بسم الله الرحمن الرحيم

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ؤ صيف عظم الحو ض لدى الو دانين باستخدام التصو ير بالأشعه المحو سبه

A Thesis Submitted for Partial Fulfillment of B.Sc.Ddegree in

Diagnostic Radiological Technology

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Ag - 2014

الآية

قال تعالى:

(وَعَلَّمَ آدَمَ الْأَسْمَاءَ كُلَّهَا ثُمَّ عَرَضَهُمْ عَلَى الْمَلَائِكَةِ فَقَالَ أَنْبِئُونِي بِأَسْمَاءِ هَؤُلَاءِ إِنْ كُنْتُمْ صَادِقِينَ)

صدق الله العظيم

سورة البقرة: الآيه (31)

Dedication

To

Our parents and family and cousins for the generous and endless support through our life.

To our dear Dr. Caroline and colleagues without their patience, understanding, supports and all the love The completion of this work would not have been possible.

Acknowledgment

Abstract

This study aimed to characterize the Sudanese pelvis using computed radiography and compare the finding with age and BMI .

The study was performed on 44 cases in both gender during the period from may 2014 up to august 2014 at Antalya ,al Nelaen center and Ibn al Hytham hospital .

The study found that the Distant Between Iliac Crests was ±3.8, ASIS was ±3.9, Brim Length was ±2.4 , Brim Width was ±1.7, Distant Between Acetabulum was ±3.0 and Pubic Angle was ±19.7 .

The study also revealed a linear relation between age and BMI .A significance different between the two genders were noticed .

computed radiography is a good method for characterizing the pelvis .

Sudanese pelvis is differ from what was mention in previous study.

ملخص الدراسه

هدفت الدراسة لتوضيح عظم الحوض لدى السودانين بستخدام التصوير الاشعاعئ بالحاسب ومقارنه النتائج بالعمر وكتله الجسم.

أجريت الدراسة على 44 حاله في خلال الفتره من مايو 2014 الى اغسطس 2014 فى مركز انطاليا، النيلين ومستشفى ابن الهيثم .

وجدت الدراسة ان المسافة بين الشفتين الباطنيتين لعرف الحرقفه كان 3.8± والمسافه بين الشوكتين الحرقفيتين الاماميتين العلويتين كان 3.9± ومسافه القطر المتقارن 2.4± ومسافه القطر المستعرض 1.7±والمسافة بين حافتين الحق 3.0± والمسافه بين زاويه التقوس العاني19.7±.

أيضا كشفت الدراسة وجود علاقه خطية بين العمر وكتلة الجسم . وتم ملاحظة فرق بين الجنسين .

التصوير الاشعائى بستخدام الحاسب طريقه جيدة لتوضيح عظم الحوض .

يختلف عظم الحوض لدى السودانين من ما ذكر فى البحوث السابقه .

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List of Abbreviations

The anterior Superior Iliac Spine	ASIS
Body mass index	BMI
Computed radiography	CR
Anterior posterior	AP
Pelvic Inflammatory Disease	PID
Oblique	OBI
True Conjugate	TC
Diagonal Conjugate	DC
Image plate	IP
Right Posterior Oblique	RPO
Left Posterior Oblique	LPO
Digital Radioghraphy	DR
Linear Diode Array	LDA
Image Intensifier	II
Signal to Noise Ratio	SNR
Detective Quantum Efficincy	DQE
Second lumber spine	L_2
Fourth lumber spine	L_4
Second sacrum spine	S_2
Fourth sacrum spine	S_4
Transverse diameter	TV

Contents

1.1 Introduction:

The pelvis, so called from its resemblance to a basin, is a bony ring, interposed between the movable vertebra of the vertebral column which it supports, and the lower limbs upon which it rests; it is stronger and more massively constructed than the wall of the cranial or thoracic cavities, and is composed of four bones: the two hip bones laterally and in front and the sacrum and coccyx behind.

The pelvis is divided by an oblique plane passing through the prominence of the sacrum, the arcuate and pectineal lines, and the upper margin of the symphysis pubis, into the greater and the lesser pelvis. The circumference of this plane is termed the linea terminalis or pelvic brim. its contains, supports, and protects the pelvis viscera.in this study we used computed radiography to measure the variable(distant between iliac crests , Line Joining The anterior Superior Iliac Spine(ASIS),brim length, brim width, distant between acetabulumn and pubic angle). (Chung K.W ,1996)

Computed radiography (CR) uses very similar equipment to conventional radiography except that in place of a film to create the image, an imaging plate (IP) made of photostimulable phosphor is used. The imaging plate is housed in a special cassette and placed under the body part or object to be examined and the x-ray exposure is made. Hence, instead of taking an exposed film into a darkroom for developing in chemical tanks or an automatic film processor, the imaging plate is run through a special laser scanner, or CR reader, that reads and digitizes the image. The digital image can then be viewed and enhanced using software.(medscap.com)

1.2 Problem of the study:

There is inadequate knowledge about measurement of the pelvis of Sudanese population.

1.3 Significance of the study:

Can predict value for Sudanese subject and differentiate Sudanese from other nationality.

1.4 Objective of the study:

1.4.1 General objective:

To characterize the Sudanese pelvis using computed radiography.

1.4.2 Specific objectives:

- To measure distance between two acetabulums
- To measure distance between two anterior superior iliac spines
- To measure distance between two iliac crests.
- To measure angle of pubic angle in both male and female.
- To measure diameter between brim length and brim width .
- To correlate findings with patient's age and body mass index.

1.5 Overview of the study:

The Study will contain five Chapters; Chapter one will include general introduction about anatomy physiology, in addition to problem of the study, significant of the study, general and specific objective also the overview of the study. Chapter two will contain the literature review which consists of previous studies done for this measurement. Chapter three will deals with methodology (include material and method). Chapter four will include the presentation of the main result. Chapter five will include the discussion, conclusion and recommendation in addition to references and appendices.

2.1 Anatomy of the pelvis:

Is the region of the trunk that lies below the abdomen and connected between the vertebral and lower limbs.

The bony pelvis is composed of four bones: the two hip bones, which form the lateral and anterior walls, and the sacrum and the coccyx, which are part of the vertebral column and form the back wall. The two hip bones articulate with each other anteriorly at the symphysis pubis and posteriorly with the sacrum at the sacroiliac joints. The bony pelvis thus forms a strong basin-shaped structure that contains and protects the lower parts of the intestinal and urinary tracts and the internal organs of reproduction (Snell, 2008) .

Key
☐ Greater (false) pelvis
☐ Lesser (true) pelvis
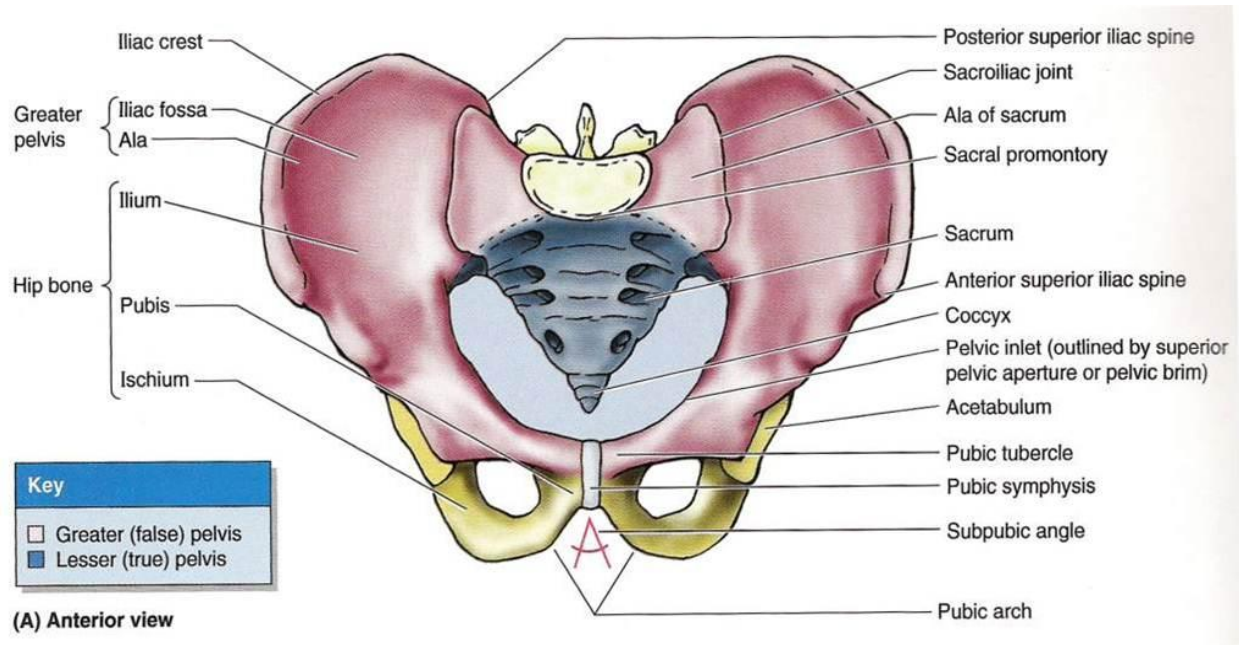
(A) Anterior view

Figure 2-1: shows anterior view of pelvic bone.(google.com/images)

2.1.1 The ilium :

It The large flared out part. Its concave inner surface is the iliac fossa. The curved upper border is the iliac crest. When you place your hand on your hip it rests on the iliac crest. At the front of the iliac crest there is a bony prominence known as the

anterior superior iliac spine and below it is the interior inferior iliac spine. At the other end of the iliac crest are two similar points called the posterior superior and posterior inferior iliac spines .(Putz R, et al, 1997)

2.1.2 The ischium:

It forms part of the acetabulum above whilst the thick lower part is the ischial tuberosity. When you are sitting down you are sitting on your two ischial tuberosoities. These can be palpated through the buttocks and the distance apart can be assessed by placing a closed fist between them. The slight projection behind and just above the tuberosity is called the ischial spine. The two ischial spines can be palpated vaginally and in labour the station of the fetal head is estimated in relation to them. (Snell,2008)

2.1.3 The pubis:

It is a small bone that has a body and two projections called, the superior ramus and the inferior ramus. The two pubic bones meet at the symphysis pubis, The two inferior rami form the apex of the pubic arch, merging in to a similar ramus on the ischium, this forms the anterior boundary of the obturator foramen and the subpubic arch. In the normal gynaecoid pelvis the subpubic arch should be at least 90 degree.(Snell,2008)

2.1.4 Sacrum:

The sacrum is the wedge-shaped bone consisting of five fused vertebrae, the first of which has a prominent upper border known as the sacral promontory . This is an important pelvis landmark .It projects forward decreasing the anterposterior diameter of the pelvis brim . If this diameter is seriously decreased it can impair the descent of the fetal head in to the pelvis . The smooth concave anterior surface is referred to as the hollow of the sacrum and the areas either side are the alae or

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wings. The convex posterior surface is roughened to receive attachments of muscles. The sacrum is perforated by four sets of holes or foramina through which the sacral nerves pass . (snell,2008)

2.1.5 Coccyx:

The coccyx is at the lower part of the spine and is a vesitigal tail . It is a small triangular-shaped bone consisting of four fused vertebrae . The coccyx gives attachment to ligaments, deep muscles of the pelvic floor and to muscle fibres of the anal sphincter. (snell.2008)

During 1abour the moves backwards to enlarge the pelvic outlet allowing more space for passage of the fetus . (Snell 2008)

2.1.6 Pelvic Joints:

There are four pelvic joints. One symphysis pubis; two sacro-iliac joints; One sacrococcygeal joint.

The pelvic joints and ligaments are relaxed in pregnancy to hormonal action . This relaxation allows a slight increase in the pelvic measurements. This could be advantageous for some women during 1abour but for other it can increase the feeling of instatbility in pregnancy when walking and can be responsible for the low backache experienced by some women. (snell,2008)

2.1.6.1 The symphysis pubic:

A slightly movable joint formed at the junction of the two pubic bones . These are united by a pad of cartilage. (snell,2008)

2.1.6.2 The sacroiliac joints:

These are the strongest joints in the body .They are formed where the ilium joins with the first two sacral vertebrae thus connecting the spine to the pelvis.

(Gunn C, 1988)

2.1.6.3 The sacrococcygeal joint:

This is a hinge joint between the sacrum and the coccyx , which , at the end of labour ,allows the coccyx to be deflected backwards facilitating delivery of the fetus. (Gunn C, 1988)

2.1.7 different between female and male pelvic:

The female pelvis is distinguished from that of the male by its bones being more delicate and its depth less. The whole pelvis is less massive , and its muscular impressions are slightly marked .The ilia are less sloped ,and the anterior iliac spines more widely separated; hence the greater.

Lateral prominence of the hips . The preauricular sulcus is more commonly present and better marked. The superior aperture of the lesser pelvis is larger in the female than in the male ;it is more nearly circular ,and its obliquity is greater . The cavity is shallower and wider; the sacrum is shorter wider , and its upper part is less curved; the obturator foramina are triangular in shape and smaller in size than in the male. The inferior aperture is larger and the coccyx more movable.

The sciatic notches are wider and shallower ,and the spines of the Ischia project less inward. The acetabula are smaller and look more distinctly forward. The ischial tuberosities and the acetabula are wider apart, and the former are more everted . The pubic symphysis is less deep, and the pubic arch is wider and more rounded than in the male, where it is an angle ratherthan an arch. The size of the pelvis varies not only in the two sexes, but also in different members of the same sex. (Chung K,1996)
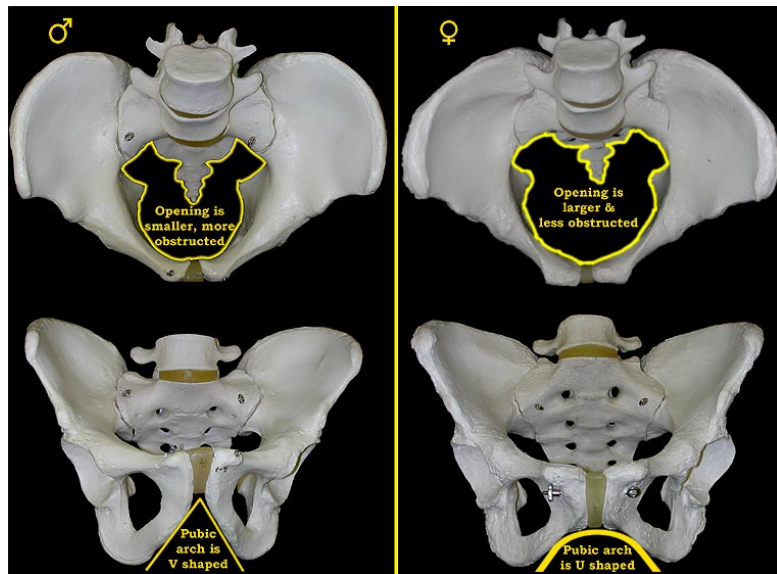
Figure 2-2 Shows the different between female and male pelvic. (google.com /image)

2.1.8 Sudanese female pelvis measurement compared with other nationality:

Table 2.1.8 shows the Sudanese female pelvis measurement compared with other nationality.

Obstetric Dimension	Sudanese	White a American n	Black America n	Euro bean	Arabian	Asian	African Nigerian
AP	11.7 ± 0.2	10.7 ± 0.7	10.0 ± 0.7	10.5	11.0	7.9	8.4 ± 0.9
TV	13.5 ± 0.2	13.5	13.0	13.0	13.5	9.5	14.0 ± 0.8
0bi	12.0	12.0	12.0	12.0	12.5	8.0	13.0

	± 0.2						
TC	11.5 ± 0.2	11.2	10.5	11.0	11.5	8.4	8.9
DC	13.0 ± 0.2	12.0	12.0	12.5	13.0	9.9	10.4
Outlet	13.0 ± 0.3	12.3 ± 0.1	11.8 ± 0.9	13.5	13.5	8.6	11.5 ± 1.2

Dr. Fhatma Dehia Mohamed Ali (2010).

2.1.9 Types of Pelvic:

The pelvis has been classified into four types, chiefly by the shape of the brim. Many individuals, however, have a combination of more than one type.

2.1.9.1 The Gyneacoid Pelvis:

As described above, is the true female pelvis. Its main features are the rounded brim, the generous fore – pelvis (the part in front of the transverse diameter), straight side walls, a shallow cavity with a broad, well – curved sacrum, blunt ischial spines, a wide sciatic notch and a pubic arch of 90 degrees. It is found in women of average build and height with a shoe size of 4 or larger. It is well suited to child bearing.(slideshare.net).

2.1.9.2 The Android Pelvis:

Is so called because it resembles the male pelvis. Its brim is heart shaped with a narrow fore – pelvis, and has a transverse diameter which is towards the back. The side walls coverage, making it a funnel shape with a deep cavity and a straight sacrum. The ischial spinesare prominent and the sciatic notch is narrow. The angle of the pubic arch is less than 90 degrees. It is found in short and heavily built women who have a tendency to be hirsute. This type of pelvis predisposes to an occipito posterior position of the fetal head and is the least suited to child –

bearing . (s l i d e s h a r e . n e t)

2.9.1.3 The Anthropoid Pelvis:

Has a long, oval brim in which the antero posterior diameter is longer than the transverse. The side walls diverge and the sacrum is long and deeply concave. The ischial spines are not prominent and the sciatic notch is very wide, as is the sub – pubic angle. Women with this type of pelvis tend to be tall, with narrow shoulders. Labor does not usually present any difficulties, but a direct occipito – posterior position is often a feature. (slideshare.net)

2.1.9.4 The Platypelloid Pelvis:

It is flat, with a kidney shaped brim in which the anteroposterior diameter is reduced and the transverse increased. The side walls diverge, the sacrum is flat and the cavity shallow. The ischial spinesare blunt, and the sciatic notch and the sub – pubic angle are both wide. The head must engage with the sagittal suture in the transverse diameter, but usually descends through the cavity without difficulty. (slide share.net)
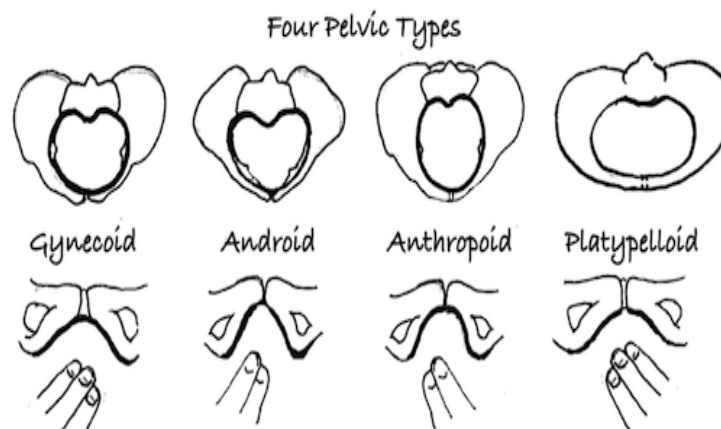
Figure 2-3: show four pelvic types. (google.com/images)

2.1.10 True and false pelvic:

The true pelvis contains the pelvic inlet and is a short, curved canal, deeper on its posterior than on its anterior wall also the pelvic colon, rectum, bladder, and some of the reproductive organs. The rectum is at the back, in the curve of the sacrum and coccyx; the bladder is in front, behind the pubic symphysis. In the female, theuterus and vagina occupy the interval between these viscera. The pelvic splanchnic nerves arising at S2-S4 are in the lesser pelvis. (inner body.com)

The true or "lesser" pelvis is bounded in front and below by the pubic symphysis and the superior rami of the pubis; above and behind, by the sacrum and coccyx; and laterally, by a broad, smooth, quadrangular area of bone, corresponding to the

inner surfaces of the body and superior ramus of the ischium, and the part of the ilium below the arcuate line. (inner body.com)

The false pelvis supports the intestines (specifically, the ileum and sigmoid colon) and transmits part of their weight to the anterior wall of the abdomen. The false pelvis supports the intestines (specifically, the ileum and sigmoid colon), and transmits part of their weight to the anterior wall of the abdomen. The femoral nerve from L2-L4 is in the greater pelvis, but not in the lesser pelvis

The false "greater" pelvis is bounded on either side by the ilium; in front it is incomplete, presenting a wide interval between the anterior borders of the ilia; behind is a deep notch on either side between the ilium and the base of the sacrum. Some consider this region part of the pelvic cavity, while others consider it part of the abdominal cavity (hence the name false pelvis). Others compromise by referring to the area as the abdominopelvic cavity. (inner body.com)
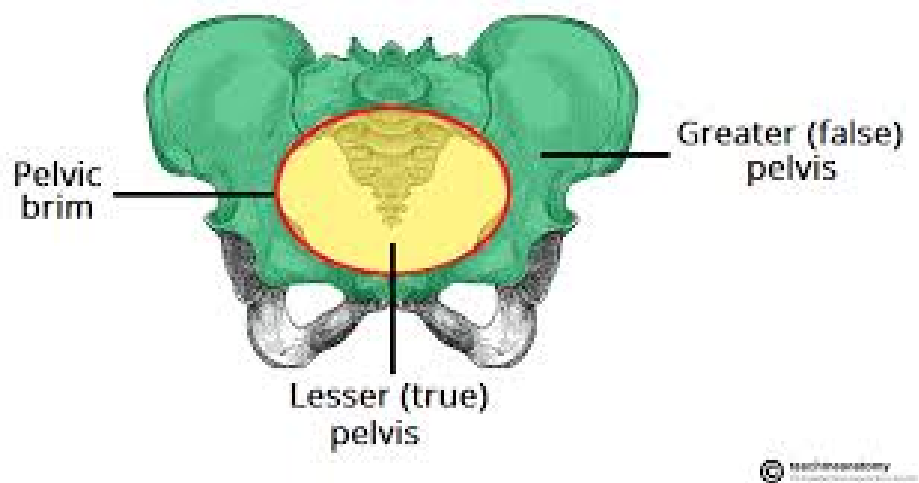

Figure 2-4:show anterior view of true and false pelvic.(google.com/images)

2.2 physiology of the pelvic:

The bony pelvis main function is to transmit the weight of the body from the vertebral column to the femurs. In addition, its contains, supports, and protects the pelvis viscera and provides attachment for trunk and lower limb muscles. (Education .yahoo.com).

supported through the presence of the four sets of muscles and connecting tendons that operate together with machine-like precision. The hip flexors, extensors, adductors, and external rotators combine to provide a 360° range of motion. The importance of the hip joint is not confined to the range of motion that it permits the upper leg, but also through the considerable muscular power and endurance that is delivered in concert with the motion. (Education .yahoo.com).

The hip joint flexor the hip joint is capable of a remarkable range of motion, due to the construction of the joint, supports the process of flexion, the movement of the hip joint that produces a bend, which helps propel the legs forward and upward. Extension is the hip action that straightens the leg. Rotation is the ability of the hip joint to direct the femur and the upper thigh through the 360° range of motion. Adduction is movement of the hip muscles that draws the femur and upper thigh toward the body; the adductors are important stabilizing muscles in running.

The hips and pelvis are directed through a number of nerve endings, the most important of which is the sciatic nerve. The pelvis is not capable of independent movement as it is not a joint. However, it is a structure with a reasonable degree of flexibility, absent the weakening of the pelvis of hip bones due to osteoarthritis or osteoporosis, two similar and degenerative bone conditions that can cause fractures. The female pelvis is slightly wider and shallower than that of the male, to facilitate the female in childbirth. (SuKKar, 1992)

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2.3 Technique of pelvic:

2.3.1 Conventional radiography:

2.3.1.1 Standing AP Pelvis with Bilateral Flamingo

The distance between patient and bucky is 40 cm, and the bucky upright with focal spot large ,the image plate 14x17 cm ,the central ray Perpendicular entering the midline 2" superior to the pubic symphysis and patient positioning is Standing AP Pelvis done with patient standing evenly on both feet. & without rotation. No shielding. Flamingo views are done sequentially First, have the patient bring their feet together. Then transfer weight to the right leg and lift left foot barely off the floor . Then, repeat for the opposite side. No rotation or shielding. Patient to hold on to something for stability only if needed.

(Bontrager,2007).

2.3.1.2 Pelvis-Judet View

The distance between patient and bucky 44 and focal spot large with imaging plate 14x17 cm , the central ray mid pelvis perpendicular to film. Patient supine, oblique patient 45degree both ways (RPO & LPO).The central ray mid pelvic and perpendicular to film. Patient positioning in judet views of a single hip may be ordered if doctor desires. (Bontrager,2007)

2.3.1.3 pelvis-inlet/outlet view

 The distance between patient and bucky 44 and focal spot large with imaging plate 14x17 cm , the central ray used in inlet view-35o caudal angle entering at midline at the level of the ASIS ,while the outlet-35o cephalic angle entering at midline at the symphysis. (Bontrager, 2007)

2.4 Other modalities:

2.4.1 Ultrasound:

A pelvic ultrasound provides pictures of the structures and organs in the lower abdomen and pelvis.

There are three types of pelvic ultrasound:

Abdominal (transabdominal).

Vaginal (transvaginal, endovaginal) for women.

Rectal (transrectal) for men.

2.4.2 A Doppler ultrasound exam may be part of a pelvic ultrasound examination Evaluates blood flow through a blood vessel.

Pelvic ultrasound exams are also used to monitor the health and development of an embryo or fetus during pregnancy. Obstetrical Ultrasound.

Pelvic ultrasound is also used to guide procedures such as needle biopsies, in which needles are used to extract a sample of cells from organs for laboratory testing.

A pelvic ultrasound provides pictures of the structures and organs in the lower abdomen and pelvis. (Radiologyinfo.org)

2.4.3 Magnetic resonance imaging:

The patient lies supine on the examination couch. Foam pads and compression bands are applied across the patient's lower pelvis to reduce respiratory and bowel motion. the patients is positioned so that longitudinal alignment light lies in the midline and the horizontal alignment light passes through a point midway between symphysis pubic and the iliac crest . If a local rectal coil is used it should be carefully inserted prior to the examination .Ensure that it is correctly positioned and fully inflated. (Radiologyinfo.org)

2.4.4 Computed tomography imaging:

A localizing or scout radiograph should be taken with the in supine position.

 The scan range for upper abdomen only is generally from the xiphoid process to iliac crest.

The scan range for abdomen and pelvis is from xiphoid process to the symphysis pubis.

10 mm slice thickness is usually preferred for abdomen and pelvis examinations. A 5 to 8 mm slice thickness may be used for the tumor of specific organs as liver, pancreas or kidney is suspected.

Exposure times of 1 to 3 seconds are needed to reduced peristaltic and respiratory artifacts.

Respiration must e suspended in consistent manner to produce high quality image (Radiologyinfo.org)

2.5 Bony Pelvic pathologies:

2.5.1 Congenital and Hereditary Diseases:

2.5.1.1 Osteogenesis Imperfecta: Congenital disease in which the bones are abnormality brittle and subject to fractures.(Roderick, 1992)

2.5.1.2 Osteopetrosis: Hereditary disease characterized by abnormally dense bone, likely as a result of faulty bone resorption. (Roderick, 1992)

2.5.2 Inflammatory Diseases:

2.5.2.1 Arthritis: Inflammtion in which lesion are confined to the joints, characterized by pain, swelling, and limited movement in joints and connective tissues in the body. (Rubin, 1999)

2.5.2.2 Osteomyelitis: Infection of bone, most often caused by staphylococcus, which may localize or spread to the bone to involve the marrow and other bone tissue. (Walter JB , 1987)

2.5.2.3 Pelvic Inflammatory Disease (PID): A bacterial infection of the female genital system, most often caused by bacteria. (Walter JB , 1987)

2.5.3 Metabolic Diseases :

2.5.3.1 Osteoporosis: Metabolic bone disorder resulting in demineralization of bone, most commonly seen in women post-menopause. (Walter JB , 1987)

2.5.3.2 Paget`s disease: A metabolic disorder of unknown etiology ,most common in the elderly , characterized by an early ,osteolytic stage and a late , osteoblastic stage. (Rubin, 1999)

2.5.4 Neoplastic Diseases:

2.5.4.1 Ewing`s Sarcoma: A primary malignant bone tumor arising in medullary tissue, occurring more often in cylindrical bones.(medscape.com)

2.5.4.2 Chondrosarcoma : Is a malignant tumor of cartilaginous origin and is composed of atypical cartilage, common locations are pelvis, shoulder and ribs. (Rubin, 1999)

2.5.4.3 Metastasis: The spread of cancer cells, the bones of skeletal system that contain red bone marrow are the major bones affected by the metastatic disease because of their good vascuiariztion. These include flat bones (such as the ribs and pelvis), and the vertebra.(education.yahoo.com)

2.6 Factors that affect the shape of the bone and measurements of the pelvis:

It was found that the following factors affect the shape and measurement of the pelvis:

- Environment and social habits: The variation in body habits has significant effect on the shape and location of internal organ and pelvis ,the four common body types effect the pelvic shape, contributing different measurement of pelvic . In sthenic body the pelvic is relatively small ,while in asthenic body the pelvic is wide , and the hyposthenic body the pelvic intermediate between the sthenic and asthenic body habitus types, hypersthenic body the pelvic is narrow.(medicenet.com)

- Poor socioeconomic condition(shortage of protein and calcium in the diet at early stage of development.)

- Pelvic deformity due to childhood rickets or adult osteomalacia (relatively higher incidence in developing countries.)

- Fracture of pelvis

- Congenital abnormalities,(abnormality of lower limb, abnormalities of pelvic girdle, sublaxation of joints and abnormalities of vertebral column.)

- Female age.

- Bone disorders

- Hormonal factors(e.g. Excessive androgen which may produce android pelvis.)

- Genetic factors.

- Life style. (medicenet.com)

2.7 Computed radiography:

Computed radiography (CR) uses very similar equipment to conventional radiography except that in place of a film to create the image, an imaging plate (IP) made of photostimulable phosphor is used. The imaging plate is housed in a special cassette and placed under the body part or object to be examined and the x-ray exposure is made. Hence, instead of taking an exposed film into a darkroom for developing in chemical tanks or an automatic film processor, the imaging plate is run through a special laser scanner, or CR reader, that reads and digitizes the image. The digital image can then be viewed and enhanced using software that has functions very similar to other conventional digital image-processing software, such as contrast, brightness, filtration and zoom.(medscap.com)

2.7.1 Imaging plate:

The CR imaging plate (IP) contains a photostimulable storage phosphor layer (typically 0.1 to 0.3 mm thick), which store the radiation dose as a latent image within the phosphor layer as elevated electron energies. When the IP is then transported through the scanner (read out), the scanning laser beam causes the electrons to relax to lower energy levels (photostimulated luminescence), emitting light that is detected by a photo-multiplier tube, which is clocked at a specific resolution or pixel capture frequency, this signal then being converted to an electronic signal and significantly amplified. The electronic signal is then quantized via an ADC to discrete (digital) values for each pixel and placed into the image processor pixel map.(medscap.com)

Imaging plates can theoretically be re-used thousands of times if they are handled carefully and under certain radiation exposure conditions. IP handling under industrial conditions often results in damage after a few hundred uses. Mechanical damage such as scratches and abrasions are common, as well as radiation fatigue or imprinting due to high energy applications. An image can be erased by simply exposing the plate to a room-level fluorescent light - but more efficient, complete erasure is required to avoid signal carry-over and artifacts. Most laser scanners automatically erase the IP after laser scanning is complete. The imaging plate can then be re-used. Reusable phosphor plates are environmentally safe but need to be disposed of according to local regulations due to the composition of the phosphor, which contains the heavy metal Barium. .(medscap.com)

2.7.2 Industrial applications:

Common applications for computed radiography include:

corrosion surveys on pipes, often through insulation;

Examination of valves for erosion;

- Information shots on industrial components; e.g. checking to see if a valve is closed properly, or checking for obstructions in valves and pipes;.

- Examination of boiler water walls.

- Automotive casting inspection .

- High pressure braze joint inspection (aerospace) .

- Wax pattern core integrity verification in investment casting foundries.

- Best when used with Se75 for small core piping due to internal scatter created by Ir192's wavelength.

- Code work for Nuclear Applications on all size piping .(medscap.com)

2.7.3. Medical applications:

Computed Radiography systems are the most common in medical applications because they have proven reliability over more than two decades, flexibility to address a variety of clinical applications and lower costs to take multiple exam rooms digital. DR in the form of a portable detector starts at around $65,000, while a basic low volume CR can start as low as $20,000 (but higher volume, hospital-grade applications can be higher.) DR systems are generally sold as a full x-ray room replacements and tied to a single x-ray generator. But are also commonly sold as a DR Panel which simply takes the place of where the cassette is placed. These can be either wireless or teathered. CR IPs can be retrofitted to existing exam rooms and used in multiple x-ray sites since IPs are processed through a CR reader (scanner) that can be shared between multiple exam rooms.(medscape.com)

2.7.4 Limitations of conventional radiology:

Films cannot tolerate a wide range in radiation exposure , One has to chose between good, contrast and good latitude, Image cannot be adjusted once taken, Require space for dark room and film/ storage, chemicals .(medscap.com)

2.7.5 Advantages:

- No silver based film or chemicals are required to process film.

- Reduced film storage costs because images can be stored digitally.

- Computed radiography often requires fewer retakes due to under- or over-exposure which can result in lower overall dose to the patient, if you assume a moderate amount of retakes. CR can require up to 30% less dose than film.

- Image acquisition is much faster - image previews can be available in less than 10 seconds.

- By adjusting image brightness and/or contrast, a wide range of thicknesses may be examined in one exposure, unlike conventional film based radiography, which may require a different exposure or multiple film speeds in one exposure to cover wide thickness range in a component.

- Images can be enhanced digitally to aid in interpretation.

- Images can be stored on disk or transmitted for off-site review.

- Ever growing technology makes the CR more affordable than ever today. With chemicals, dark room storage and staff to organize them, you could own a CR for the same monthly cost while being environmentally conscious, depending upon the size of the radiographic operation. (medscap.com)

2.7.6 Disadvantages:

- In medical applications, manual handling of the cassette housing the IP is considered a disadvantage versus DR but it also offers more flexibility for patient positioning.

- CR is still not an approved method for higher quality radiologic applications (aerospace), due to the possibility of digital manipulation to the captured image, the inherent geometric unsharpness and resultant lower spatial resolution as compared to film (radiographic) images, SNR issues, sensitivity to scattered radiation, and the general lack of procedural consensus among primes .

- There also are no quality (image resolution)standards for general radiography, only for mammography (21 CFR 900.12 (e)), however, competition among manufacturers has raised the bar and newer CR technologies with increased detective quantum efficiency (DQE) and higher spatial resolution have emerged.

- Imaging plates (IPs) are expensive and can be damaged if the system being used requires manual handling of the IPs. Theoretically, IPs may be reused thousands of times, but constant use will always result in damage to the IP and image artifacts, eventually to the point of necessary replacement. (medscape.com)

2.8 Previous study:

-The study done by Ahmet Harma, MD ,etal about The subpubic angle in sex determination: Anthropometric measurements and analyses on Anatolian Caucasians using multidetector computed tomography datasets which aimed to study, the accuracy rate of the subpubic angle in sex and determination was investigated in living Anatolian Caucasians, and the result was that The sub pubic angle was not significantly correlated with age in males ($p = 0.953$), or in females ($r = 0.975$).(Ahmet Harma,et al,2013).

- study done by Robert G. about Variation in pelvic size between males and females. was found that it has been hypothesized that, owing to opposing selection pressures on pelvic morphology in females between efficiency in locomotion and obstetric adequacy, female pelvic morphology is less variable than that in males, The results showed that there were no sexual differences in pelvic variability. Consequently, while males and females are equally variable in the dimensions of the true pelvis, the visual cues that osteologists use to sex pelves are more variable in males.(Robert G Tague et al,2005).

- study done by Beri Ridgeway, about The relationship between anthropometric measurements and the bony pelvis in African American and European American women Which aims   to examine the relationship between anthropometric measurements and the size of the adult female bony pelvis usingThree-dimensional points they use 96 adult female bony pelvises were obtained and the true conjugate, interspinous distance, intertuberous distance, and pelvic inlet and outlet areas were calculated. The relationship between these measurements and height and multiple anthropometric measurements were evaluated using Pearson's correlation coefficient (*r*).The results of the study showed Multiple anthropometric measurements were significantly correlated with the true conjugate and pelvic inlet and outlet areas, but not with the interspinous or intertuberous widths. Height had a greater correlation with pelvic areas than any other anthropometric measure considered, even after controlling for race. There were no significant differences in pelvic areas between races(Beri Ridgeway, et al,2010).

- In addition Metric sex determination from the pelvis in modern Greeks done by M. Steyna, In a study to showed develop discriminant functions which can be used for sex determination on measurements of the pelvis of modern Greeks. A sample of 97 male and 95 female pelves in a skeletal collection housed in Heraklion, Crete, was used. Measurements were taken from the articulated pelvis, single os coxae and the sacrum. Discriminant function formulae for all measurements and various combinations were used in order to assess the degree of sexual dimorphism in various parts of the pelvis, and to make the formulae usable on fragmented remains. For the single os coxae, average accuracies of 79.7–95.4% (79.1–93.5% on cross-validation) were found. The result showed that measurements of the sciatic notch were unreliable and yielded poor results, and it is advisable that this characteristic must only be used as a last resort. Dimensions of the sacrum were not very dimorphic (average accuracy 60.9%), while measurements from the articulated pelvis yielded poorer results than that from single innominate bones. The diameter of the acetabulum was the single most dimorphic characteristic, providing on average 83.9% accuracy when used in isolation, (M. Steyna, 2008).

- study done by M. Yaşar Işcan Assessment of race from the pelvis the study was assessment of human postcranial skeletal remains has been a major concern for forensic and skeletal anthropologists. Materials (N = 400) of the present study are from the Terry Collection and consist of 100 black and white American pelves of both sex with known age and race. Measurements were taken from the articulated pelves. The result showed discriminant function analysis indicate classificatory accuracy may be as high as 88%. Transverse pelvic breadth contributes more to the function than biiliac breadth and antero-posterior height. The females are more easily assessed racially than males. Although a highly reliable classification is produced, the results of the study should be employed with caution, as samples were of questionable nutritional status and of low socioeconomic class(M. Yaşar Işcan 2005).

3.1 Material

3.1.1 Study sampling:

In this study the data were collected from a sample of 44 cases of pelvis demonstrated by conventional x-ray to depict ,measurement the primary data were include the gender, age length ,and weight and BMI. The data were collected from x-ray departments of:

Antalya Medical Center

Al-Nailelan Medical center

Ibn Al hytham

3.1.2 Equipment:

The computed radiography machine used in this study model:

1. Toshiba DS-TA-5Amanufacture in japan
2. Shimadiz R-20J manufacture in japan

3.2 Method

3.2.1 Technique:

The antero-posterior projection is a general image used as a first assessment of the pelvis bones and hip joints.

Position of the patient and cassette:

The patient lies supine and symmetrical on the x-ray tube with the median sagittal plane perpendicular to the tabletop. To avoid pelvic rotation the anterior superior iliac spines mast be equidistant from the tabletop .the limbs are slightly abducted and internally rotated to bring the femoral necks parallel to the cassette. The center of the cassette is placed midway between the upper border of the symphysis pubic and anterior superior iliac spine for the whole of the pelvis and proximal femur. The center in the midline with a vertical central beam. (Clark ,2005).

3.3 Image interpretation

3.3.1 Image evaluation:

All image evaluation by technologist, the evaluated every image from position, Technical factor and processing.

Evaluation criteria of the image for position is two hip joints is clear, upper shaft of the femora, symphasis pubic.

3.3.2 different Pelvic measurements:

Measurement of iliac crest was done by drawing a line between two edge of iliac crest .And ASIS measurement by drawing a line joining the two points.

Measurement of pelvis brim both width and length ; the length a line joining the Promontory of the sacrum to the superior border of symphysis pubic ; width a line joining two sciatic notch.

Measurement of pubic angel was done by drawing a line along the two pubis bone to symphysis pubic.

Image 3-1:show different measurement of the pelvic.

Chapter Four

4. Results

This chapter dealt with the results obtained form 44 Sudanese subjects all were examined using AP projection for pelvis using computed radiography technique, the following lines were selected for characterizing the pelvis dimensions including distant between iliac crests , Line Joining The anterior Superior Iliac Spine(ASIS), brim length, brim width. Distant Between Acetabulum as well as gender, age, weight ,height, body mass index.

Table 4.1 The mean and Standard deviation of the Patient Demographic Data

Variables	Mean	STDV
Age	40.9	±14.8
Weight	66.4	±18.5
Height	160.9	±15.9
BMI	2.6	± 1.1

Table 4.2 The mean and Standard deviation of the Study Variables

Variables	Mean	STDV
Distant Between Iliac Crests	19.9	±3.8
ASIS	29.3	±3.9
Brim Length	13.5	±2.4

Brim Width	13.4	±1.7
Distant Between Acetabulum	14.7	±3.0
Pubic Angle	124.5	±19.7

Table 4.3 The Correlation between the variables and genders

Variables	Gender	P-Value
Distant Between Iliac Crests	Male	0.026
	Females	
ASIS	Male	0.059
	Females	
Brim Length	Male	0.001
	Females	
Brim Width	Male	0.006
	Females	
Distant Between Acetabilum	Male	0.004
	Females	
Pubic Angle	Male	0.000
	Females	
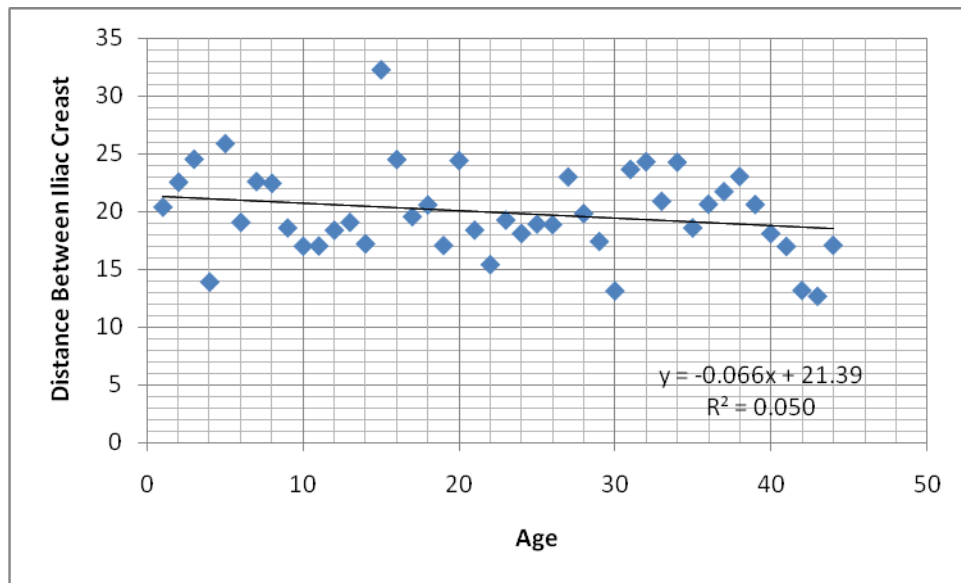
Figure4.1 Scatter plot diagram shows linear relationship between age and Distance between Iliac Crest, as the age increased the distance between iliac crest decreased by 0.066 mm starting from 21.39 /year
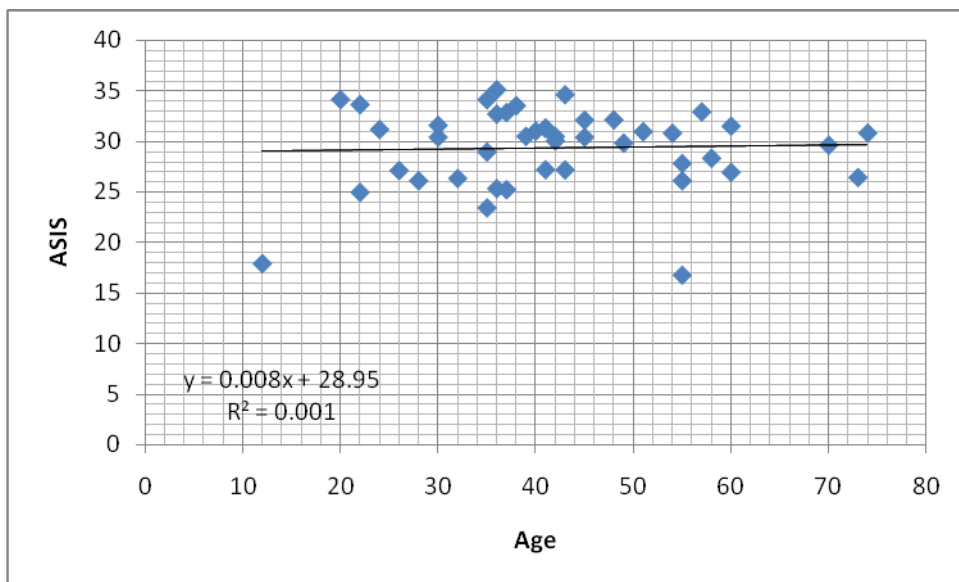
Figure4.2 Scatter plot diagram shows linear relationship between age and Distance between ASIS, as the age increased the distance between ASIS increased by 0.008 mm starting from 28.95 /year
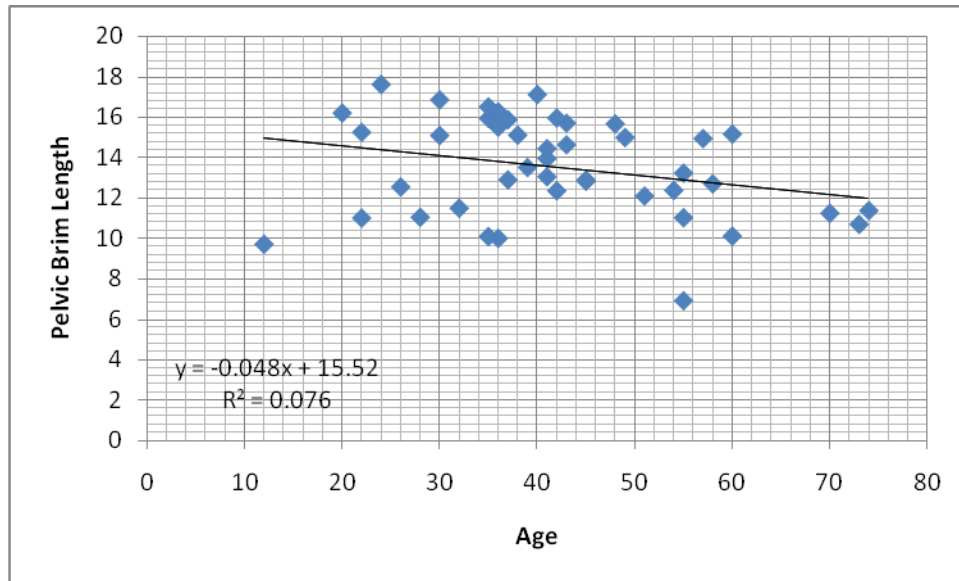

Figure4.3 Scatter plot diagram shows linear relationship between age and pelvic brim length, as the age increased the pelvic brim length decreased by 0.048 mm starting from 15.52 /year
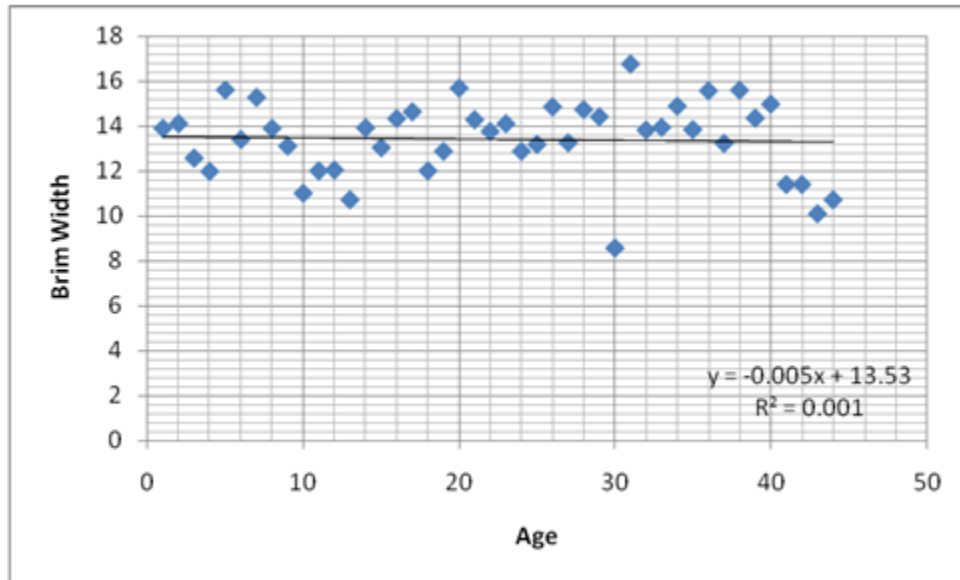
Figure4-4 Scatter plot diagram shows linear relationship between age and brim width, as the age increased the pelvic brim width decreased by 0.oo5 mm starting from 13.53 /year.,
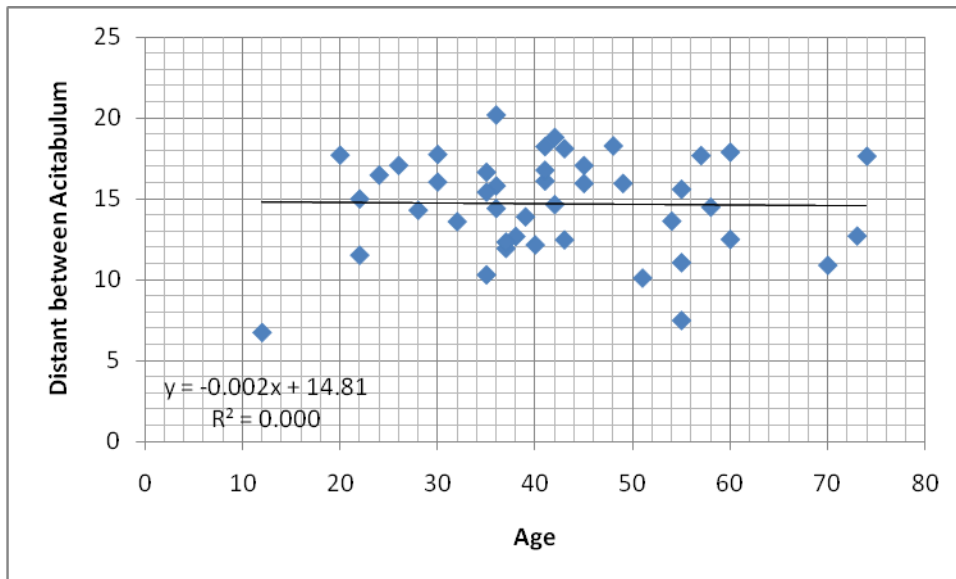

Figure4.5 Scatter plot diagram shows linear relationship between age and Distance between Acetabulum, as the age increased the distance between acetabulum decreased by 0.002 mm starting from 14.81 /year
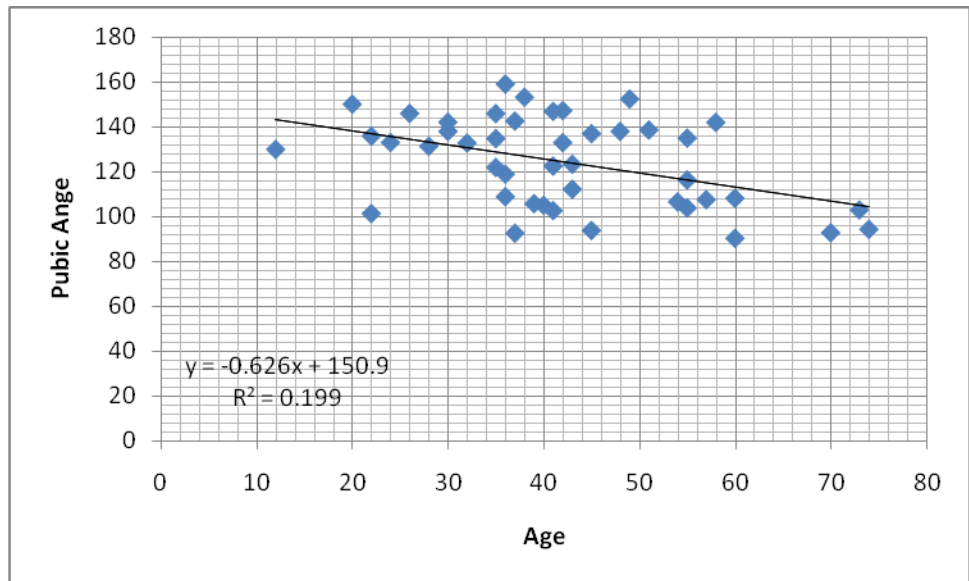
Figure4.6 Scatter plot diagram shows linear relationship between age and pubic angle, as the age increases the distance decrease by 0.626 mm starting from 150.9 /year
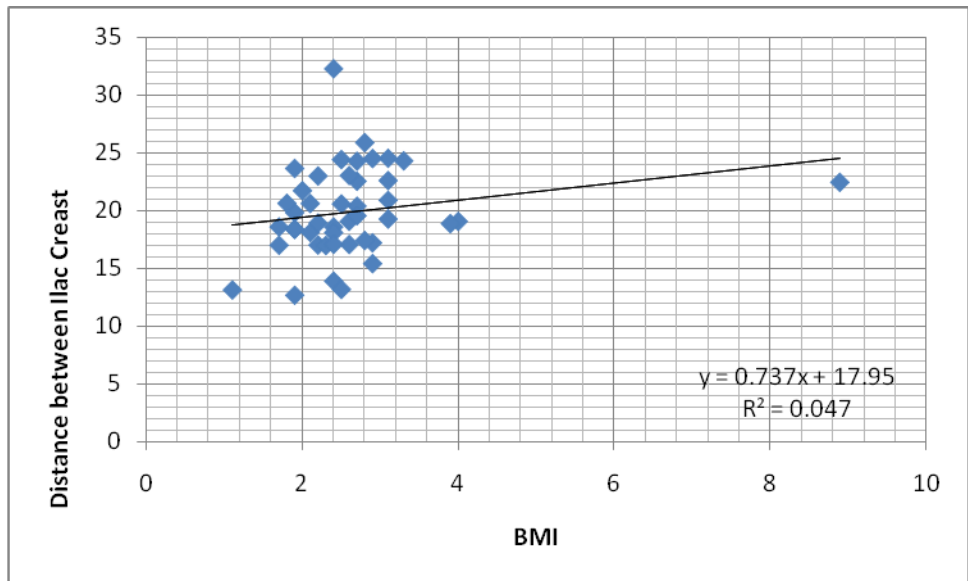
Figure4.7 Scatter plot diagram shows linear relationship between BMI and Distance between Iliac crest, as the BMI increases the distance increased by 0.737 mm starting from 17.95
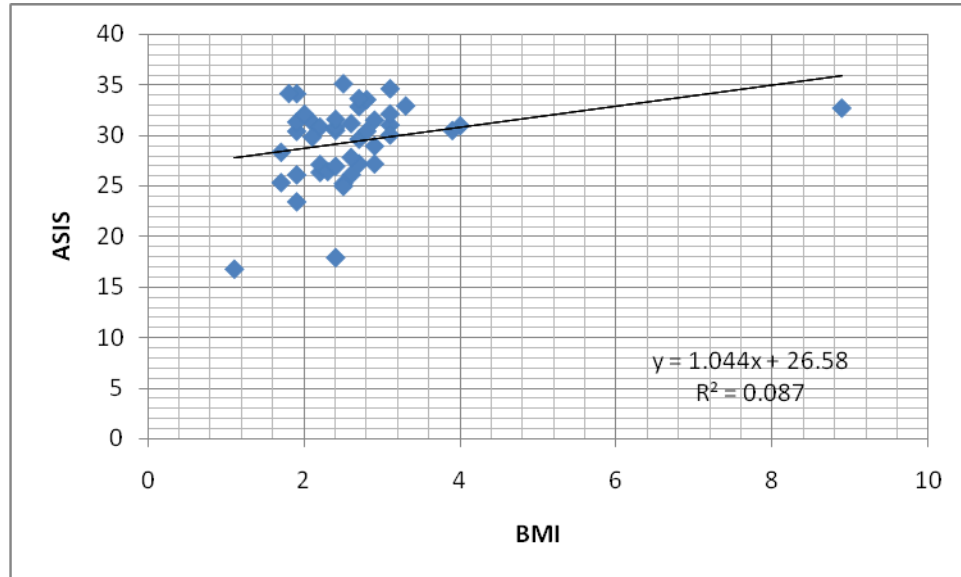

Figure4.8 Scatter plot diagram shows linear relationship between BMI and ASIS, as the BMI increases the distance increased by 1.044 mm starting from 26.58
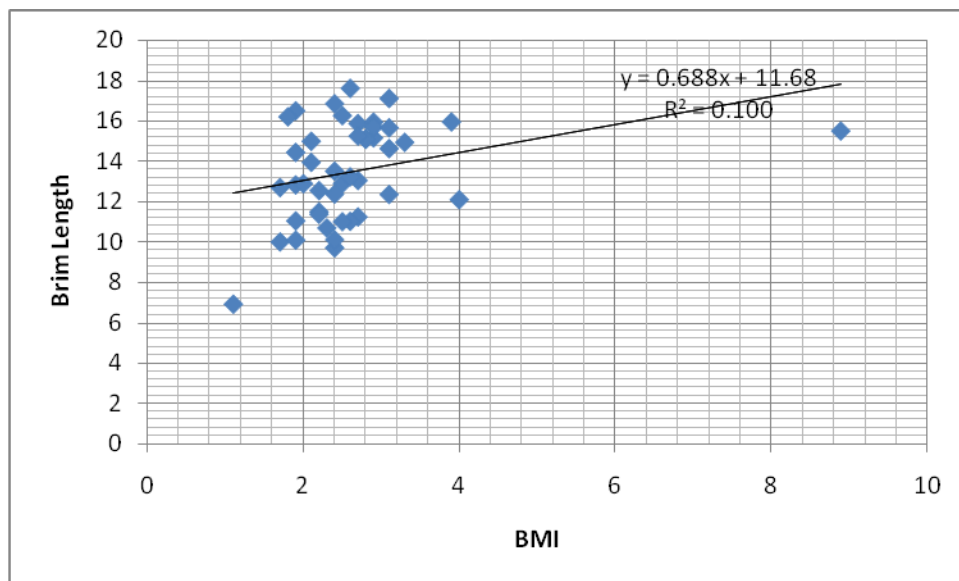
Figure4.9 Scatter plot diagram shows linear relationship between BMI and Brim Length, as the BMI increases the distance increased by 0.688 mm starting from 11.68
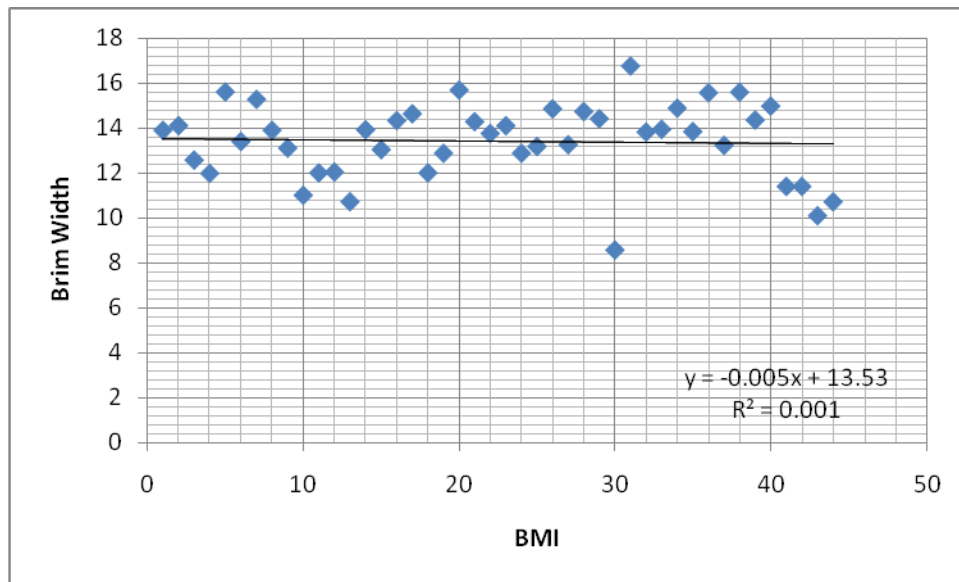

Figure4.10 Scatter plot diagram shows linear relationship between BMI and Brim Width, as the BMI increases the distance decreased by 0.005 mm starting from 13.53
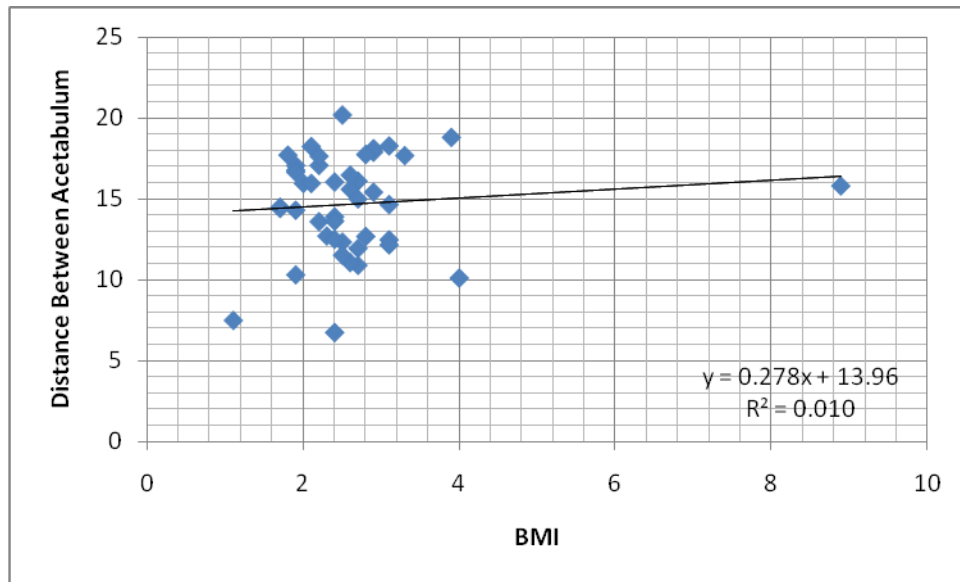
Figure4.11 Scatter plot diagram shows linear relationship between BMI and Distance between acetabulum, as the BMI increases the distance increased by 0.278 mm starting from 13.96
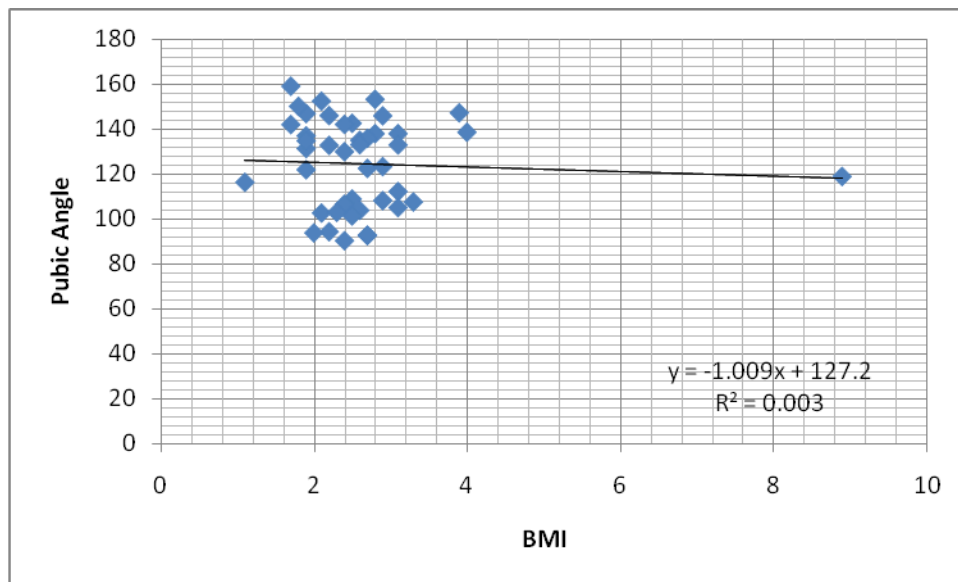
Figure4.12 Scatter plot diagram shows linear relationship between BMI and Pubic angle, as the BMI increases the distance decreased by 1.009 mm starting from 127.2.

5.1 Discussion:

The study we aimed to characterize Sudanese pelvis in order To build an index for Sudanese. To help the anthropologists and radiologist in diagnosing as well as to compere the result with previous study. the results obtained form 44 Sudanese subjects all were examined using AP projection for pelvis using computed radiography technique, the following lines were selected for characterizing the pelvis dimensions including distant between iliac crests , Line Joining The anterior Superior Iliac Spine(ASIS),brim length, brim width Distant Between Acetabulum as well as gender, age, weight ,height.

After applying the correlation between the age , body mass index with distant between iliac crests , Line Joining The anterior Superior Iliac Spine(ASIS),brim length, brim width Distant Between Acetabulum.

(Figure 4.1) shows that there is negative correlation between age and Distance between Iliac Crests; as the age increased the distance between iliac crest decreased by 0.066 mm starting point of regression line was 21.39year (R^2=0.050).And (Figure4.2) shows a positive correlation between age and Distance between ASIS ; as the age increased the distance between ASIS increased by 0.008 mm starting point of regression line was 28.95 /year(R^2=0.001). (Figure4.3) showes a positive correlation between age and pelvic brim length as the age increased the pelvic brim length decreased by 0.048 mm starting point of regression line was 15.52/ year(R^2=0.076). (Figure4-4) shows negative correlation between age and brim width; as the age increased the pelvic brim width decreased by o.oo5 mm starting point of regression line was 13.53 /year (R^2=0.001).

In (Figure4.5) there is positive correlation between age and Distance between Acetabulum as the age increased the distance between acetabulum decreased by 0.002 mm starting point of regression line was 14.81 /year(R^2=0.000). (Figure4.6) shows a noticeable significantly linear relationship between age and pubic angle; as the age increases the distance decrease by 0.626 mm starting point of regression line was 150.9 /year (R^2=0.199) This result's consistent with the result that carried out in The sub pubic angle in sex determination: Anthropometric measurements and analyses on Anatolian Caucasians using multidetector computed tomography datasets by Ahmet Harma, MD, Prof.b, which aimed to study, the accuracy rate of the subpubic angle in sex and determination was investigated in living Anatolian Caucasians, and the result was that The sub pubic angle was not significantly correlated with age in males (p = 0.953), or in females (r = 0.975).(Ahmet Harma,etal,2013) .And (Figure4.7) shows positive correlation between BMI and Distance between Iliac creast; as the BMI increases the distance increased by 0.737 mm starting point of regression line was 17.95 (R^2=0.047).(Figure4.8) shows positive correlation between BMI and ASIS; as the BMI increases the distance increased by 1.044 mm starting point of regression line was 26.58(R^2=0.087) .(Figure4.9) shows positive correlation between BMI and Brim Length; as the BMI increases the distance increased by 0.688 mm starting point of regression line was 11.68(R^2=0.100) . (Figure4.10)shows negative correlation between BMI and Brim Width; as the BMI increases the distance decreased by 0.005 mm starting point of regression line was13.53(R^2=0.001).And (Figure4.11) shows positive correlation between BMI and Distance between acetabulum; as the BMI increases the distance increased by 0.278 mm starting point of regression line was 13.96 (R^2=0.010).

(Figure4.12) shows negative correlation between BMI and Pubic angle; as the BMI increases the distance decreased by 1.009 mm starting point of regression line was 127.2(R^2=0.003).

The diameter of brim was also study previously as found in (medscap.com) . That mention antroposterior diameter, which extend from sacral promontory to upper border of pupic was found to be 11cms . In the measurement it was found to be 13.5cm ± 2.4 cm, also mention transvers diameter which extend between the widest points on the iliopectineal lines was found to be 13cms, at our mesuerment was found to be 13.4cm ±1.7cm

Interspinous distance which extend between the anterior superuior ilic spine 26 cms ,at our mesuerment was found to be 29.3cm ± 3.9 cm.

Intercristal distance which extend Between furthest lateral points of iliac crest
 was found to be 29cm, at our mesuerment was found to be 19.9cm ± 3.8 cm
 that mean the mesuerment of Sudanese is larger than what was mention previously except the Intercristal distance that was less than what was mention previously   .

5.2 Conclusion:

Regarding the measurement the study reveal that Sudanese measurement was larger than what was mentioned   previously. Significant different between males and females were found according to correlation between variable and genders were p-value for iliac crest was 0.026,the anterior superior iliac spine (ASIS) 0.059,brim length 0.001, distant between acetabulam 0.004 , brim width 0.006 and pubic angle 0.000 .

 A *linear relation decreased between age* and brim length, distant between acetabulum, brim width, pubic angel with a decreasing linear relation between age and iliac crest the anterior superior iliac spine (ASIS) .And increasing linear relation between body mass index and iliac crest, the anterior superior iliac spine (ASIS),brim length, distant between acetabulam and decreasing linear relation between body mass index and brim width , pubic angle .

5.3 Recommendations:

1-because the study used a small sample which may reflect limitation of the study, we recommended to increase sample ,compare mainly large group of male and large group of female , classify the sample according to different age groups .

2-we recommended doing another studies using   computer tomography scan.

3-we recommended to do another studies in different Sudanese ethnic group.

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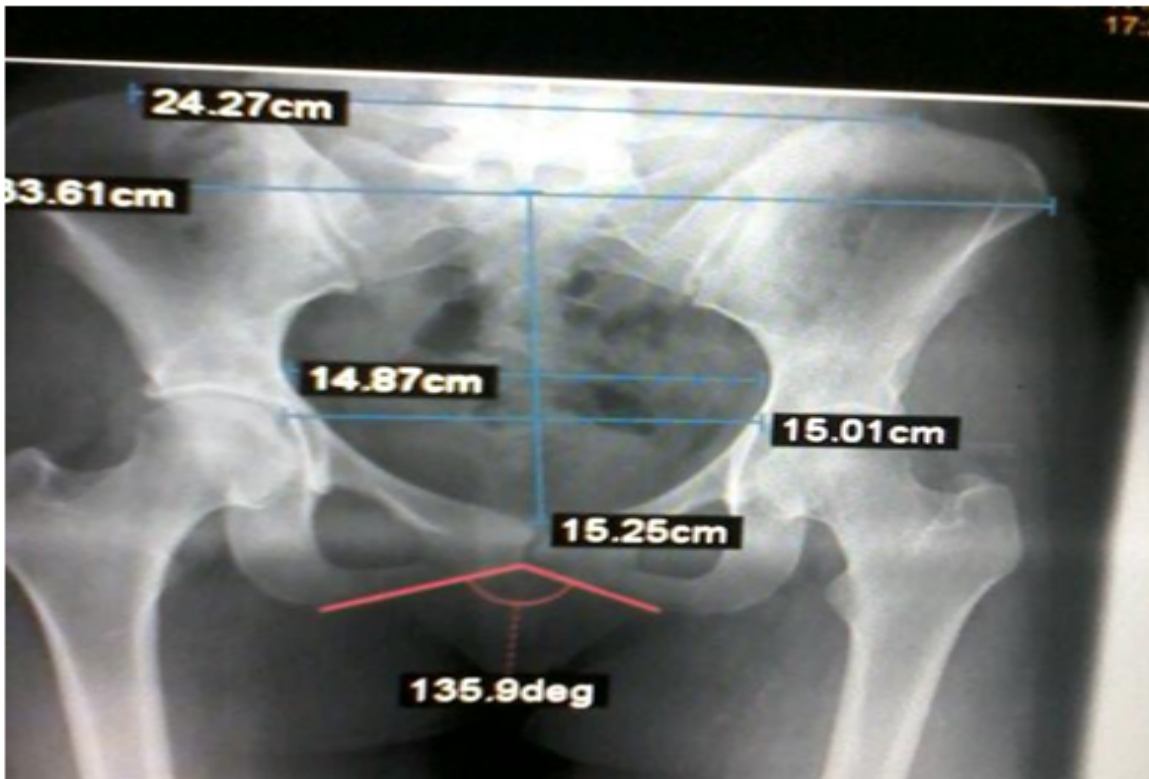
Appendixes

A Anthropoid

B Android

C Gynaecoid

D Platypelloid
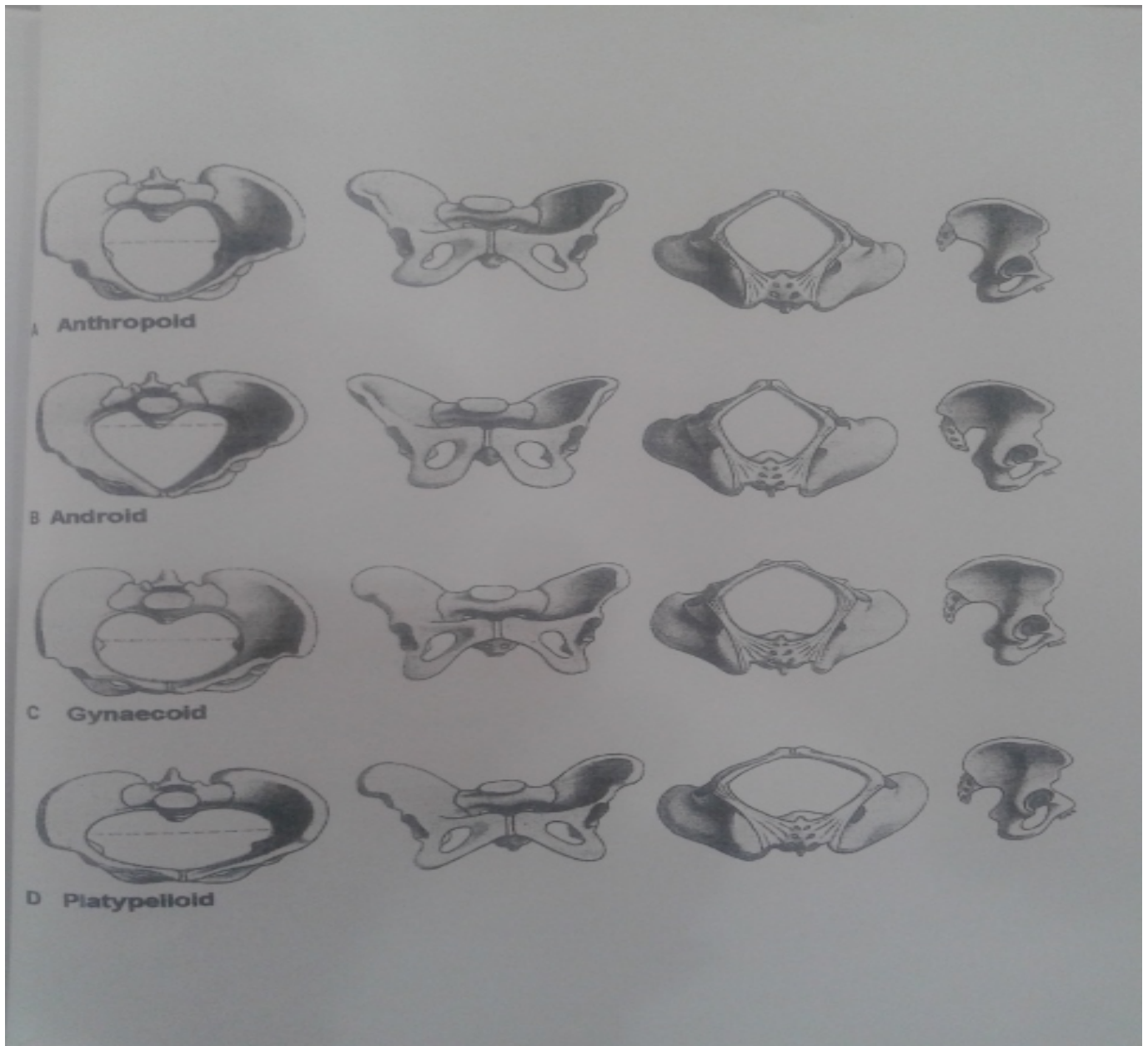
(Figure A -1):show all types of pelvic.(www.google/images.com).

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(Figure A-2):Show the measurement of male pelvic

(Figure A-3) :show measurement of female pelvic.

Master data sheet

Cases of routine x-ray

Pelvic brim	Length								
	Width								
Iliac creast									
Distance between acetabulum									
Asis									
Pupic Angel									
Length									
Wigth									
Age									
Gender									

Pt.No									