Sudan University of science and Technology
College of graduate study

Measurement of Spinal Canal Using Computed Tomography in Sudanese Patients

قياس قناة العمود الفقري لدى السودانيين باستخدام التصوير بالأشعة المقطعية المحوسبة

A thesis Submitted for Partial Fulfillment of the M.Sc Degree in Medical Diagnostic Radiology

Prepared by:

Alaa Babikir Mohammed Masaad Mustafa

Supervisor:

Asmaa Abrahim Ahmed Elameen

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الآيـــــــــــــــة

قال تعالى:

المجادلة الاية :11

Dedication

Dedicated this research to;

My beloved parents for their endess love, support, patience and everything you have done since I was born
And to all who help me to complete this study

Acknowledgement

First and always thank Allah for everything secondly a great thank to Dr Asmaa Ebraheem for her help.
My teacher and our supervisor thirdly a big thanks to all member of Ibn Ealhaitham Diagnostic center and I would like to thanks all those who provide me to do this work

My teachers for their, guidance

Abstract

This descriptive cross sectional study, aimed to measure the normal dimension range of lumber spinal canal in Sudanese population using computed tomography (Toshiba 4 slice in Ibn Elhaitham Diagnostic Center) in Khartoum state during the period from February to August. the study sample include 50 pt (31 male and 19 female)any pt had lumber spine disorder were excluded in order to assess the normal variant between the Sudanese populations.

The study found that the mean of anteroposterior (AP) diameters in fifth lumbar vertebra (L5) spine was (14.24) in male and (14.57) in female. While the mean of transverse diameters of L5 was (15.62) in male and (14.30) in female.

There were no significant differences in anteroposterior (AP) and Transvers diameters according to gender, but the differences are found according to age and weight.

The technologist and specialists should study the normal range of lumbar canal diameter.

Keywords: anteroposterior, transvers diameters, lumbar vertebra and computed tomography

المستخلص

هذه الدراسة الوصفية المقطعية ، تهدف إلى قياس المدى البعد الطبيعي لقناة العمود الفقري لدى السودانيين باستخدام التصوير المقطعي المحوسب (شريحة توشيبا 4 في مركز ابن الهيثم التشخيصي) في ولاية الخرطوم خلال الفترة من فبراير إلى أغسطس. وتشمل عينة الدراسة 50 شخص (31 ذكور و 19 إناث) أي نسبة ضرر تم استبعادها من اضطراب العمود الفقري من أجل تقييم المتغير الطبيعي بين السكان السودانيين.

ووجدت الدراسة أن متوسط القطر الأمامي الخلفي (AP) في العمود الفقري القطني الخامس (L5) كان (14.24) في الذكور و (14.57) في الإناث. بينما كان متوسط القطر المستعرض من 15.62) L5) في الذكور و (14.30) في الإناث.

لم تكن هناك فروق ذات دلالة إحصائية في الأطوار الأمامي (AP) وأقطار Transvers وفقا لنوع الجنس ، ولكن تم العثور على الاختلافات وفقا للعمر والوزن.

يجب أن يدرس المتخصصون والمتخصصون التقنيين النطاق الطبيعي لقطر القناة القطنية.

كلمات البحث: anteroposterior، transvers بأقطار ، فقرة القطني و التصوير المقطعي.

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List of abbreviations

Abbreviation	Full meaning
AP	Anerioposterior
CT	Computed tomography
FOV	Field of view
L1	First lumber vertebrae
L3	Third lumber vertebrae
L4	Fourth lumber vertebrae
L5	Fifth lumber vertebrae
MM	millimeters
MRI	Magnetic resonance imaging
S1	First sacrum vertebrae
SPSS	Statistical package for social science
UEs	

CHAPTER ONE

INTRODUCTION

1-1.Introduction:

Spinal canal refers to the hollow passage formed by the foramen of the vertebrae through which the spinal cord runs. The spinal canal is filled with cerebrospinal fluid that bathes the nerves. The canal originates at the base of the skull and ends at the sacrum. As the spinal cord descends through, nerve roots emerge from holes to each side of the canal and at the end of spinal cord, nerves branch out forming a horse –like tail. A condition called spinal canal stenosis results when the nerve root becomes compressed or choked as it exits the spinal canal due to disk herniation or bone spurs (Int J Health Allied Sci 2015).

Spinal stenosis is caused by narrowing of the spinal canal or neural foramina producing root ischaemia and neurogenic claudication. Stenosis of spinal canal is most often caused by combination of loss of disk space, osteophytes and hypertrophic ligamentum flavum. Not all patients with narrowing develop symptoms. Lumber spinal stenosis, therefor, refers to a clinical syndrome of lower extremity pain caused by mechanical compression on the neural elements or their blood supply (Sudan Med Monit 2014).

Spinal canal measurements are important diagnostic information for many orthopedic and neurological diseases. This study was aimed to determine the normal diameter range of lumber canal by using CT scan in Sudanese patients. The diameter of spinal canal was not significantly correlated with age and gender (Sudan Med Monit 2014).

1-2.Problem of study:

Although spinal stenosis has been recognized for many years as a clinical problem, it has yet to be exactly defined and agreed on narrowing diameter. And that there were no reference measurements of spinal canal diameter for Sudanese population

1-3.General Objective:

To measure the spinal canal using computed tomography in Sudanese patients

1-3-1 Specific Objective:

To determine the normal diameters of spinal canal

To determine if there are differences related to age, weight, and gender

1-4.Overview of study:

This study will fall into five chapters, Chapter one consist of introduction, problem of study, objectives, and overview of study .Chapter two include literature review, Chapter three consist of material and methods, Chapter four includes the presentation of results, Chapter five include the discussions, conclusion, recommendation finally references and appendices.

CHAPTER TWO

LITERATURE REVIEW

2-1. Theoretical background

2.1.1 Anatomy of lumbar spine

The human vertebral column is the backbone or spine, consisting of twenty four articulating vertebrae, and nine fused vertebrae in the sacrum and the coccyx. The vertebrae in the column are separated from each other by intervertebral discs. It houses and protects the spinal cord in its spinal canal. There are normally thirty-three vertebrae; the upper twenty-four are articulating and separated from each other by intervertebral discs, and the lower nine are fused, five in the sacrum and four in the coccyx or tailbone. 3

The articulating vertebras are named according to their region of the spine. There are seven cervical vertebrae, twelve thoracic vertebrae and five lumbar vertebrae. The number of vertebrae in a region can vary but overall the number remains the same. The number of those in the cervical region however is only rarely changed. (Gray, Henary 2009.)

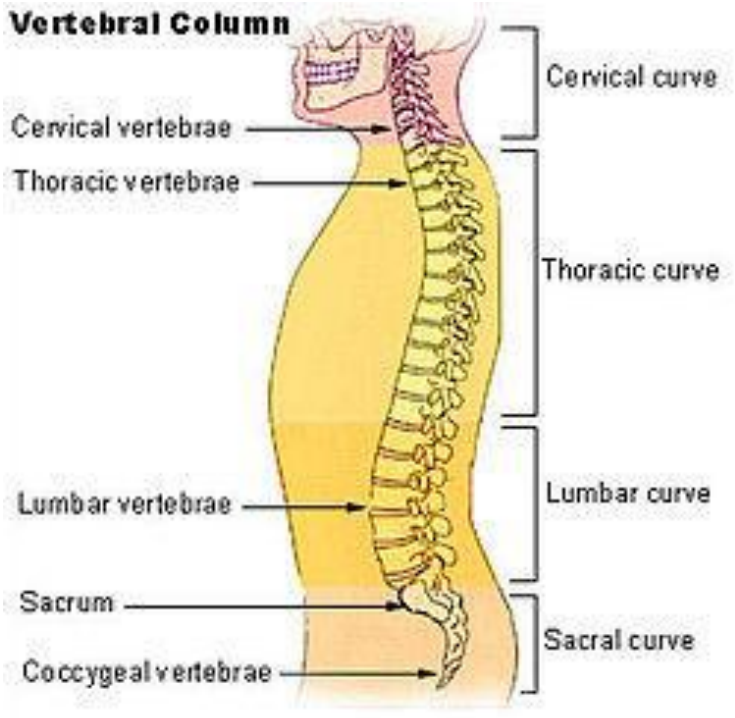

Figure:2.1.1: Anatomy of vertebral column

The human shows the human vertebral column consists of 33 vertebrae. are divided into different regions, which correspond to the curves of the spinal column. These regions are called the cervical spine, thoracic spine, lumbar spine, sacrum and coccyx. There are a total of 33 vertebrae in the vertebral column. The articulating vertebrae are name and five lumbar vertebrae.

The human vertebral column consists of 33 vertebrae. Are divided into different regions, which correspond to the curves of the spinal column. These regions are called the cervical spine, thoracic spine, lumbar spine, sacrum and coccyx. There are a total of 33 vertebrae in the vertebral column. The articulating vertebrae are named according to their region of the spine. There are seven cervical vertebrae, twelve thoracic vertebrae and five lumbar vertebrae. Vertebrae in these are regions essentially alike, with minor variation. The number of vertebrae in a region can vary but overall the number remains the same. The number of those in the cervical region however is only rarely changed Individual vertebrae are named according to their region and position. From top to bottom (Gray's
2012)

2.1.1.1 Shape;

The upper cervical spine has a curve, convex forward, begins at the second cervical vertebra the axis at the apex of the odontoid process known as the dens, and ends at the middle of the second thoracic vertebra; it is the least marked of all the curves. The thoracic curve, concave forward, begins at the middle of the second and ends at the middle of the twelfth thoracic vertebra. Its most prominent point behind corresponds to the spinous process of the seventh thoracic vertebra. (Gray's
2012)

This curve is known as a kyphotic curve the lumbar curve is more marked in the female than in the male; it begins at the middle of the last thoracic vertebra, and ends at the sacrovertebral angle. It is convex interiorly, the convexity of the lower three vertebrae being much greater than that of the upper two. This curve is described as a lordotic curve. (Gray's 2012)

The sacral curve begins at the sacrovertebral articulation, and ends at the point of the coccyx; its concavity is directed downward and forward. The thoracic and sacral curves are termed primary curves, because they are present in the fetus. The cervical and lumbar curves are compensatory or secondary, and are developed after birth. The cervical curve forms when the infant is able to hold up its head (at three or four months) and to sit upright (at nine months). The lumbar curve forms later at twelve or eighteen months, when the child begins to walk. (Gray's 2012)

2.1.1.2 anterior surface:

When viewed from in front, the width of the bodies of the vertebrae is seen to increase from the second cervical to the first thoracic; there is then a slight diminution in the next three vertebrae; below this there is again a gradual and progressive increase in width as low as the sacrovertebral angle. From this point there is a rapid diminution, to the apex of the coccyx (Gray's 1977)

2.1.1.3 Posterior surface;

From behind, the vertebral column presents in the median line the spinous processes. In the cervical region (with the exception of the second and seventh vertebrae) these are short, horizontal and bifid. In the upper part of the thoracic region they are directed obliquely downward; in the middle they are almost vertical, and in the lower part they are nearly horizontal. (Gray's 1977)

In the lumbar region they are nearly horizontal. The spinous processes are separated by considerable intervals in the lumbar region, by narrower intervals in

the neck, and are closely approximated in the middle of the thoracic region. (Gray's 1977).

Occasionally one of these processes deviates a little from the median line which can sometimes be indicative of a fracture or a displacement of the spine. On either side of the spinous processes is the vertebral groove formed by the laminae in the cervical and lumbar regions, where it is shallow, and by the laminae and transverse processes in the thoracic region, where it is deep and broad; these grooves lodge the deep muscles of the back. Lateral to the vertebral grooves are the articular processes, and still more laterally the transverse processes. In the thoracic region, the transverse processes stand backward, on a plane considerably behind that of the same processes in the cervical and lumbar regions. In the cervical region, the transverse processes are placed in front of the articular processes, lateral to the pedicles and between the intervertebral foramina. In the thoracic region they are posterior to the pedicles, intervertebral foramina, and articular processes. In the lumbar region they are in front of the articular processes, but behind the intervertebral foramina (Gray's 2005).

2.1.1.4 Lateral surfaces;

The sides of the vertebral column are separated from the posterior surface by the articular processes in the cervical and lumbar regions, and by the transverse processes in the thoracic region. They present, in back, the sides of the bodies of the vertebrae, marked in the thoracic region by the facets for articulation with the heads of the ribs. More posteriorly are the intervertebral foramina, formed by the juxtaposition of the vertebral notches, oval in shape, smallest in the cervical and upper part of the thoracic regions, and gradually increasing in size to the last lumbar. They transmit the special spinal nerves and are situated between the transverse processes in the cervical region, and in front of them in the thoracic and lumbar region (Gray's 2005).

The vertebral column consists of vertebrae. The vertebrae of the cervical, thoracic and lumbar spines are independent bones, and generally quite similar. The vertebrae of the sacrum and coccyx are usually fused and unable to move independently. Two special vertebrae are the atlas and axis, on which the head rests. A typical vertebra consists of two parts: the vertebral body and the vertebral arch. The vertebral arch is posterior, meaning it faces the back of a person. Together, these enclose the vertebral foramen, which contains the spinal cord. Because the spinal cord ends in the lumbar spine, and the sacrum and coccyx are fused, they do not contain a central foramen (Gray's 2005).

The vertebral arch is formed by a pair of pedicles and a pair of laminae, and supports seven processes, four articular, two transverse, and one spinous, the latter also being known as the neural spine. Two transverse processes and one spinous process are posterior to (behind) the vertebral body. The spinous process comes out the back, one transverse process comes out the left, and one on the right. The spinous processes of the cervical and lumbar regions can be felt through the skin (Gray's 2005).

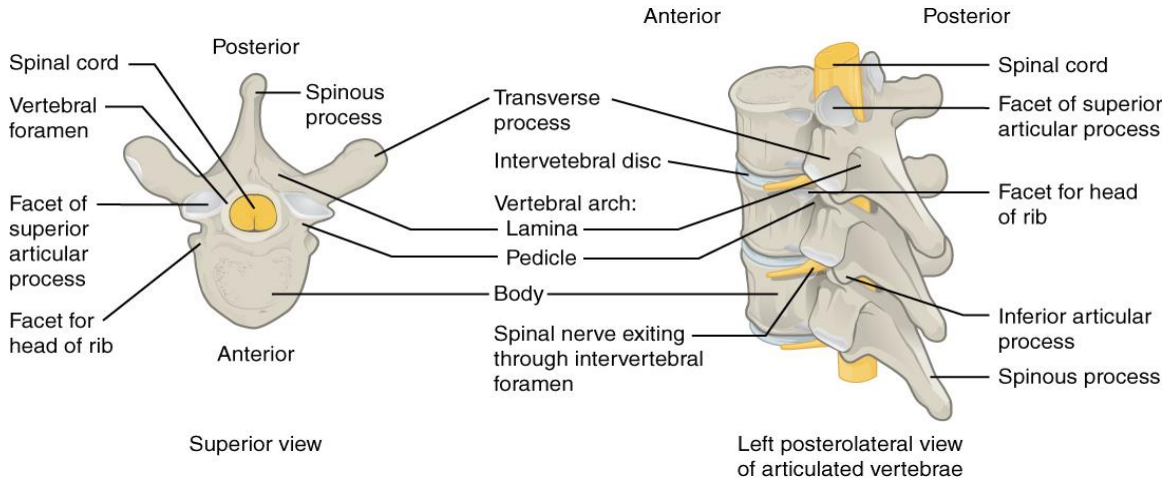

Figure2.1.2: Anatomy of vertebra

Above and below each vertebra are joints called Zygapophyseal joints. These restrict the range of movement possible, and are joined by a thin portion of the neural arch called the pars interarticularis. In between each pair of vertebrae are two small holes called intervertebral foramina. The spinal nerves leave the spinal cord through these holes. (Gray's 2005).

2.1.1.5 Muscles;

Ligaments and tendons are fibrous bands of connective tissue that attach to bone. Ligaments connect two or more bones together and help stabilize joints. Tendons attach muscle to bone. Tendons vary in size and are somewhat elastic and attach bones to muscles. (Gray's 2005).

2.1.1.6 A Ligaments;

The system of ligaments in the vertebral column, combined with the tendons and muscles, provides a natural brace to help protect the spine from injury. Ligaments aid in joint stability during rest and movement and help prevent injury from hyperextensin and hyper flexion (excessive movements). (Gray's 2005).

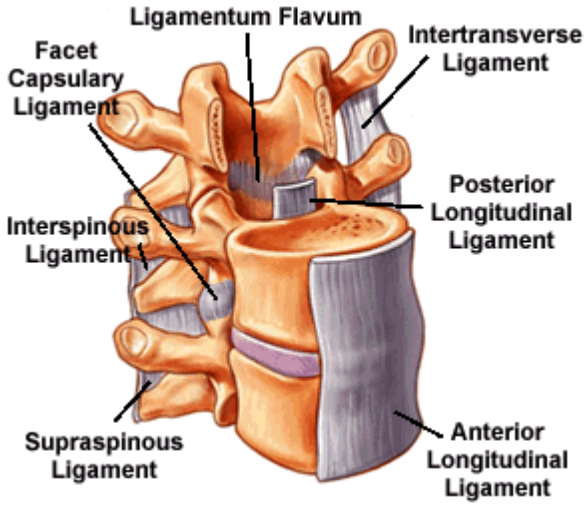

Figure2.1.3: shows the vertebral ligament (Gray's 2005).

2.1.1.7 Tendons and Muscles;

Tendons are similar to ligaments, except these tension-withstanding fibrous tissues attach muscle to bone. Tendons consist of densely packed collagen fibers. Muscles, either individually or in groups, are supported by fascia. Fascia is strong sheath-like connective tissue. The tendon that attaches muscle to bone is part of the fascia. (Gray's 2005).

The muscular system of the spine is complex, with several different muscles playing important roles. The primary function of the muscles is to support and stabilize the spine. Specific muscles are associated with movement of parts of the anatomy. For example, the Sternocleidomastoid muscle (neck area) assists with movement of the head, while the Psoas Major muscle (low back area) is associated with flexion of the thigh. The muscles in the vertebral column serve to flex, rotate, or extend the spine. (Gray's 2005).

2.1.1.8 Vasculature;

The abdominal aorta follows the left side of the spine until L4, where it bifurcates into the left and right common iliac arteries. The femoral arteries arise from the common iliac arteries. The middle sacral artery, iliolumbar artery, and internal iliac artery supply blood to L5 and the sacrum. Segmental arteries branch off the aorta and supply the vertebral body, posterior elements, and paraspinal muscles of the lumbar spine. Near the posterior wall of the vertebrae, each segmental artery bifurcates into a posterior branch and spinal branch. The spinal branch enters the vertebral canal through the intervertebral foramen and supplies portions of the posterior vertebral body. It joins other spinal branches at other levels to form the anterior spinal artery. The anterior spinal artery supplies the anterior two-thirds of the spinal cord. Segmental veins drain into the inferior vena cava, which originates at the convergence of the left and right common iliac

veins at the L4 level The inferiorvena cava terminates in the right atrium of the hear (Becske & Nelson ,2009).

2.1.2 Physiology:

The function of spinal column include supporting the majority of body weight, supporting the head, trunk, and UEs against the forces of gravity, protection of the spinal cord, shock absorption , providing a stable structure by we can maintain an upright posture.

Functional pillars that assist spine functionality , antrerior pillar : vertebral bodies and intervebral disks provide hydraulics , weight bearing ability and shock – absorption , posterior pillar : consists of articular processes facet joints , transverse processes , and spinous processes , this allows spinal movement and serves as the attachment for posterior musculature .

2.1.2.1Spine mobility:

Flexion: Occurs in the sagittal plane. Anterior portion of the vertebral bodies approximate and the spinous processes separate.

Extension: Occurs in the sagittal plane. Anterior portion of the vertebral bodies separate and the spinous processes approximate

Lateral flexion: Occurs in the frontal plane. The body of vertebra will rotate towards the side in which the person is moving as the spinous process moves towards the opposite side

Shear: Occurs in sagittal, frontal and transvers plane. When the body of the superior vertebra translate over the body of the inferior vertebra Distraction/compression:

2.1.3 Computed Tomography

The basic principle behind CT is that the internal structure of an object can be reconstructed from multiple projections of the object. The patient lies on the table within the CT gantry, which is shaped like a giant donut. During each slice acquisition, an X-ray tube circling the patient produces an X-ray beam that

passes through the patient and is absorbed by a ring of detectors surrounding the patient (Fig. 1.2). The intensity of the X-ray beam that reaches the detectors is dependent on the absorption characteristics of the tissues it passes through. Since the beam is moving around the patient, each tissue will be exposed from multiple direction (step by step CT scan first edition 2005)

Using a process called Fourier analysis, the computer uses the information obtained from the different amounts of X-ray absorption to reconstruct the density and position of the different structures contained within each slice. A thin cross-section of the human body, or a tomographic slice, can be reconstructed from images, or projections, taken from multiple angles around the human body.

CT images show a radiographic difference in the various soft tissues and structures forming the human body. Projections are obtained by passing an X-ray beam through the object at different angles and measuring the transmitted radiation. Then, the internal structure of an object can be reconstructed by adding multiple projections of the object: X-rays passing through a body section are attenuated at different rates by different tissues. (step by step CT scan first edition 2005)

2.1.3.1 System Components of CT scanner:

Three main components are—gantry, assembly computer and operating console.

Hardware Consideration: X-ray tube, Collimators Detectors—Scintillation crystals and Xenon gas ionisation chambers. (step by step CT scan first edition 2005)

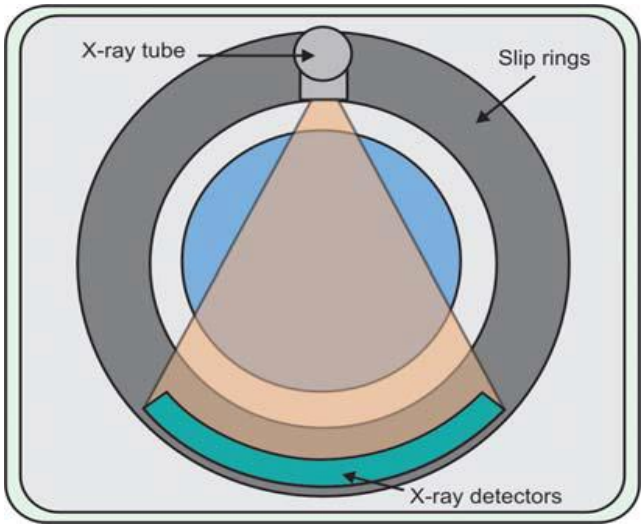

Figure2.1.4: *Schematic diagram showing the CT scan gantry assembly*

(step by step CT scan first edition 2005)

2-2 Previous study:

Yasir A Elhassan,etal (2014) were studied Sagittal diameter of the lumbosacral spinal canal in normal (asymptomatic) adult Sudanese population **.** This study aims to determine the normal Anteroposterior diameter of the spinal canal in lumbosacral region among the adult Sudanese population using the MRI and to determine whether there are any differences related to age, sex and race regarding this diameter. MRI measurements were performed for 142 normal Sudanese subjects to study the lumbosacral region. The data was collected through check list, analyzed by SPSS. The majority of the participants were male (57%), young between 20and 28 years of age with mean height 168cm and mean weight 66 kilogram. The results showed that the longest mean AP diameter was at L1 (17.5±2.0mm) in male while (18.1±2.7) in female. The shortest mean AP diameter was at S1 (15.9±3.2mm) in male and (15.4±3.2) in female. The AP diameter gradually decreased from L1 to S1.there is no significant difference

between both sexes. There is significant difference between people live in different zones. There is association between age, height and weight and the AP canal diameter. Two study groups were studied, the symptomatic LCS group, consisted of 30 individuals of either sex in age group of 45-65 years. Dimensions of lumbar canal at all the levels (L1-L5) of lumbar vertebra of 60 patients were measured .Critical canal dimension were found to be 11.13 mm.

Mehmaz Mashoufi et al (2010) was studied The Evaluation of Lumbar Spinal Canal Diameters by MRI.The aim of this study is to evaluate lumbar spinal canal diameters and relationship with gender, age, stature, weight and job. The results showed that at least anteroposterior diameter was at the third lumbar vertebra but the narrowest transverse diameter was at the first lumbar vertebra. The mean anteroposterior diameter of the lumbar spinal canal decreased from the first to the third lumbar vertebra, followed by an increase from the third to the fifth. From the first to the fifth lumbar vertebra, there was an increase in the mean transverse diameters. The mean transverse diameter in the middle part of the vertebra is longer than the lower part

Dae Moo Shim,etal (2008) were studied Analysis and Measurement of the Lumbar Spinal Canal Dimension using Magnetic Resonance Imaging The purpose of this study is to determine reference values of the spinal canal dimension in a population of normal Korea subjects and to evaluate other measurement methods of the spinal canal dimension that correlate to normal spinal canal dimensions determined using Magnetic Resonance Imaging (MRI) were studied 100 patients who had mild symptoms and had normal MRI findings from 2475 outpatients that had undergone lumbar MRI from November 2002 to May 2004. The dimension of the spinal canal and dural sac was measured at the center of intervertebral discs L3/4, L4/5 and L5/S1.

The dimension of the spinal canal and vertebral body was measured and was compared at the transverse plane perpendicular to the spinal canal that transected

L4, L5 and the S1 pedicle .The results for the sequence of L3/4, L4/5 and L5/S1, the mean spinal canal dimensions were 249.38±38.30 mm2, 253.04±48.62 mm2 and 288.46±57.62 mm2, respectively. For the sequence of L4, L5 and S1, the mean spinal canal dimensions were 279.78±42.36 mm2, 301.50±54.26 mm2 and 355.10±60.65 mm2, respectively. The correlation coefficient was high at 0.913 for the L3/4 and L4 interpedicular transverse plane. The correlation coefficient for L4/5 and L5 was 0.905, and the correlation coefficient for L5/S1 and S1 was 0.845 .

Raheeq Faisal etal (2017) were study the normal lumber spinal canal dimention by using MRI in 200 sudanes population 109 male and 91 female. The study found that the longest mean AP diameter was ay L1 (17.9 ± 2.0mm) in male while (17.9± 2.7) in female. The shortest mean AP diameter was at S1 (15.9± 3.3) in male and (15.5 ±3.1) in female. The AP diameter gradually decreased from L1 to S1 . There was no significant statistical difference between both gender. There were significant statistical differences exist between AP canal diameter with age and weight of the study sample. This standardiza□on measurement was made at level L1 to S1, The technologist should know the normal range of spinal canal diameter by seminars and training to correct image interpretation.

CHAPTER THREE MATERIALS AND METHODS

Chapter Three

Materials and Methods

3.1 Materials.

3.1.1. Study Design;

This study was retrospective descriptive cross-sectional analytical study. All measurement was done in Ibn ELHaytham Diagnostic Center

3.1.2. Area of study

Khartoum state at Ibn ELHaytham Diagnostic Center

3.1.3. Duration of study

From February 2018 to August 2018

3.1.4. Inclusion criteria

All patients come to department for CT lumber

3.1.5. Exclusion criteria

Pregnant female, patient under 18 years, patient up to 70 years and known case of spinal fracture

3.1.6. Machines used

TOSHEBA CT machine 4 slice.

3.2. Methods

3.2.1. Technique

3.2.1.1 Patient preparation, protocol and technique

All metallic object should be removed. Use sedation or sedation or anesthesia (no motion during scan).

Pt lies in supine position feet first the land mark is xiphoid process .the CT investigation protocol initially involves a lateral scout in lumber spine area in order to center the axial sections of spine, axial sections are then angled to the direction of intervertebral disk.in case trauma or imaging of numbers of vertebrae set of stacked axial images are then obtained using relatively thin section width and without space between the sections, this will enable multiplanar reconstruction to be performed .in the lumber spin area it is possible to use

Slice thickness up to 5mm. the data postprocessing FOV must be of 15 or 18 cm in order to be able to visualize the spinal column as well as the perivertebral structures. Larger postprocessing FOVs are used for studying the surrounding tissues especially when the clinical situation or trauma dynamic suggest injuries of these organs. Thicker slice will not reveal fracture for other types of injury due to the partial effect. The use of thin (2mm) slice or isotopic voxel makes it possible. The acquisition field of view (FOV) must be wide enough to cover the entire volume being examined (35or 50 cm) in lumber spine.

3.2.2. Data collection :

Using data collection sheet

3.2.3. Data analysis

Data were first summarized into master data sheet then analayzed by SPSS program and then used Microsoft excel (variables using descriptive table, frequency, percentage distribution tables, cross tabulation) for data presentation

3.2.4. Ethical considerations:

Verbal concept was taken from the patient to be included in this study.

CHAPTER FOUR

THE RESULTS

4. The Results

Table (4.1.1) Gender Distribution, frequency and percentage

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	31	62.0	62.0	62.0
	Female	19	38.0	38.0	100.0
	Total	50	100.0	100.0	

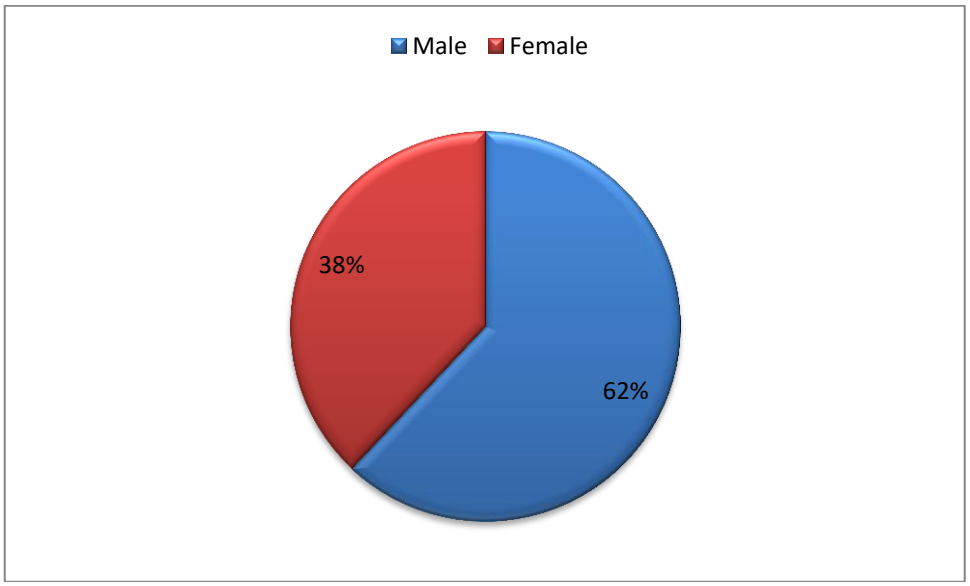

Figure 4.1.5: Gender distribution

Table: 4.1.2 Showed age distribution frequency and percentage

Age	Frequency	Percentage
1-20	4	8%
21-40	17	34%
41-60	23	46%
61-80	6	12%

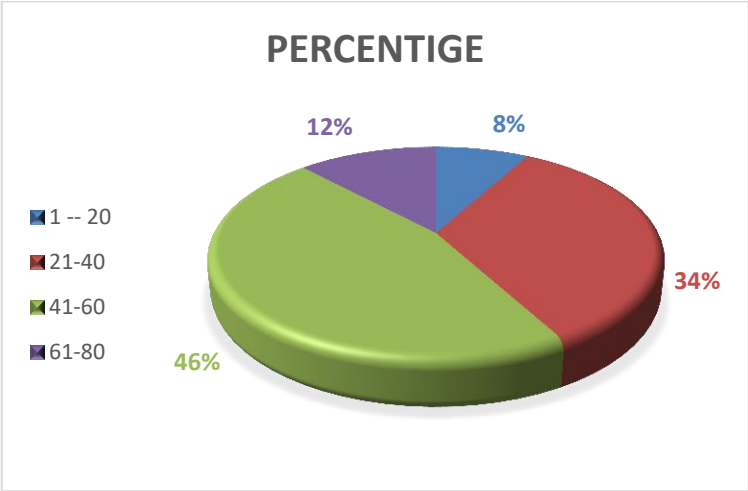

Figure 4.1.6: Diagram of age distribution in percentage

Table4.1.3: Showed weight distribution frequency and percentage

Weight	Frequency	Percentage
40-60	11	11.22%
61-80	22	22.44%
61-80	17	17.34%

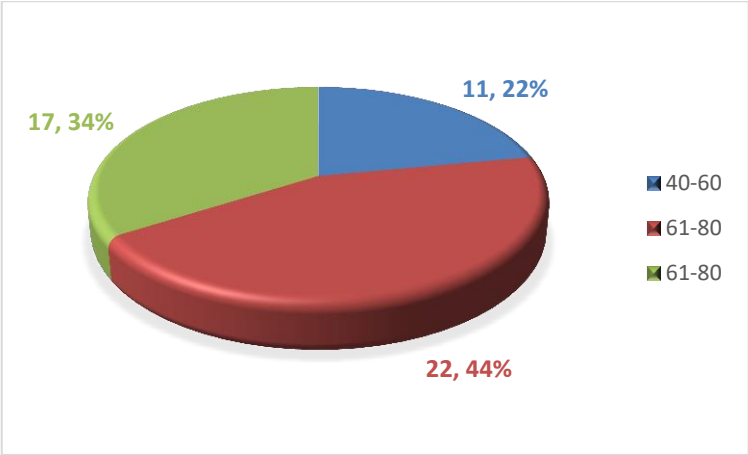

Figure 4.1.7: Diagram of weight distribution in percentage

Table : 4.1.4 Age, weight, AP Diameter and transverse diameter measurements for gender, means and standard deviation.

Variables	Gender	Mean	Std. Deviation
Age	Male	43.47	14.88
	Female	43.8	10.83
Weight	Male	73.8	12.30
	Female	76.15	12.79
AP Diameter	Male	14.24	3.04
	Female	14.57	3.22
Transverse Diameter	Male	15.62	2.50
	Female	14.30	2.90

Table :4.1.5 AP diameter of L5 spine measurements according to the age

Age/ years	AP diameter /cm
1 – 20	13.45±0.7
21-40	14.20±2.1
41-60	14.75±3.08
61-80	13.85±5.6

Table:4.1.6 transverse of L5 spine measurements according to the age

Age/ years	Transverse diameter /cm
1 – 20	13.75±6.4
21-40	14.59±2.6
41-60	15.59±2.5
61-80	15.93±3.09

Table :4.1.7 AP diameter of L5 spine measurements according to the patient weight

Weight/kg	AP diameter/cm
40-60	15.12±2.2
61-80	14.41±3.4
81 -100	13.95±3.3

Table:4.1.8 transverse diameter of L5 spine measurements According to the patient weight

Weight/kg	Transverse diameter/cm
40-60	15.5±3.3
61-80	14.63±2.7
81 -100	15.17±2.27

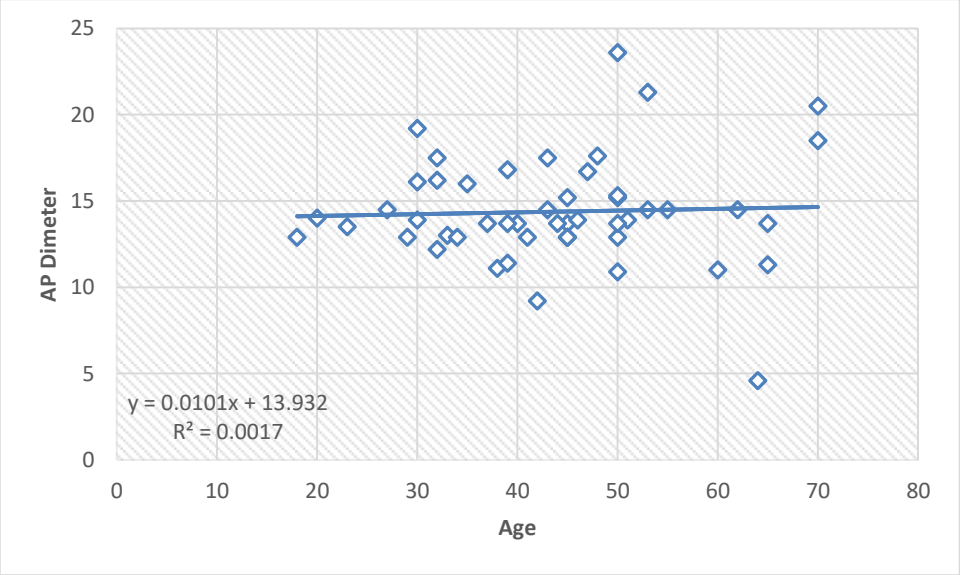

Figure 4.1.8: showed the relation between the age and AP diameter of L5spine

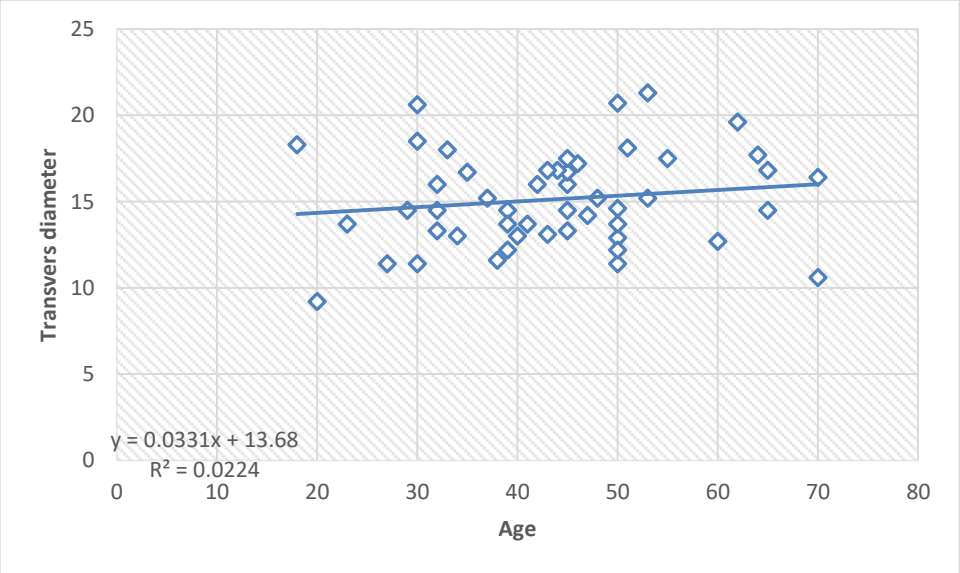

Figure4.1.9: showed the relation between the age and transverse diameter of L5 spine

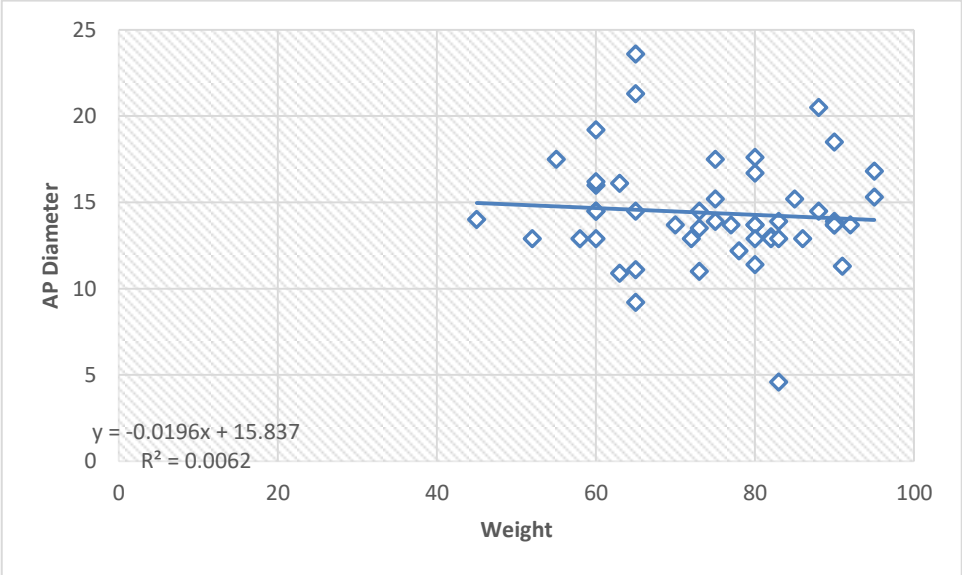

Figure 4.1.10: showed the relation between the weight and AP diameter of L5spine

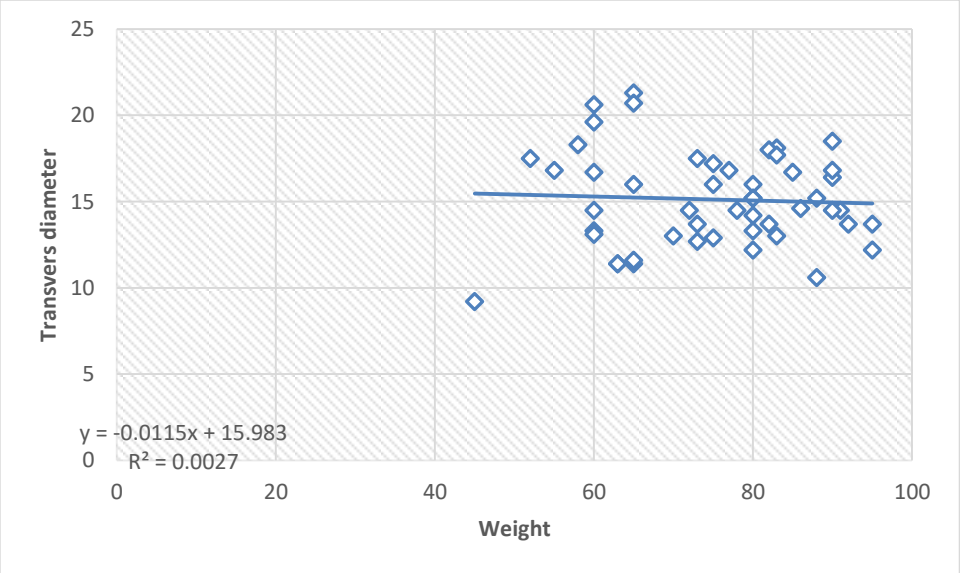

Figure 4.1.11: showed the relation between the weight and transvers diameter of L5 spine.

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 Discussion:

Accurate anatomic descriptions of vertebral anatomy are necessary for the diagnosis of various spinal diseases. In this study, CT was used. To make lumbosacral canal measurement in Sudanese pt. All measurements was done in the axial sections of the vertebrae allowed the best view for studying the normal morphology of the vertebra. Table and figure (4.1.1) show the gender distribution among the study sample as 31 (62%) in male and 19(38%) in female. Table and figure (4.1.2) showed the age distribution frequency and percentage. table and figure (4.1.3) showed the weight distribution in both male and female. Table (4.1.4) showed the mean and stander devation of age, weight AP and transvers diameters according to gender. Table (4.1.5) and (4.1.6) showed the AP Transvers diameters of L5 according the group

The mean of AP diameter in this study was (14.57) in female, (14.24) in male this measurements is agree with (Y.M.Alhasan, 2014) and (Raheeq, 2017) who do their study in whole lumber spine vertebrae and they found that the AP and Transvers measurements of spin are slightly decrease from L1 to S1 in both male and female While the transvers diameters mean was(15.62) in male and(14.30) female. The last tables (4.1.7) and (4.1.8) also showed the AP and Transvers diameters of L5 according to the weight. Fig (4.1.8) show relation between age and AP diameter of lumbar vertebrae, the scatter diagram shown, AP diameter increased slightly with increasing of age (y=0.01, R2=0.0017) because the specific age effects

Fig (4.1.9) show relation between transverse diameter and age, the transverse diameter, increased linearly with age groups (y=0.03, R2=0.022), because the specific age effects also

Fig (4.1.10) show relation between weight and AP diameter of fifth lumbar vertebrae, the scatter diagram shown, AP diameter decrease slightly with increasing of patient weight

(y=-0.019, R2=0.0062) Fig (4.1.11) show relation between transverse diameter and weight, the transverse diameter, decrease slightly with increasing of patient weight (y=-0.0115, R2=0.0027). This results are different to study of MehmMzhoufi that said there was no relation with weight but similar to study of Yasirelhasan and Raheeq Faisal.

5.2 Conclusion:

The study concluded that the mean of AP diameters of L5 was (14.24) in male and (14.57) in female while the mean of transvers diameters of L5 was (15.62) in male and (14.30) in female

Also I found that there is no significant differences in AP and Transvers diameters according to gender. But the differences are found according to age and weight.

5.3 Recommendations:

The study recommends the following:

The technologist and specialists should study the normal range of lumbar canal diameter.

For other researchers can use more other variables such like height and life style.

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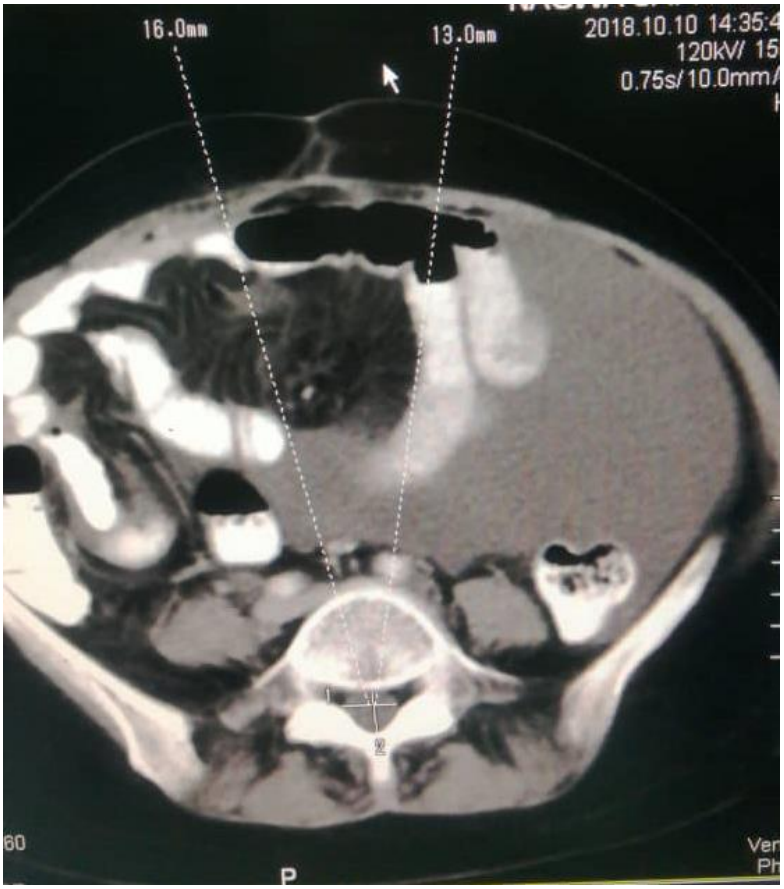
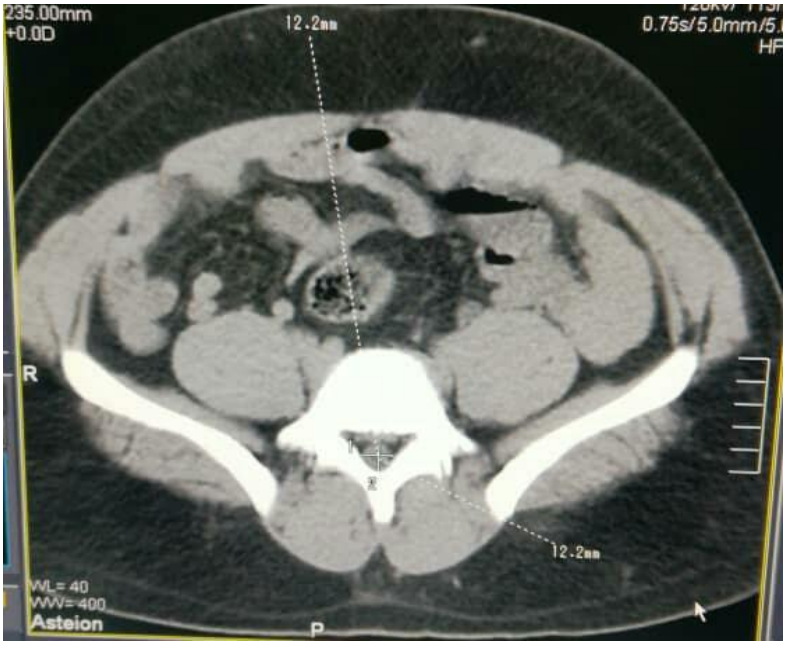
Appendices

Appendix (A)

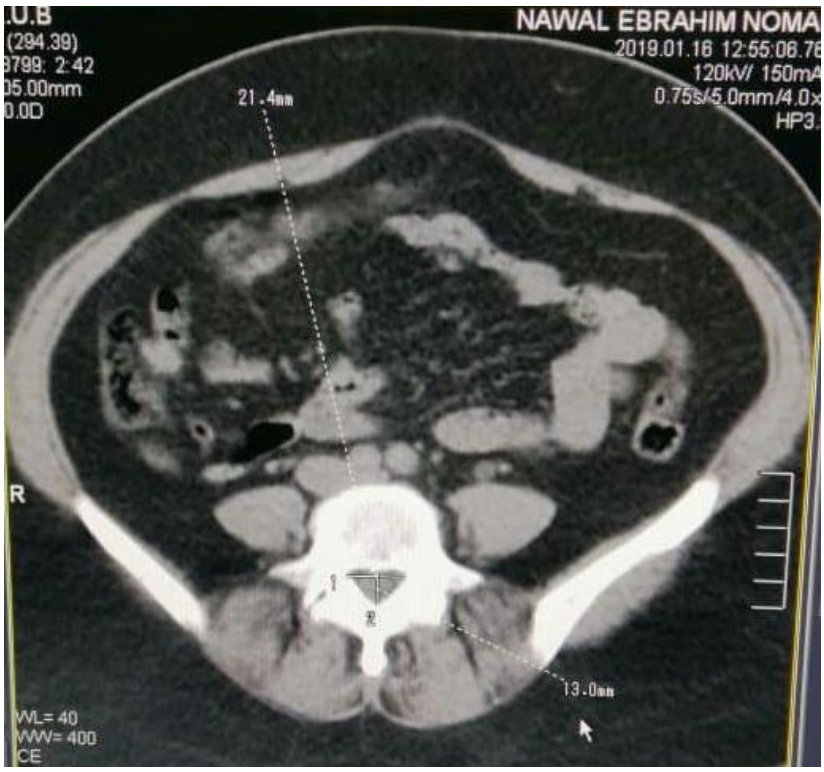
A 37 years old male 70 KG .the AP diameter was 16.8mm and the transvers was 18.5mm.



A 45 years old female 88 KG. the AP diameter was 16mm and the transvers was 13mm



A 45 years old male 82KG the AP dimeter was 12.2mm and trnsvers was 12.2mm



A 45yers old female 78KG the AP dimeter was 21.4mm and the transvers was 13.00mm.

Appendix (B):

Chart of data collection

Title:

……

Data collection sheet

No	Age	Gender	Pt wieght	Foramen size