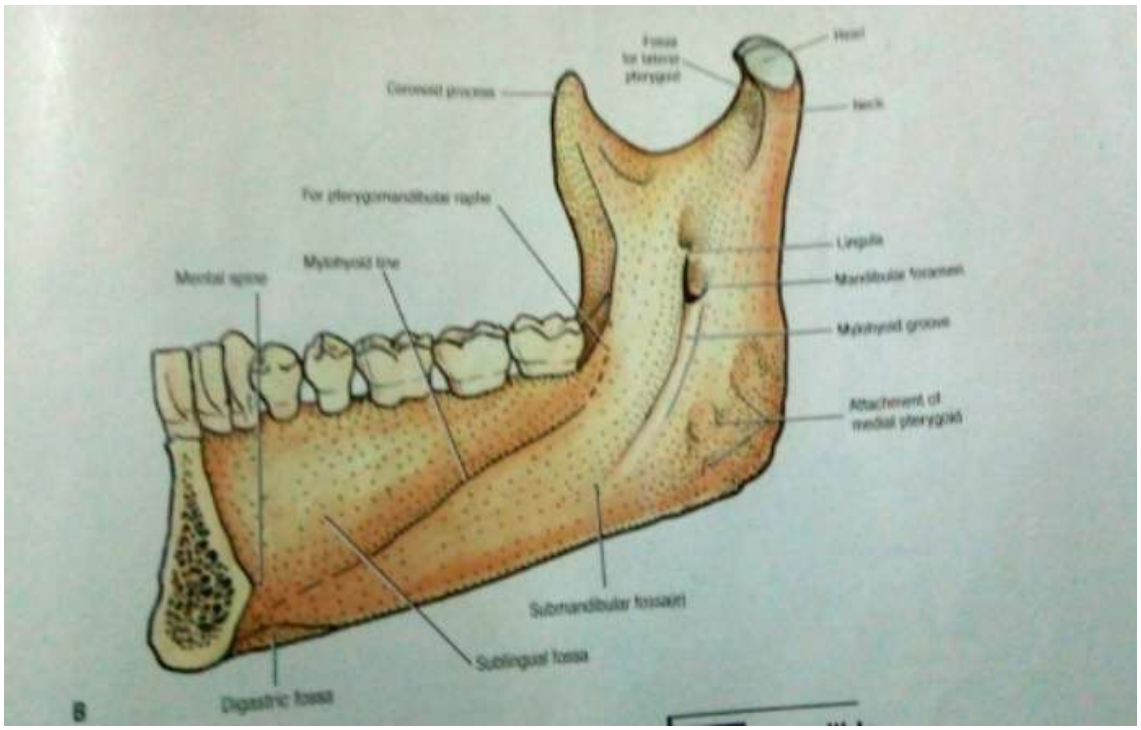


Fig.(2-2) Mandible. Medial view, Internal surface. (Anne, et al,1999).

The mandible consists of:

a curved, horizontal portion, the *body or* base. two perpendicular parts, the *rami*, or ramus for each one, unite with the ends of the body nearly at right angles.. The angle formed at

this junction is called the angle of the mandible or the gonial angle. process, tooth bearing area of the mandible (upper part of the body of the mandible) Condyle, superior (upper) and posterior projection from the ramus, which makes the temporomandibular joint with the temporal bone Coronoid process, superior and anterior projection from the ramus. This provides attachment to the temporalis muscle. The mandible articulates with the *two* temporalbone temporomandibular joints.(http:www.wikipedia.com/mandible-Anatomy).

2-1-2 Foramina:

Mandibular foramen, paired, in the inner (medial) aspect of the mandible superior to the angle in the middle of the ramus. Mental foramen, paired,

lateral to the mental protuberance (chin) on the body of mandible, usually inferior to the apices of the mandibular first and second premolars. As mandibular growth proceeds in young children, the mental foramen alters in direction of its opening from anterior to posterosuperior. The mental foramen allows the entrance of the mental nerve and blood vessels into the mandibular canal.(http:www.wikipedia.com/mandible-Anatomy).

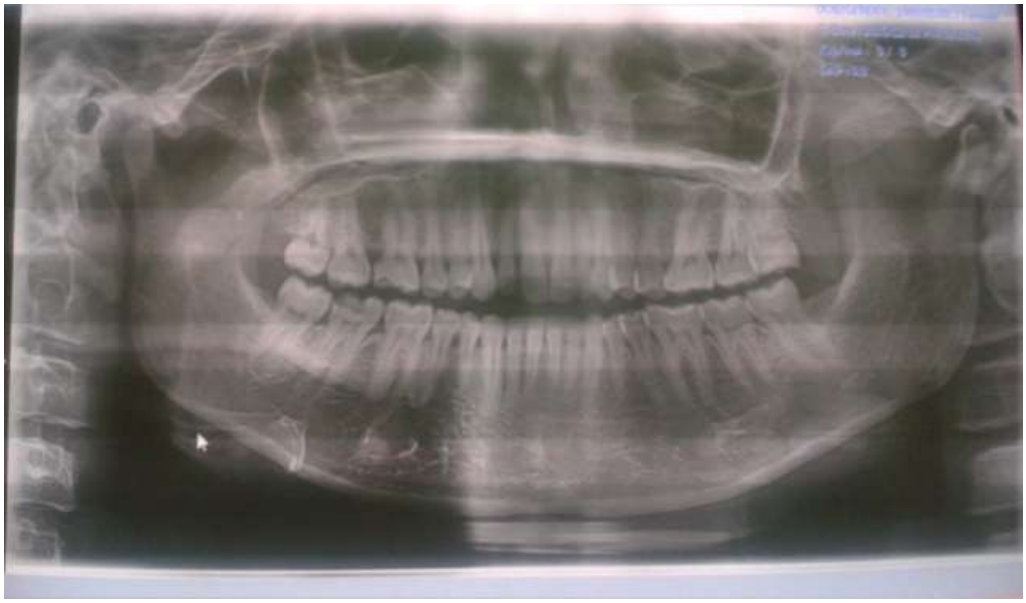


Fig.(2-3).the heads and necks of the mandibular condyles, the coronoid processes of the mandible, as well as the nasal antrum and maxialry sinuses.

2-1-3 Nerves:

Inferior alveolar nerve, branch of the mandibular division of Trigeminal (V) nerve, enters the mandibular foramen and runs forward in the mandibular canal, supplying sensation to the teeth. At the mental foramen the nerve divides into two terminal branches: incisive and mental nerves. The incisive nerve forward in the mandible and supplies the anterior teeth. The mental nerve exits the mental foramen and supplies sensation to the lower lip. Rarely, a bifid inferior alveolar nerve may be present, in which case a second mandibular foramen, more inferiorly placed, exists and can be detected by noting a double mandibular canal on a radiograph .(http://www.ejomr.org /JOMR/archives/2010/e3/e3ht.pdf).

2-1-4 Blood Supply of the mandible:

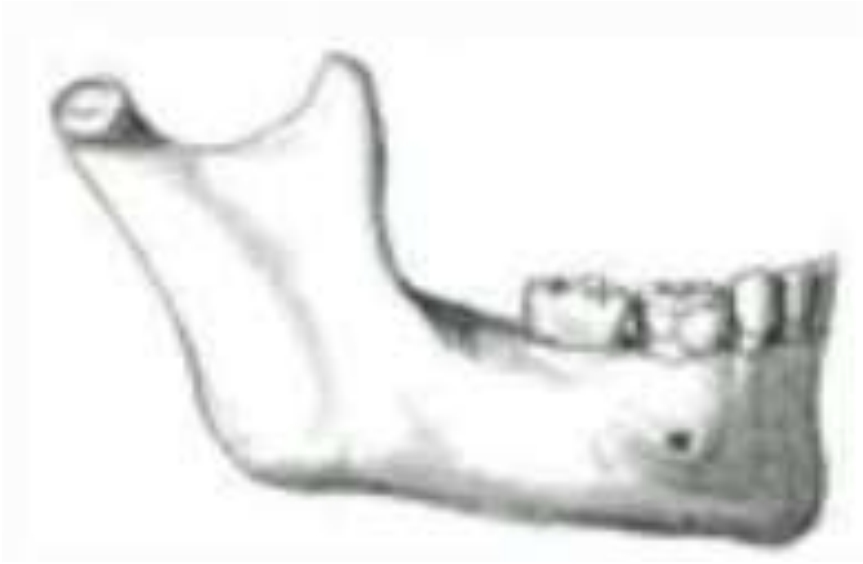
Three arteries that provide the major blood supply to the mandible are important for dental implantology. These are the lingual ,facial, and inferior alveolar arteries. The first 2 arise directly from the external carotid, a major artery. All 3 supply structures in and around the mandible. A perforation of the facial or lingual cortex of the mandible and a severance of a branch of 1 of these arteries during an osteotomy may result in a life-threatening situation. Uncontrolled bleeding from the lingual artery, if left unchecked, may cause an expanding ecchymosis that could compromise the airway and/or blood volume and may result in fatalit.(http://www.Journal of implantology- .com/Arterial supply).

2-1-5 Changes by age:

When remains of humans are found, the mandible is one of the common findings, sometimes the only bone found. Skilled experts can estimate the age of the human upon death because the mandible changes over a person's life, as described in this article. At birth, the body of the bone is a mere shell, containing the sockets of the two incisor, the canine, and the two deciduous molar teeth, imperfectly partitioned off from one another. The mandibular canal is of large size and runs near the lower border of the bone; the mental foramen opens beneath the socket of the first deciduous molar tooth. The angle is obtuse (175°), and the condyloid portion is nearly in line with the body. The coronoid process is of comparatively large size, and projects above the level of the condyle.(http://www.wikipedia.com/mandible Anatomy). After birth, the two segments of the bone become joined at the symphysis, from below upward, the first year; but a trace of separation may be visible in the beginning of the year near the alveolar margin. The body becomes elongated in its whole length, more especially behind the mental foramen, to provide space for the three additional teeth developed in this part. The depth of the body increases owing increased growth of the alveolar part, to afford

room for the roots of the teeth, and by thickening of the subdental portion which enables the jaw to action the masticatory muscles; but, the alveolar portion is the deeper of the two, and consequently, the chief part of the body lies above the oblique line. mandibular canal, after the second dentition, is situated just above the level of mylohyoid line; and the mental foramen occupies the position usual to it in the adult. angle becomes less obtuse, owing to the separation of the jaws by the teeth; about the fourth year it is 140(http://www.wikipedia.com/mandible Anatomy). In adult, the alveolar and subdental portions of the body are usually of equal depth. mental foramen opens midway between the upper and lower borders of the bone, and the mandibular canal runs nearly parallel with the mylohyoid line. ramus is almost vertical in direction, the angle measuring from 110° to 120 also the adult condyle is higher than the coronoid process and the sigmoid becomes deeper. In old age, the bone becomes greatly reduced in volume due to the loos of teeth and consequent resorption of the alveolar processes and septa Consequently, the chief part of the bone is below the oblique line. The mandibular canal, with the mental foramen opening from it, is closer to the alveolar border. The ramus is oblique in direction, the angle measures 140°, and the neck of the condyle is more or less bent backward.

Fig(2-4) lateral mandible view at birth,(Anne, et al, 1999)



Fig(2-5)lateral mandible view in childhood.(Anne, et al, 1999)

Fig (2-6)lateral view of mandible in the adult.(Anne, et al ,1999)

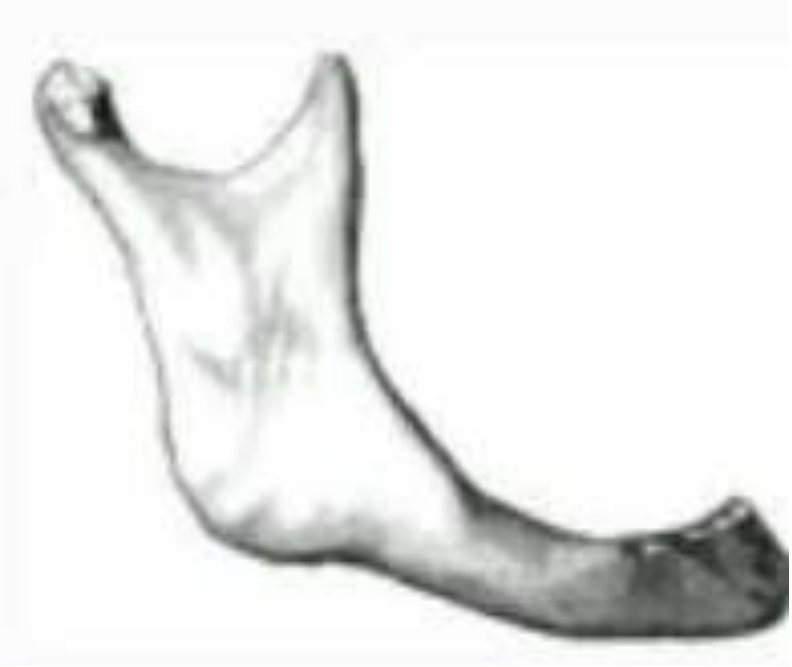


Fig (2-7) in old age. side view of the mandible.(Anne, et al, 1999)

Males generally have squarer, stronger, and larger mandibles than females. Mental protuberance is more pronounced in males but can be visualized palpated in females.

2-2physiology:

The functional conditions of the mandible are differentiated according to the number of kinematic degrees of freedom assigned to each movement. One degree of freedom :pro-and retrusive occlusal border movement.the interplay of the TMJs with the occluding teeth determines a compulsory corresponds 4-bar-chin guidance.Two degrees of freedom: free sagittal mouth without tooth contact. Using graphic recording of cyclic mandibular movement, identified mandibularly fixed line which is not directly categorized as structure. In the maxillary coordinate system , its cylinder; saittally,it describes a circl . mandibular positions are clearly identifiable with2 angles. The invivo measurements show that neuromuscularly healthy system supply the anticipatory guidance. Three degrees of freedom: bolus function. The articular space in the TMJ is ultilized. (Meesenburg , et al , 1999).

2-3 Pathology:

One fifth of facial injuries involve mandibular fracture. Mandibular are often accompanied by a 'twin fracture' on the contralateral (opposite) side. There is no universally accepted treatment protocol, as there is no consensus on the choice of techniques in a particular anatomical shape of mandibular fracture clinic. Common treatment involves attachment of metal plates to the fracture to assist in healing. The mandibular alveolar process can become resorbed when completely edentulous in the mandibular arch (occasionally noted also in partially edentulous cases). This resorption can occur to such an extent that the mental foramen is virtually on the superior border of the mandible, instead of opening on the anterior surface, changing its relative position. However, the more inferior body of the mandible is not affected and remains thick and rounded, with age and tooth loss, the alveolar process is absorbed so that the mandibular canal becomes nearer the superior border. Sometimes with excessive

alveolar process absorption, the mandibular canal disappears entirely and leaves the inferior alveolar nerve without its bony protection ,although it is still covered by soft tissue. (http://www.ejomr.org /JOMR/archives 2010/e3/e3ht.pdf).

2- 4 Development of mandible:

The ossification of the mandible refers to the Human mandible laying down new bone material in the fibrous membrane covering the outer surfaces of Meckel's cartilages. These cartilages form the cartilaginous bar of the mandibular arch, and are two in number, a right and a left. Their proximal or cranial ends are connected with the ear capsules, and their distal extremities are joined to one another at the symphysis by mesodermal tissue. They run forward immediately below the condyles and then, bending downward, lie in a groove near the lower border of the bone; in front of the canine tooth they incline upward to the symphysis. From the proximal end of each cartilage the malleus and incus, two of the bones of the middle ear, are developed; the next succeeding portion, as far as the lingula, is replaced by fibrous tissue, which persists to form the sphenomandibular ligament. Between the lingula and the canine tooth cartilage disappears while the portion of it below and behind the incisor teeth becomes ossified and incorporated with this part of the mandible. Ossification takes place in the membrane covering the outer surface of the ventral end of Meckel's cartilage which lies below and behind the incisor teeth is surrounded and invaded by the membrane bone. Somewhat later, accessory nuclei of cartilage make their appearance: a wedge-shaped nucleus in the condyloid process and extending downward through the ramus; a small strip along the anterior border of the coronoid process; smaller nuclei in the front part of both alveolar walls and along the front of the lower border of the bone. These accessory nuclei possess no separate ossific centers, buts are invaded by the surrounding membrane bone and undergo absorption. The inner alveolar border, usually described as arising from a separate ossific

center (*splenial center*), is formed in the human mandible by an ingrowth from the main mass of the bone. At birth the bone consists of two parts, united by a fibrous symphysis, in which ossification takes place during the year.(http://www.wikipedia.com/mandible anatomy).

2-5 Panoramic Radiographic Machine:

2-5-1 Panoramic radiograph:

panoramic radiograph is a panoramic scanning dental x- ray of the upper and lower jaw. It shows a two dimensional view of a half-circle from ear to ear. Panoramic radiography is a form of tomography; thus, images of multiple planes are taken to make up the composite panoramic image, where the maxilla and mandible are in the focal trough and the structures that are superficial and deep to the trough are blurred.

Other non proprietary names for a panoramic radiograph are dental panoramic radiograph and pantomogram; trade names are Panorex and Orthopan-tomograph (genericized versions of the latter, such as *orthopan-tomography* or *orthopant omogram*, are best avoided in favor of the other non proprietary names). Abbreviations include PAN, DPR, OPT and OPG (the latter, based on genericizing a trade name, are often avoided in medical editing). (http://www.google.com/panoramic radiograph).

Fig (2- 8)Digital panoramic machine

Dental panoramic radiography equipment consists of a horizontal rotating arm which holds an X-ray source and a moving film mechanism (carrying a film) arranged at opposed extremities. The patient's skull sits between the X-ray generator and the film. The x-ray source is collimated toward the film, to give a beam shaped as a vertical blade having a width of 4-7mm when arriving on the film, after crossing the patient's skull. Also the height of that beam covers the mandibles and the maxilla regions. The arm moves and its movement may be described as a rotation around an instant center which shifts on a dedicated trajectory.

The manufacturers propose different solutions for moving the arm, trying to maintain constant distance between the teeth to the film and generator. Also those moving solutions try to project the teeth arch as orthogonally as possible. It is impossible to select an ideal movement as the anatomy varies very much from person to person. Finally a compromise is selected by each

manufacturer and result magnification factors which vary strongly along the film (15%-30%). The patient positioning is very critical in regard to both sharpness and distortions. (pasler, et a, 2005).

2-5-2 Film

There are two kinds of film moving mechanisms, one using a sliding flat cassette which holds the film, and another using a rotating cylinder around which the film is wound. There are two standard sizes for dental panoramic films: 30 cm × 12 cm (12″ × 5″) and 30 cm x 15 cm (12″ × 6″). The smaller size film receives 8% less X-ray dosage on it compared to the bigger size. (http://www.google.com/panoramic radiograph).

2-5-3 Digital:

Dental X-rays' radiology is moving from film technology (involving a chemical developing process) to digital x-ray technology, which is based on electronic sensors and computers. One of the principal advantages compared to film based systems is the much greater exposure latitude. This means many fewer repeated scans, which reduces costs and also reduces patient exposure to radiation. Lost X-rays can also be reprinted if the digital file is saved. Other significant advantages include instantly viewable images, the ability to enhance images, the ability to email images to practitioners and clients (without needing to digitize them first), easy and reliable document handling, reduced X-ray exposure, that no darkroom is required, and that no chemicals are used.

One particular type of digital system uses a photomultiulable phosphor plate(aka PSP - Phosphor Plate) in place of the film. After X-ray exposure the plate (sheet) is placed in a special scanner where the latent formed image is retrieved point by point and digitized, using a laser light scanning. The digitized images are stored and displayed on the computer screen. This method is in between old film based technology and the current direct digital imaging technology. It is similar to the film process because it involves the

same image support handling and differs because the chemical development process is replaced by the scanning process. This is not much faster than film processing and the resolution and sensitivity performances are contested. However it has the clear advantage of being able to fit with any existing equipment without any modification because it replaces just the existing film.

Also sometimes the term "digital X-rays" is used to designate the scanned film documents which further are handled by computers.

The other types of digital imaging technologies use electronic sensors. A majority of them first convert the X-rays in light which is further captured using aCCD or aCOMS image sensor. Few of them use a hybrid anlog-to-digital arrangement which first converts the X-ray into electricity and then this electricity is rendered as an image by a reading section based on CMOS technology.

In current state of the art digital systems, the image quality is vastly superior to conventional film-based systems. The latest advancements have also seen the addition on Cone Beam 3D Technology to standard digital panoramic devices (http://www.google.com/panoramic radiography).

2-5-4 Indication of panoramic radiograph:l

impacted wisdom teeth diagnosis and treatment planning the most common use is to determine the status of wisdom teeth and trauma to the jaw ,periodontal bone loss and periapical involvement, Finding the source of dental pain ,Assessment for the placement of dental implants, orthodontic assessment, pre and post operative Diagnosis of developmental anomalies such cherubism, cleido cranial dysplasia , carcinoma in relation to the jaws, temporomandibular joint dysfunctions and ankylosis, Diagnosis of osteosarcoma ,ameloblastoma, ankylosis, renal osteosarcoma, affecting jaws and hypophosphatemia. Diagnosis, and pre- and post-surgical assessment of oral and maxillofacial trauma, e.g. dentoalveolar fractures and mandibular

fractures, Salivary stones (sialolithiasis) Other diagnostic and treatment applications. (Rothschild, et al, 2007).

2-5-5 Mechanism of Digital OPG Unit:

Normally, the person bites on a plastic spatula so that all the teeth, especially the crowns, can be viewed individually. The whole orthopantomogram process takes about one minute. The patient's actual radiation exposure time varies between 5.5 and 22 seconds for the machine's excursion around the skull. The collimation of the machine means that, while rotating, the X-rays project only a limited portion of the anatomy onto the film at any given instant but, as the rotation progresses around the skull, a composite picture of the maxillo-facial block is created. While the arm rotates, the film moves in a such way that the projected partial skull image (limited by the beam section) scrolls over it and exposes it entirely. Not all of the overlapping individual images projected on the film have the same magnification because the beam is divergent and the images have differing focus points. Also not all the element images move with the same velocity on the target film as some of them are more distant from and others closer to the instant rotation center. The velocity of the film is controlled in such fashion to fit exactly the velocity of projection of the anatomical elements of the dental arch side which is closest to the film. Therefore, they are recorded sharply while the elements in different places are recorded blurred as they scroll at different velocity.

The dental panoramic image suffers from important distortions because a vertical zoom and a horizontal zoom both vary differently along the image. The vertical and horizontal zooms are determined by the relative position of the recorded element versus film and generator. Features closer to the generator receive more vertical zoom. The horizontal zoom is also dependent on the relative position of the element to the focal path. Features inside the focal path arch receive more horizontal zoom and are blurred; features outside receive less horizontal zoom and are blurred.

The result is an image showing sharply the section along the mandible arch, and blurred elsewhere. For example, the more radio-opaque anatomical region, the cervical vertebrae (neck), shows as a wide and blurred vertical pillar overlapping the front teeth. The path where the anatomical elements are recorded sharply is called "focal path". (Pasler, et al ,2005).

2.5.6 Principal advantage of panoramic image:

Low patient radiation dose, Convenience Broad coverage of facial bone and teeth of examination for the patient (films need not be placed inside the mouth), Ability to be used in patients who cannot open the mouth or when the opening is restricted e.g.: due to trismus, Short time required for making the image ,Patient's ready understandability of panoramic films, making them a useful visual aid in patient education and case presentation. And easy to store compared to the large set of intra oral x-rays which are typically used. (Pasler, et al , 2005).

2-5-7 Preparation:

Persons who are to undergo panoramic radiography usually are required to remove any earrings, jewellery, hair pins, glasses, dentures or orthodontic appliances. If these articles are not removed, they may create artifacts on the image (especially if they contain metal) and reduce its usefulness. There is also a need for the person to stay absolutely still during the 18 or so second cycle it takes for the machine to expose the film. For this reason, radiographers often explain to the person beforehand how the machine will move. (pasler, et al, 2005).

2-5-8 Adverse effects:

Like any medical imaging utilizing ionizing radiation, there will be a minute degree of direct ionizing damage and indirect damage from free radicals created during the ionization of water molecules within cells. A rough estimate of the risk of fatal cancer from a panoramic radiograph is about 1 in 20,000,000. The age of the person being imaged also alters the

risk, with younger people having a slightly higher risk. E.g. the 1 in 10,000,000 risk would be doubled for someone in the 1-10 age group.(Rothschild, et al, 2007).

2-5-9 History:

Historical milestones for digital panoramic systems:

1985-1991 - The first attempt to build a dental digital panoramic was of McDavid et al. at UTHSCSA .was based on a linear pixel array(single pixel column)sensor which was not appropriate for such an application because: a) there is no tomographic effect; b) huge difficulties to collimate the X-rays beam and to control the X-ray dose delivered to the patient; c) poor generator efficiency.

1995 - DXIS, the first dental digital panoramic X-rays system available on the market, created by Catalin Stoichita at Signet (France). DXIS targeted to retrofit all the panoramic models.

1997 - SIDEXIS, Of Siemens (currently Sirona dental systems, Germany) offered a digital option for Ortophos Plus panoramic unit, DigiPan of Trophy Radiology (France) offered a digital option for the OP100 panoramic made by Instrumentarium (Finland).

1998-2004 - many panoramic manufacturers offered their own digital systems. 2006 - SCAN300FP, of Ajat' (Finland) is the latest innovation offered. It shows the feature to acquire many hundreds of mega bytes of image information at high frame rate and to reconstruct the panoramic layer by post acquisition computing. (http://www.google.com/panoramic radiography).

2-6 Previous studies:

One of some previous study by Hegde ,et al (2013). The appearance of mandibular condyle varies greatly among different age groups and individuals. Human mandibular condyles may be categorized into five basic types: flattened, convex, angled, rounded and Morphologic changes of condyle ons , remodeling, various diseases, trauma, endocrine disturbances and radiation therapy. Genetic, acquired, functional factors, age groups individuals have a role in morphologic changes in shapes and sizes of condyle. Thus variability in the shapes and sizes of condyles should be an important factor indiagnosing the disorders of temporomandibular joint. Differentiating diseased conditions from anatomical variations of the condylar head possess a diagnostic challenge for the radiologist and surgeons on numerous occasions. The purpose of this review is to describe in detail about normal anatomical and morphological variations in condylar head, thus helping an investigator to distinguish between variations in form and pathologic condition. (Hegd, et al , 2013).

Another study by Poongodi , et al, (2013). The aim of these study was to investigate age, sex, based on gonial angale, width and breadth of the ramus of the mandible by digital orthopantomograph. A digital radiographic study carried out in 2013 on the mandibular ramus indicated that the minimum ramus bereadth was the best parameter for sex determination. An anthropological study was conducted by Thakur et al, on the mandibular angle and height of the ramus to know their role in sexual dimorphism, and it was found that both these parameters are greater in males than females.(Poongodi, et al, 2013).

Another study by Taleb ,et al ,(2015). Human identificiation of sex and age is necessary in forensic practice and medico legal purposes.

Mandible may play a vital role in sex estimation as it is the most dimorphic bone of skull that often recovered intact. In this respect, the availability of

plentiful antemortem orthopantomograms may be of great value in studying and developing population specific standards for accurate sex and age estimation. Therefore, the purpose of the study was to assess the usefulness of various mandibular ramus linear and gonial angle measurements on digital panoramic images as indicators for sex and age in an Egyptian population sample.

191 panoramic images (105 males and 86 females) of Egyptian patients aged (6-70) years old were selected. Five mandibular ramus linear measurements (upper ramus breadth, lower ramus breadth, projective height, condylar ramus height and coronoid ramus height) and gonial angle measurements were performed bilaterally resulting in a total of 382 rami being assessed. Stepwise discriminant and regression analyses were performed to determine the most significant predictors of sex and age respectively males showed statistically significant higher mean linear ramus measurements and lower mean gonial angle values than females. Condylar and coronoid ramus heights were the most significant predictors for sex and age respectively. estimation in the whole studied sample was: (Age=-32.306+8.481 coronoid ramus height) that yields no significance on comparing actual estimated ages.

In the selected Egyptian population sample, the mandibular ramus showed a high sexual dimorphism and proved to be beneficial in sex and age estimation; while, the gonial angle could assist in sex estimation only.(Taleb, et al, 2015).

Anather study by Saheb ,et al (2014). 100 mandibles were collected different medical colleges in Karnataka. they have assessed the shape of Coronoid process and Lingula of mandible. *The results was,* The triangular shape of lingula were 51% out of that male were 39% and female were 12%. The truncated shape of lingual were 13% out of that male were 11% and female were 2%. The nodular shape of lingula were 24% out of that male were 15% and female were 9%. The assimilated shape of lingula were 12% out of that

male were 17% and female were 5%. The shape of coronoid process was triangular in 68%, Hook shaped in 24% and round shape in 8% of cases. The shape of coronoid process and lingula of mandible very helpful in anthropological and forensic practice. (Saheb, et al, 2014).

And Kumar, et al , (2013). *Human identification is the goal of forensic dentistry and dental records, importantly the radiographic images like the orthopantomographs and intra oral radiographs form the basis to identify people. In his study he was attempt to set forth the foundations of a biometric system to compare and evaluate various measurements of mandibular ramus, mental index and their relationship to sex and also the usefulness of these parameters in sex determination. The Radiographs were taken by Kodak 8000C Digital Panoramic and Cephalometric System (73 kVp, 12 mA, 13.9 s) and mandibular ramus measurements carried out using 3.0 software. Initial experimental results on a small database of radiographs indicate that matching dental images based on mandibular ramus and mental indices and their relative positions is a feasible method for forensic analysis of human gender(Kumar ,et al 2013).*

Chapter three

Materials and methods

Chapter three
Materials and methods

The study is a cross sectional descriptive study ,carried out to measure and observe certain structure in mandible from OPG digital image by using special software tools, in Khartoum state adult population.

3-1 Materials:

3-1-1 The patient:

100 adult patient their age ranged from 18 to 70 years old used in this study.(55females and 45males).

All patient under OPG study these with abnormal mandible (trauma , tumor, fracture)were excluded from this study . because the measurement of the structure is not accurate.

3-1-2The machine:

OPG digital panoramic machine (Vatech) was used in these study.

3-2 Methods:

3-2-1 OPG Technique:

The x-ray tube and film(or other image receptor) rotates about the head of the patient, at different velocities, resulting in a flat representation of the curved surface of the jaws. Only objects in the image layer (or focal trough) remain in focus and other structures appearing blurred and distorted. Positioning is crucial to ensure that the teeth and jaws are within the image layer .all foreign objects, including dental appliances, spectacles and earrings were removed. The patients head was achieved by having the incisors resting in a radiolucent notched.

Patient erect or seated procedure, guide patient in to OPG unit, resting chin on bite block, have patient stand in close with spine straight adjust chin rest until IOML is aligned parallel with floor , align mid sagittal plane with the vertical centre line of the chine rest, position bit block between patients front teeth, instruct patient to place lips together and position tongue on roof of mouth.

3-2-2 Image Interpretation and measurement:

All image were dignosed as normal and certain structure were traced, abserved then flowing measurements (by using computer) are taken:

Maximum ramus breadth ,minmum ramus breadth ,maxium ramus hight (mandibular condyle), coronoid height, number of teeth in mandible ,and observation of different cortical eroded shaps.

3-2-3 Duration and place of

study: This study was conducted in Khartoum dental teaching hospital, durings the period of September 2016 to January 2017 .

3-2-4 Data analysis:

The data were analyzed using mean value , the standard deviation, Mazimum and Minimum values by using SPSS (statistical package for social sciences).

Chapter Four

Results

(4-1) Show Descriptive statistics data of mandibular ramus measurements for male and female subject presented as minimum, maximum, mean and stander deviation (SD).Rt: right side, Lt: left side, SD standard deviation,

Variables	Female				Male			
	Minimum	Maximum	Mean	SD	Minimum	Maximum	Mean	SD
Age	18	68	36.55	14.325	18	70	38.07	15.448
RT Maximum ramus width	20.0	33.6	26.724	2.7532	21.8000	35.3000	27.960000	3.8089846
LTMaximum ramus width	22.6000	45.6000	28.798182	3.7982691	21.9000	35.5000	29.620000	3.1339490
RTMinimum ramus width	18.2000	28.4000	23.429091	2.4432577	17.9000	31.0000	23.962222	3.2981599
LT Minimum ramus width	19.3000	29.6000	24.994545	2.5921833	20.4000	32.8000	25.680000	2.7147409
RT Condyle height	50.3000	71.7000	60.341818	4.5602425	56.2000	77.4000	65.806667	4.4366449
LT Condyle height	53.0000	70.0000	61.627273	3.7950482	55.5000	80.0000	67.144444	5.2016412
RT Coronoid height	42.6	63.8	52.844	4.8223	50.5000	66.6000	58.777778	4.3690486
LT Coronoid height	26.4000	69.9000	54.230909	6.3160253	50.8000	68.6000	60.217778	4.7209537
NO of Tooth on mandible	7	16	14.64	1.840	4	16	14.67	2.153

Table (4-2):Show male to female ratio

Gender	Frequency	Percent
Male	45	45%
Female	55	55%
Total	100	100%

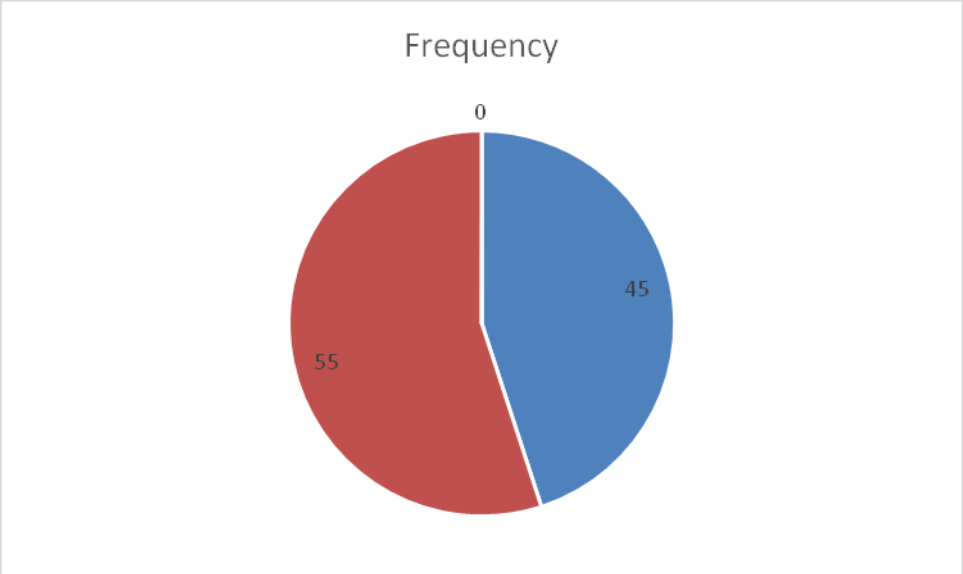


Fig (4-1) Show gender distribution

Table (4-3) show Descriptive data of the male and female subjects presented as mean and standard deviation (SD) in age group (18-25years). RT: right side, LT: left side, SD standard deviation

Variable	Female		Male	
	Mean	SD	Mean	SD
RT Maximum ramus width	27.241	1.7015	27.691	2.7858
RT Minimum ramus width	24.224	1.3311	23.481818	2.6906572
RT Condyle height	60.629412	3.8076838	63.245455	3.9243760
RT Coronoid height	51.818	3.7592	55.918	3.5927
LT Maximum ramus width	29.611765	4.8386313	30.045	2.8804
LT Minimum ramus width	25.018	2.1311	26.264	2.5077
LT	62.141176	4.5915764	64.709091	5.3625469

Condyle height				
LT Coronoid height	52.365	8.1911	57.855	3.7985
NO of tooth on mandible	15.65	.606	15.73	.647

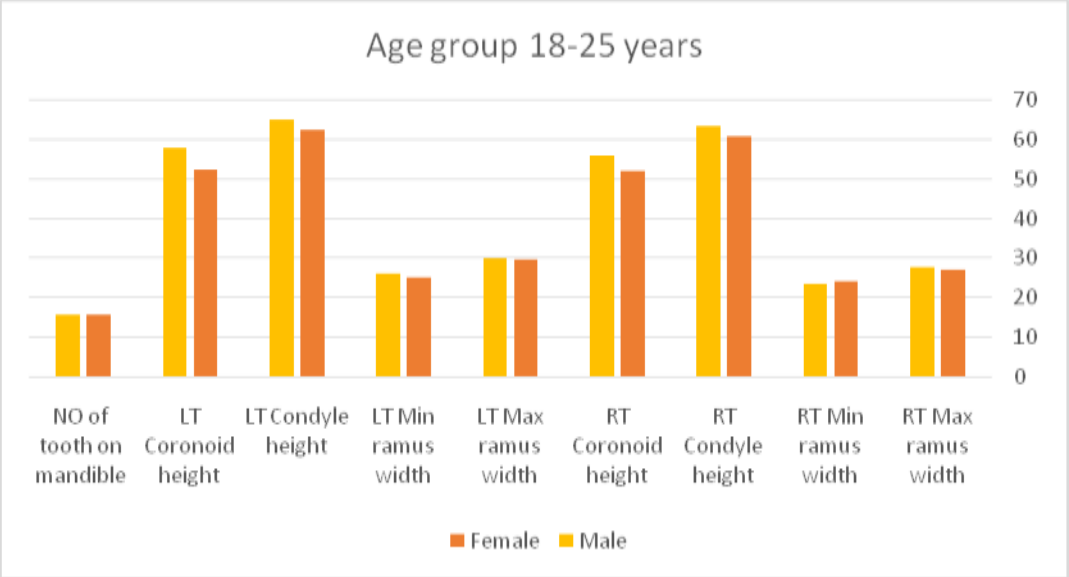


Figure (4-2) Bar Graph shows the Mean measurements compare between males and females in age Group (18-25years).

Table (4-4) show Descriptive data of the male and female subjects presented as mean and standard deviation (SD) in age group (26-40 years). RT: right side, LT: left side, SD standard deviation.

Variable	Female		Male		P value
	Mean	SD	Mean	SD	
RT Maximum ramus width	25.756	2.9784	27.542105	3.9929543	
RT Minimum ramus width	22.738889	2.9096470	24.005263	3.6699188	
RT Condyle height	60.305556	4.7891387	66.073684	3.8660692	
RT Coronoid height	53.617	5.3314	58.100000	4.6097722	
LT Maximum ramus width	27.728	3.0296	29.031579	3.8289907	
LT Minimum ramus width	25.166667	2.4609898	25.515789	3.3959556	
LT Condyle height	60.933333	3.4303147	67.331579	4.5487547	
LT Coronoid height	55.478	4.8505	59.747368	5.1488260	
NO of tooth on mandible	14.89	1.491	14.95	1.129	

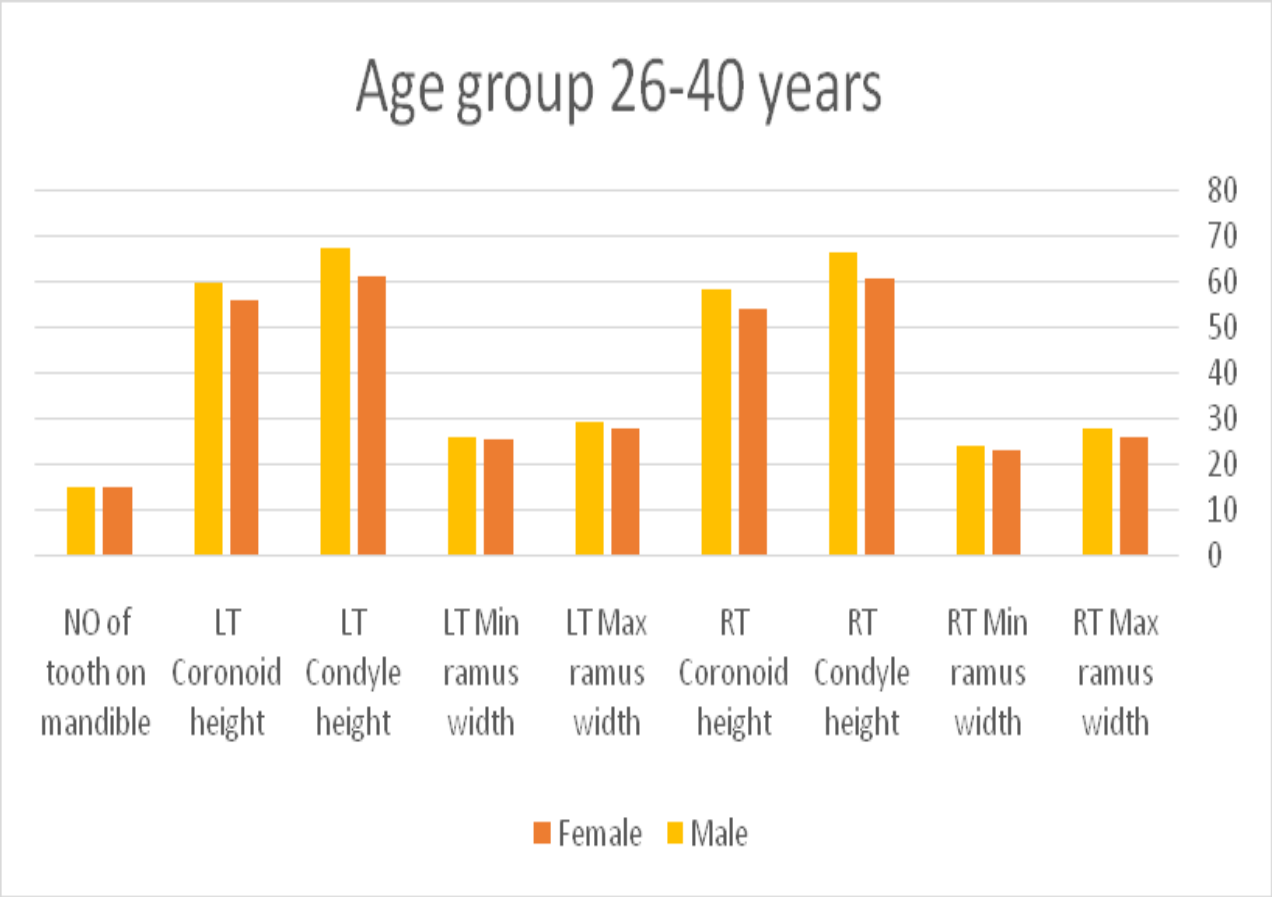


Figure (4-3) Bar Graph shows the Mean measurements compare between males and females in age Group (26-40 years).

Table (4-5) show Descriptive data of the male and female subjects presented as mean and standard deviation (SD) in age group (41-70 years).RT: right side, LT: left side, SD standard deviation.

Variable	Female		Male		P value
	Mean	SD	Mean	SD	
RT Maximum ramus width	27.155	3.1378	28.686667	4.3238321	
RT Minimum ramus width	23.375000	2.6229503	24.260000	3.3795181	
RT Condyle height	60.130	5.1235	67.346667	4.8840654	
RT Coronoid height	53.020	5.2171	61.733	2.6540	
LT Maximum ramus width	29.070000	3.3643800	30.053333	2.2974727	
LT Minimum ramus width	24.820	3.1294	25.460	1.8673	
LT Condyle height	61.815000	3.4527297	68.693333	5.5330780	
LT Coronoid height	54.695000	5.5686600	62.546667	3.8930096	
NO of tooth on mandible	13.55	2.259	13.53	3.204	

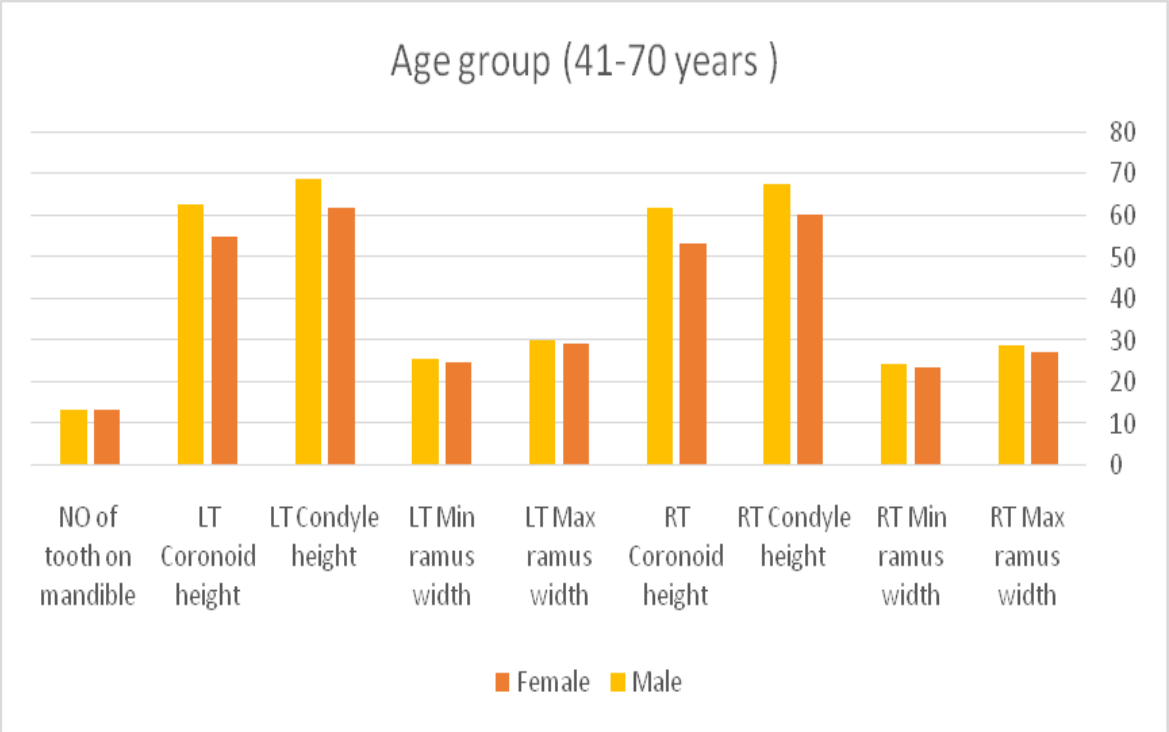


Figure (4-4) Bar Graph shows the Mean measurements compare between males and females in age Group (41-70 years).

Table(4-6) Show cortical shape according to angle eroded of mandible cortex divided into three Categories simple, mildly to moderate and severe.

cortical shape	Frequency	Percent
simple eroded (A)	49	49%
Mildly to moderate erode cortex (B)	29	29%
Sevier eroded cortex (C)	22	22%

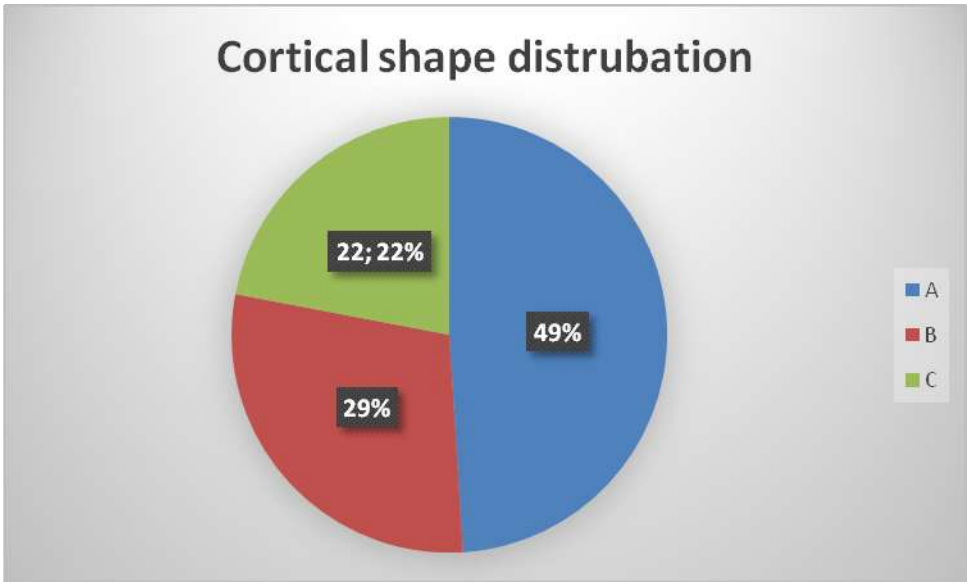


Figure (4-5) Pie chart show cortical shape according to angle eroded of mandible cortex divide into Three Categories A: simple, B: mildly to moderate and C: severe.

Chapter Five

Discussion, Conclusion & recommendations

Chapter Five
Discussion, Conclusion and recommendations

5-1 Discussion:

Investigations were carried out to determine if there was a relationship between mandibular parameters and age and gender using measurements of ramus width and ramus height on orthopantomogram radiographs(OPG) in sudanese population. Parameter were examined allowed the morphology of mandible to be observed as well as observing the effects of aging and consequential mandibular remodeling. The investigations revealed a correlation in mandibular morphology on both gender and age . it was found that males have a larger rams height and larger ramus width than females. Ageneral trend in age showed a increase in ramus height and ramus width as age increased. The mean of the ramus height on the right side were slightly higher than those on the left side. Ramus height measurement can be used for sex determination and it is more accurate than gonial angle method (former,2016). The means std values of the right and left ramus height of condyle and coronoid of females was (61.627273 _+ 3.7950482) ,(60.341818 _+ 4.5602425), (54.230909_+ 6.3160253), (52.844 4.8223) respectivly. The means -+ std of right and left ramus height (condyle and coronoid) on males was (67.14444 _+ 5.2016412), (65.806667 _+4.4366449), (60.217778 _+ 4.7209537), (58.777778 _+ 4.3690486) respectively . The mean_+ std of maximum and minimum ramus width on right and left sides on female was (28.798182 _+ 3.7982691), (26.724 _+ 2.7532), (24.994545 _+2.5921833), (23.429091 _+ 2.4432577) respectivly. the mean _+ std of minimum and maximum ramus width on right and left side on males was (29.62000 3.1339490), (27.960000 3.808946),(25.68000 2.7147409), (23.962222 3.2981599) respsctivly. The mean _+ std of number of teeth on mandible on females was(14.64 _+ 1.840) and on males was(14.67 _+ 2.153) . The cortical shape of mandible distribution was 49% was normal cortex,29%

midly to modratly eroded cortex and 22.22% severely eroded cortex shown on figure (4-6) . There is indirect relationship between age and mandibular eroded cortex. Descriptive statistics of male and female in age group are show on tables (4-3) , (4-4) and (4-5) and figures (4-2), (4-3) and (4-4) . there was a statistically significant positive (direct) correlation between age and ramus measurements i.e. an increase in age is associated with an increase in these measurements and vice versa. cortical shape distribution of mandibles show on table (4-6).

The identification of sex from human remains is of fundament importance in forensic medicine and anthropology, especially in criminal investigations as well as in the identification of missing persons and in attempts at reconstructing the lives of ancient populations. One of the important aspects of forensics is to determine sex from fragmented jaws and dentition. the Identification of sex based on morphological marks is subjective and likely to be inaccurate, but methods based on measurements and morphometry are accurate and can be used in determination of sex from the skull. Mandibles were used for the analysis for two simple reasons: firstly, there appears to be a paucity of standards utilizing this element and secondly, this bone is often recovered largely intact. The accuracy of panoramic radiography in providing anatomic measurements has been established. Orthopantomograph has been advocated routinely and widely used by the clinicians as an appropriate screening tool for the diagnosis of oral diseases. Minimum ramus breadth measurement was found to be the best parameter in the studies, which is consistent with other osteometric studies by(Giles, 1964) and(Vodanovic, 2006), where breadth measurements were found to be very dimorphic. This is related to the differences in musculoskeletal development and to the differences related to a different growth trajectory in males and females. The study performed by (Kambylafkus, et al 2013) states that panoramic radiographs are used to evaluate the mandibular asymmetry but some amount

of under diagnosis is always present. Mandibular condyle and ramus were considerd in the present study as they are sites associated with remodeling as emphasized by(Humphrey ,et al, 2015) which states that almost any site of mandibular bone deposition or resoption has apotential for becoming sexully dimorphic.

5-2 Conclusion

Orthopantomograms have been provan to be valuable tool for the determination of morphological dimensions of the mandible. The study found that the mean values of ramus height and ramus breadth on right side were slightly higher than those on left side but the differences were not statistically significant. Males have higher values of ramus height and ramus width than females. There were increase in ramus height and ramus width as age increased and there was a direct relationship between eroded of mandible cortex and age and there was no differences between males and females on number mandible teeth . therefore conlusion of this study the mandible feature change by age and gender.

5-3 Recommendations:

Considering the small sample size used in this study, the study with large proportion of samples may be necessary to confirm the result of our study conclusively.

Further studies need to be done to study another mandible parameters.

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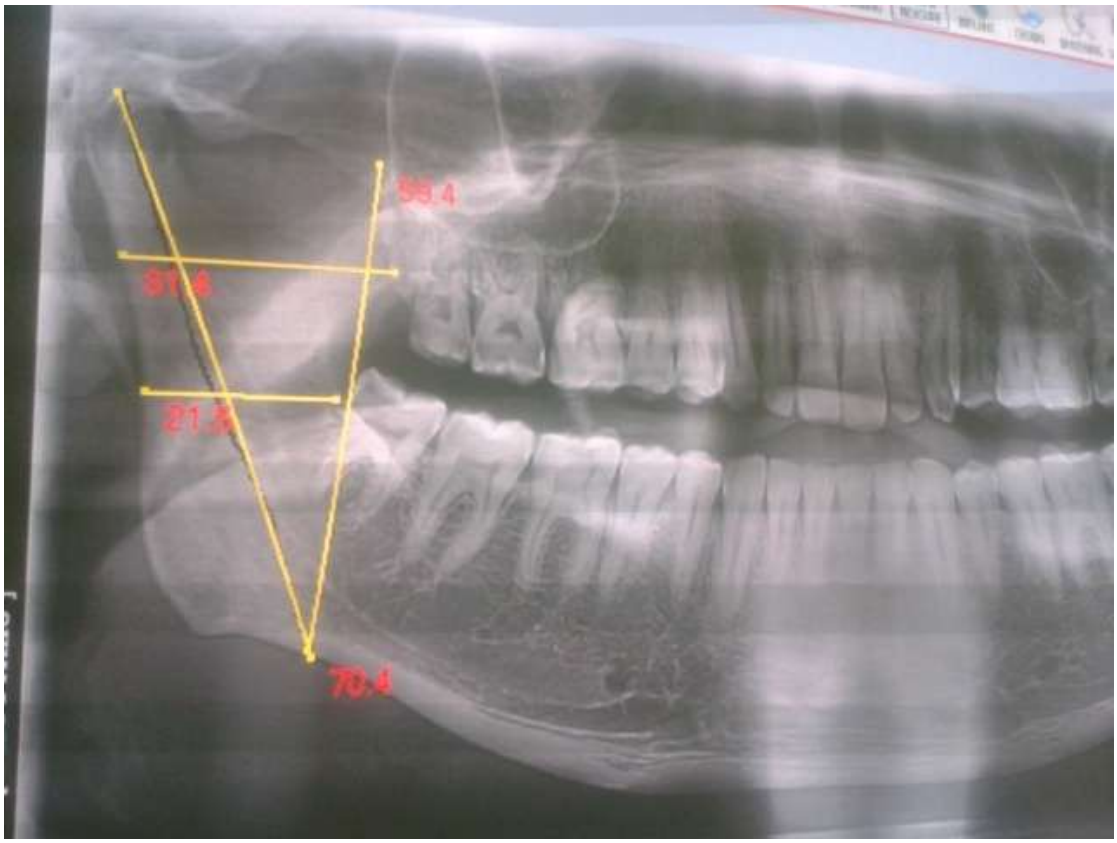
Appendices

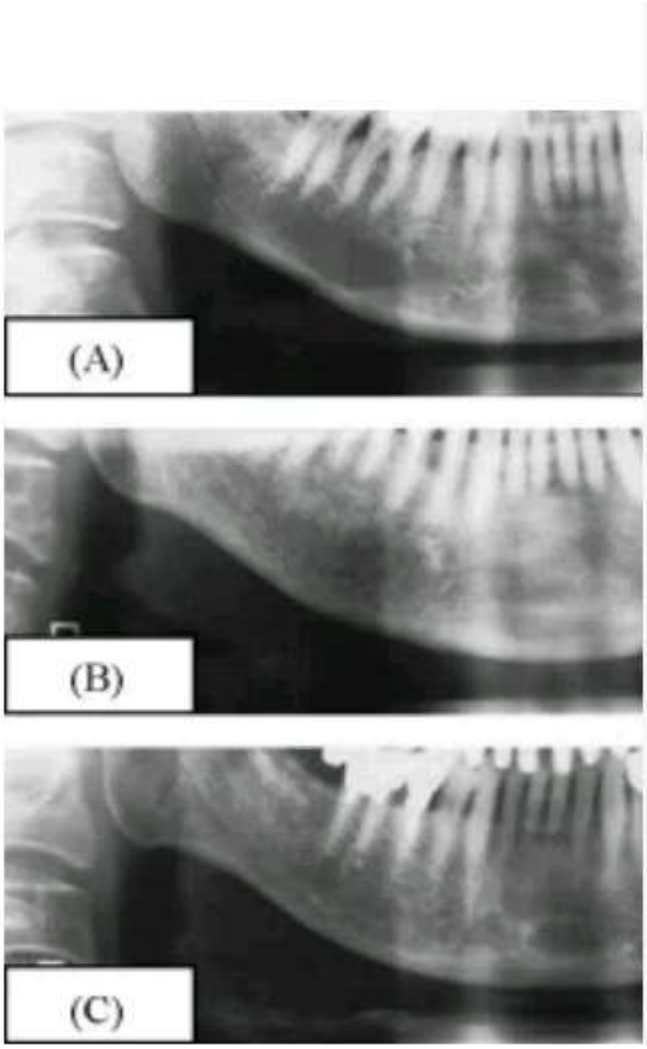
Appendices 1: show data sheet

PT ID	Age	Sex	RT Condyle height	LT Condyle height	RT Coronoid height	LT Coronoid height	RT Max ramus width	LT Max ramus width	RT Min ramus width	LT Min ramus width	NO of tooth on mandible	Shape of mandible cortex

Appendix 2: show Digital OPG for 45 years male show measurements of coronoid height(58.4mm) , condylar ramus height(70.4mm), minmum (21.5mm) and maximum ramus width(31.4mm).



Appendix 3 : Digital OPG for males show different cortical shapes



Cortical shape classification of the mandible panoramic radiographs (A) normal cortex, B) midly to moderately eroded cortex and (C)severely eroded cortex