Chapter One

1-1 Introduction

The size of the spinal canal has attracted increasing interest since Scheslinger and TaVeras (1953) an Verbiest (1954, 1955) described some of the effects of the narrow canal. The bony canal, however, is not easy to measure, especially in the clinically most significant midsagittal diameter. Rothman and Simeone (1975) state that it can only be measured accurately by direct measurement at operation. Jones and Thomson (1968) and Eisenstein (1977) have described methods of measuring the midsagittal diameter from a lateral radiograph, but in practice this is not always easy . Myelography is probably the best method of demonstrating the constraint the canal places upon its contents, but its limitations have been well documented by Ehni (1969), Williams (1975), Jacobson (1976) and Mclvor and Kirkaidy-Willis (1976). There can be significant reduction in the cross-sectional area of the canal from exaggeration of the trefoil shape, with an R. W. Porter, F.R.C.S., Consultant Orthopaedic Surgeon Ms Margaret Wicks, Research Assistant David Ottewell, B.Sc., apparently adequate anteroposterior and lateral dia- meter. This oblique narrowing may not be recognised by myelography. Sheldon, Sersiand and Leborgne (1977) have shown that computed transverse axial tomography will demonstrate this . bony enhancement .This paper presents a method of measuring the axial lumbar spinal canal by CT scan It is simple, safe and has a high degree of accuracy (Wong DA et al , 2007).

MRI, US & CT scan reused to measure the spinal canal .

1-2 Statement of Problem:

Lack of previous studies about normal measurements of lumbar spinal canal.

1-3 Objectives

1-3-1 The general objectives of this study to determine normal range of lumbar spinal canal in Sudanese population.

1-3-2 Specific objectives

- To determine the mean values of normal lumbar spinal canal diameter.
- To determine the effect of age in lumbar spinal canal measurement.

1-4 significance of the study:

This study will provide information about measurement of lumbar spinal canal measurements.

1-5 Overview of the study:

The research contains five chapters:

Chapter one: include introduction, statement of problem, objectives, significant of the study and overview of the study.

Chapter two: include lumbar spine anatomy, lumbar spine stenosis, diagnosis of lumbar spinal stenosis and literature review.

Chapter three: material and methods.

Chapter four: include results of the study.

Chapter five: include discussion, conclusion and recommendations.

CHAPTER TWO

2- 1 **Anatomy**

The lumbar spine consists of 5 moveable vertebrae numbered L1-L5. The complex anatomy of the lumbar spine is a remarkable combination of these strong vertebrae, multiple bony elements linked by joint capsules, and flexible ligaments/tendons, large muscles, and highly sensitive nerves. It also has a complicated innervation and vascular supply.(Drake R, 2009).

The lumbar spine is designed to be incredibly strong, protecting the highly sensitive spinal cord and spinal nerve roots. At the same time, it is highly flexible, providing for mobility in many different planes including flexion, extension, side bending, and rotation.

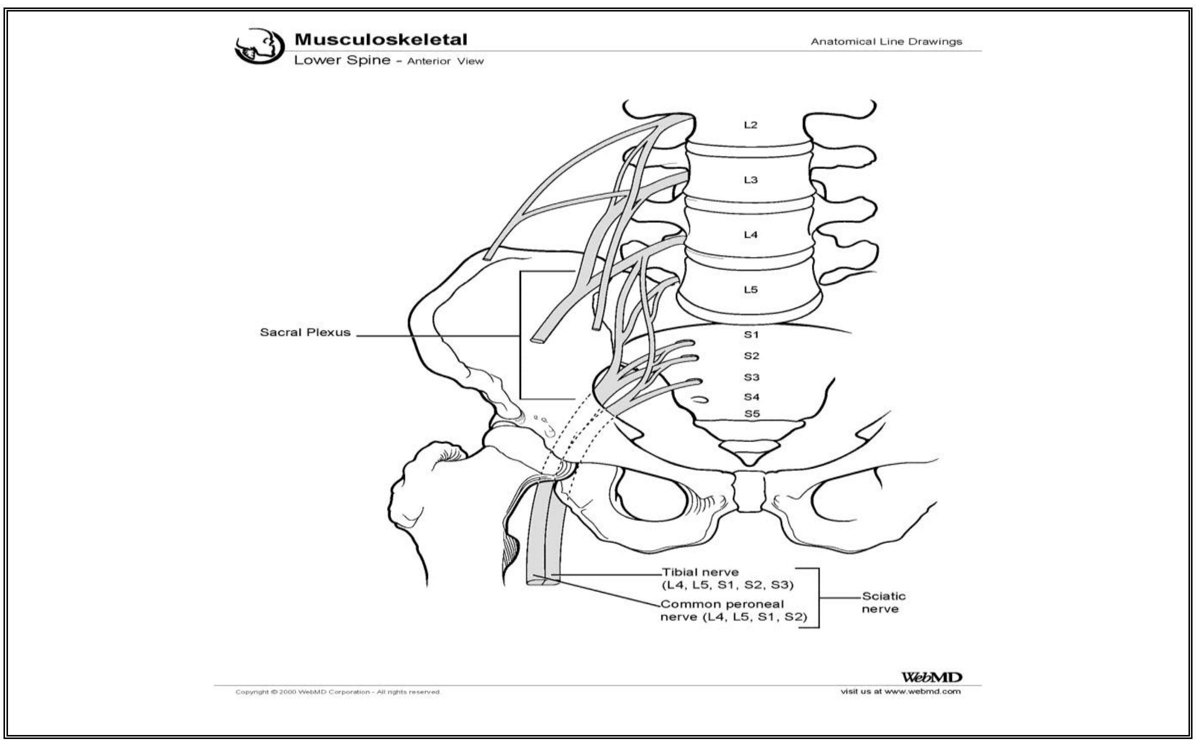


Figure 2-1 image shows lower lumbar spine (Wong DA et al , 2007).

2-1-1 **Bones**

The lumbar vertebrae, numbered L1-L5, have a vertical height that is less than their horizontal diameter. They are composed of the following 3 functional parts:

2-1-1-1 The vertebral body, designed to bear weight

2-1-1-2 The vertebral (neural) arch, designed to protect the neural element

2-1-1-3 The bony processes (spinous and transverse), which function to increase the efficiency of muscle action (Moore KL , et al 2006).

The lumbar vertebral bodies are distinguished from the thoracic bodies by the absence of rib facets. The lumbar vertebral bodies (vertebrae) are the heaviest components, connected together by the intervertebral discs. The size of the vertebral body increases from L1 to L5, indicative of the increasing loads that each lower lumbar vertebra absorbs. Of note, the L5 vertebra has the heaviest body, smallest spinous process, and thickest transverse process. (Hall et al ,1990)

The intervertebral discal surface of an adult vertebra contains a ring of cortical bone peripherally termed the epiphysial ring. This ring acts as a growth zone in the young while anchoring the attachment of the annular fibers in adults. A hyaline cartilage plate lies within the confines of this epiphysial ring , Each vertebral arch is composed of 2 pedicles, 2 laminae, and 7 different bony processes (1 spinous, 4 articular, 2 transverse) (see the following image), joined together by facet joints and ligaments. (Lippincott Williams et al 2007)

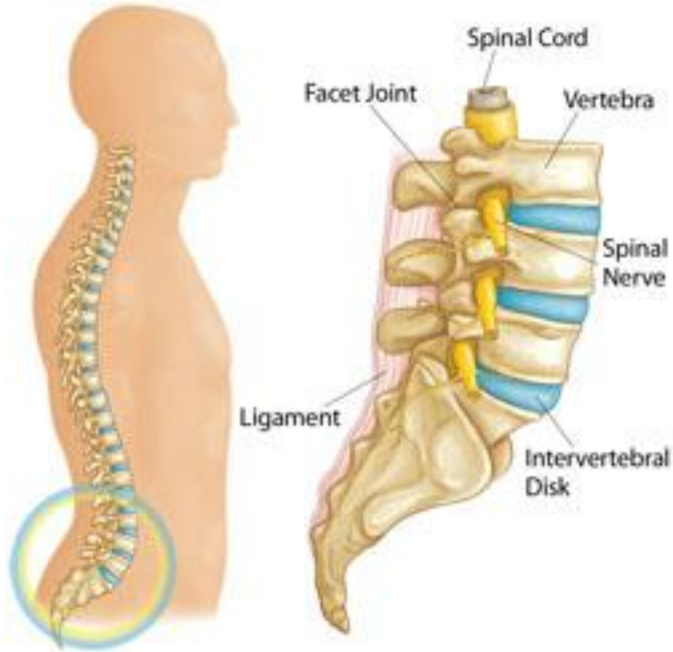


Figure 2-2 image shows lower lumbar spine (Moore KL , et al 2006)

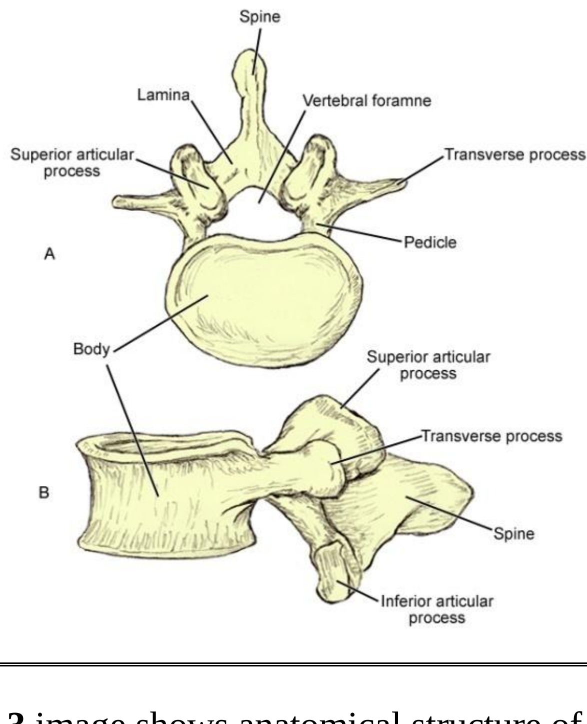


Figure 2-3 image shows anatomical structure of lumbar vertebra (Moore KL , et al 2006)

The pedicle, strong and directed posteriorly, joins the arch to the posterolateral body. It is anchored to the cephalad portion of the body and function as a protective cover for the cauda equina contents. The concavities in the cephalad and caudal surfaces of the pedicle are termed vertebral notches , Beneath each lumbar vertebra, a pair of intervertebral (neural) foramina with the same number designations can be found, such that the L1 neural foramina are located just below the L1 vertebra. Each foramen is bounded superiorly and inferiorly by the pedicle, anteriorly by the intervertebral disc and vertebral body, and posteriorly by facet joints. The same numbered spinal nerve root, recurrent meningeal nerves, and radicular blood vessels pass through each foramen. Five lumbar spinal nerve roots are found on each side. (Lippincott Williams et al , 2007)

The broad and strong laminae are the plates that extend posteromedially from the pedicle. The oblong shaped spinous processes are directed posteriorly from the union of the laminae , The 2 superior (directed posteromedially) and inferior (directed anterolaterally) articular processes, labeled SAP and IAP, respectively, extend cranially and caudally from the point where the pedicles and laminae join. The facet or zygapophyseal joints are in a parasagittal plane. When viewed in an oblique projection, the outline of the facets and the pars interarticularis appear like the neck of a Scottie dog. ([7] Lippincott Williams et al , 2007)

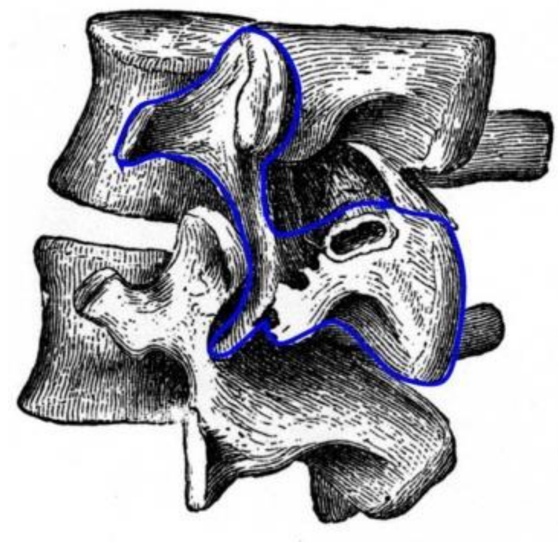


Figure 2-4 image shows outline of Scottie dog in an oblique projection (Moore KL , et al 2006)

Between the superior and inferior articular processes, 2 transverse processes are projected laterally that are long, slender, and strong. They have an upper tubercle at the junction with the superior articular process (mammillary process) and an inferior tubercle at the base of the process (accessory process). These bony protuberances are sites of attachments of deep back muscles (Pansky B et al , 1996)

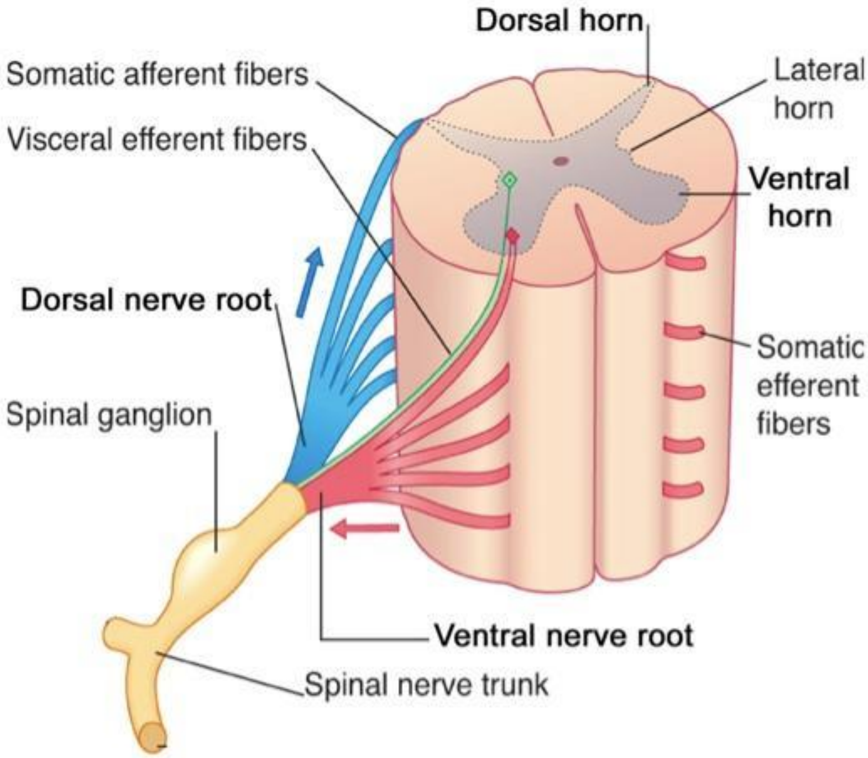
2-2 Physiology

Spinal nerves, considered part of the peripheral nervous system, generally refer to mixed spinal nerves, which carry motor, sensory, and autonomic information between the brain and spinal cord and the rest of the body , The cervical spinal nerves innervate the muscles and provide sensation for the head, neck, and diaphragm, as well as the upper limbs and back , The lumbar, sacral, and coccygeal nerves combine to form the lumbosacral plexus , The spinal cord can be divided into the lateral, posterior, and medial cord, each segment of which gives rise to specific nerves and serves specific areas of the body , The somatic nervous system is responsible for voluntary body movements, receiving information from afferent fibers and contracting muscles with efferent fibers , The autonomic nervous system involves the visceral organs and regulates involuntary movement or unconscious actions (Moore KL , et al 2006).

The sympathetic nervous system is responsible for the fight or flight reaction under stressful conditions, while the parasympathetic nervous system conserves energy after high stress situations or during rest and digesting.

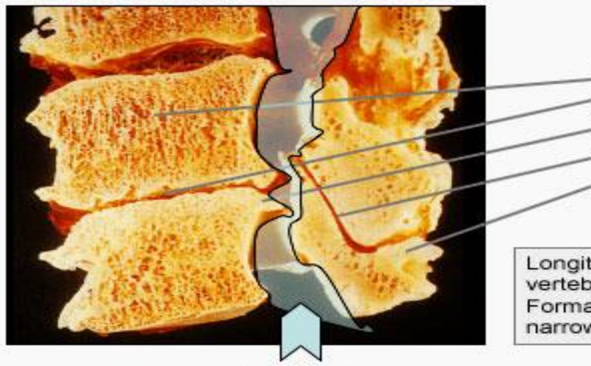
The primary neurotransmitters of the PNS are acetylcholine and noradrenaline, though other neurotransmitters are also present. Acetylcholine acts on two sets of receptors, muscarinic and nicotinic cholinergic receptors (Roose C et al , 1997)

The peripheral nervous system (PNS) consists of the nerves and ganglia outside of the brain and spinal cord . The main function of the PNS is to connect the central nervous system (CNS) to the limbs and organs. Unlike the CNS, the PNS is not protected by the bone of spine and skull, or by the blood–brain barrier, leaving it exposed to toxins and mechanical injuries. The peripheral nervous system is divided into the somatic nervous system and the autonomic nervous system , The anterior divisions of the lumbar nerves, sacral nerves, and coccygeal nerve form the lumbosacral plexus, the first lumbar nerve being frequently joined by a branch from the twelfth thoracic. For descriptive. purposes this plexus is usually divided into three parts: lumbar plexus, sacral plexus, and pudendal plexus(Roose C et al , 1997).

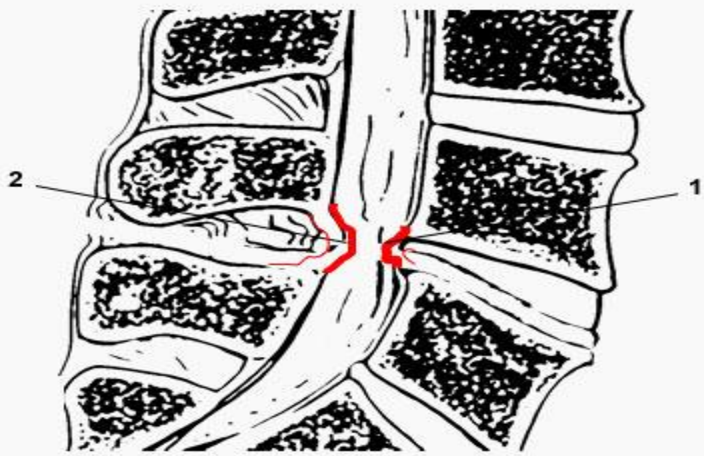


Degenerative changes of the lumbar spine , general remarks (Pansky B et al 1996).

The main functions of the lumbar spine are to protect the spinal nerves and to facilitate most of the trunk's motion. The five lumbar vertebral bodies maintain distance and transmit loads from the thorax to the pelvis and serve as muscle attachments , Motion and load create adaptive tissue changes during life. These changes include loss of tissue elasticity, growth of osteophytes and calcification of ligaments. As a result, the structures around the spinal canal increase in volume, thereby reducing the available space for the nerve roots in the canal or the outlets for the roots. This effect is sometimes emphasized by anterior vertebral slippage (degenerative spondylolisthesis) due to insufficiency by wear and tear of the vertebral facets , The narrowing of the spinal canal is referred to as spinal stenosis (Roose C et al , 1997).

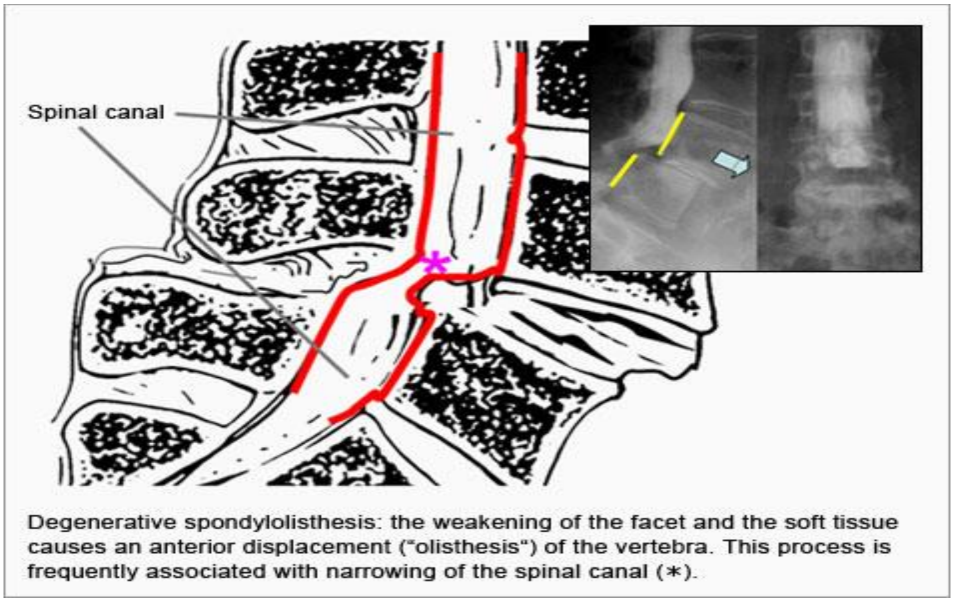


Longitudinal section of lumbar vertebrae:
Formation of osteophytes create narrowing of the spinal canal.

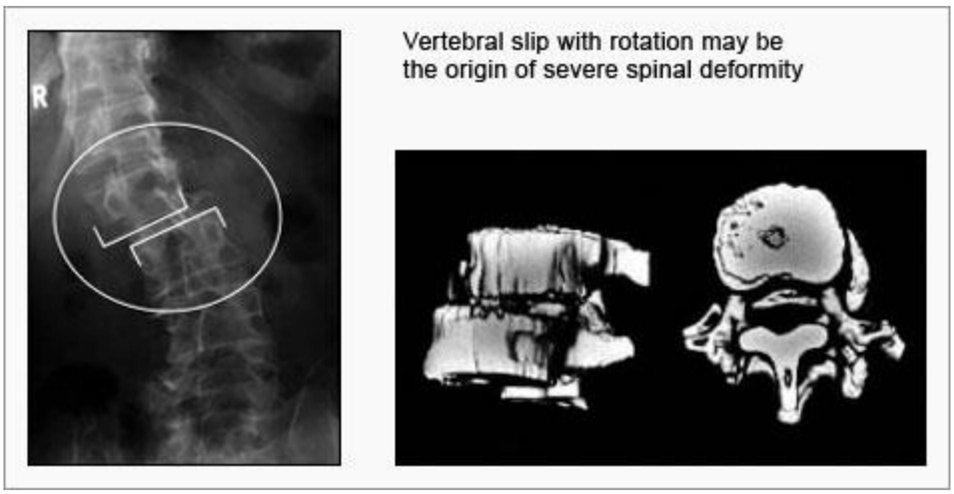


Stenosis of the lumbar spine canal: disc protrusion anterior (1) and buckling of the ligaments posterior (2) cause narrowing of the passage for the nerves and the dura.

Left: normal spinal canal
Right: narrow spinal canal with degenerative bone formation and calcified ligaments



DEGENERATIVE DEFORMITY: ROTATIONAL SPONDYLOLISTHESIS (Moore KL .et al 2006)



Abnormal Spinal used term "hunchback." This condition is most often the result of osteoporosis, a progressive bone disease characterized by decreased bone mass and density, but can also occur in people with osteomalacia Curvatures **http://www.eurospine.org/lumbar-spine**

Scoliosis: This refers to an abnormal lateral deviation or curvature, most often in the thoracic region, and common among adolescent girls. It can result from a developmental abnormality where the body and arch will fail to develop on one side of a vertebra, therefore leading to an imbalance and irregular curvature , Kyphosis: An exaggerated thoracic curvature is known as kyphosis. The upper back where the thoracic vertebrae are will be abnormally curved, thus leading to the more commonly (defective bone mineralization) or spinal tuberculosis. The predisposing risks for osteoporosis include: inadequate calcium or vitamin D, menopause, lack of exercise, weight, old age, and/or race. However, adolescent boys who often and actively engage in spine-loading activities or sports (weight lifting, wrestling, etc.) may also get kyphosis (Moore KL , et al 2006).

Lordosis: This condition is due to an exaggerated lumbar curvature. In common jargon, this is known as “swayback,” where the lower back will be abnormally curved instead of the upper back (as in kyphosis). The causes of lordosis are the same or similar to those for kyphosis. Lordosis is especially common in pregnancy or obesity due to the added abdominal weight that will force the lumbar vertebrae into an abnormal curvature (Moore KL , et al 2006).

2-3 Lumbar spinal stenosis

Lumbar spinal stenosis is a condition whereby either the spinal canal (central stenosis) or one or more of the vertebral foramina (foraminal stenosis) becomes narrowed. If the narrowing is substantial, it causes compression of the spinal cord or spinal nerves, which causes the painful symptoms of lumbar spinal stenosis, including low back pain, buttock pain, and leg pain and numbness that is made worse with walking and relieved by resting , Lumbar spinal stenosis can cause low back pain, weakness, numbness, pain, and loss of sensation in the legs. In most situations, the symptoms improve when the patient is sitting or leaning forward. Typically, painful sensations shoot down the legs with continued walking and diminish with resting. This particular activity-related symptom is sometimes referred to as pseudoclaudication because it mimics the true claudication of poor circulation from peripheral vascular disease. Standing and bending backward can make the symptoms worse. This is because bending forward increases the space in the spinal canal and vertebral foramina, while bending backward decreases this space. It is therefore more comfortable for patients to sit or lean forward. Patients are frequently unable to walk for long distances and often state that their symptoms are improved when bending forward while walking with the support of a walker or shopping cart (Drake R , et al 2009).

The symptoms commonly worsen with time. This is because degenerative arthritis is a progressive disease that gradually becomes more severe with time. If left untreated, the compression on the nerves from lumbar spinal stenosis can lead to increasing weakness and loss of function of the legs. It can also lead to loss of bowel and bladder control and loss of sexual function. Many other disorders can cause similar symptoms that mimic lumbar spinal stenosis including: diabetic neuropathy,peripheral vascular disease, and vascular claudication (Drake R , et al 2009)

2-4 Causes of lumbar spinal stenosis

The most common cause of lumbar spinal stenosis is degenerative arthritis and degenerative disc disease. As with other joints in the body, arthritis commonly occurs in the spine as part of the normal aging process and as a result of osteoarthritis. This can lead to loss of the cartilage between the bones at the joints, formation of bone spurs (osteophytes), loss of the normal height of the discs between the vertebrae of the spine (degenerative disc disease, also known as spondylosis), and overgrowth (hypertrophy) of the ligamentous structures. Further degeneration of the lumbar discs can lead to slippage of one vertebra on another, a process referred to as spondylolisthesis. Each of these processes can reduce the normal space available for the nerves in the spinal canal and result in direct pressure on nerve tissues to cause the symptoms of lumbar spinal stenosis. Lumbar spinal stenosis can also be caused by other conditions that decrease the space of the spinal canal or vertebral foramen. These can include ; tumor of the local structures or metastatic tumors (tumors that originated in another part of the body and spread to this location) and infection and various metabolic bone disorders that cause bone growth, such as Paget's disease of bone These causes, however, are much less common than degenerative arthritis (Drake R , et al 2009)

2-5 Diagnosis of lumbar spinal stenosis

The medical evaluation begins with a complete medical history and physical examination to get clues to the diagnosis of lumbar spinal stenosis. During the medical history, the patient will be asked questions regarding symptoms, including how long they have been present, what makes them better or worse, what prior treatment the patient has had, and what other medical conditions they have. These questions can also help the doctor distinguish lumbar spinal stenosis from other disorders that may produce similar symptoms . The physical examination often consists of testing the range of motion in the back and feeling for areas of tenderness in the back. The legs may be examined for range of motion, strength, sensation, reflexes, and pulses. The hips and knees may also be examined because problems with these joints can often causes symptoms similar to those of lumbar spinal stenosis. After the examination, the physician may order imaging studies to detect anatomic signs of lumbar spinal stenosis. This often begins with plain X-rays of the spine. The doctors may also order an X-ray of the patient's pelvis and hips, depending on findings from the physical examination. The X-rays can show the doctor various signs associated with spinal stenosis, including loss of the normal intervertebral disc height, the presence of bone spurs (osteophytes), and spinal instability (abnormal motion between the vertebrae). The ultimate diagnosis of lumbar spinal stenosis is made by CT scan (CT scan or computerized axial tomography). These are more advanced tests that are used to visualize the nerves in the lower back and detect if they are being compressed from lumbar spinal stenosis (Kirkaldy WH et al , 1999).

In some cases, special nerve tests, including electromyogram (EMG) or nerve conduction studies, may be ordered. These tests can identify damage to or irritation of the nerves caused by long-term compression from lumbar spinal stenosis. These tests can also help determine exactly which nerves are involved. (Kirkaldy WH et al , 1999).

2-6 Vertebral canal

The tubular vertebral canal contains the spinal cord, its meninges, spinal nerve roots, and blood vessels supplying the cord, meninges, vertebrae, joints, muscles, and ligaments. Both potential and real spaces intervene between the spinal cord, meninges, and osseoligamentous canal walls. The canal is enclosed within its column and formed by the juxtaposition of the vertebral foramen, lined up with one another in series. The vertebral bodies and discs make up the anterior wall (with the PLL draped over it), whereas the laminae and ligamentum flavum border the canal posteriorly. Laterally, spinal nerves and vessels travel through the intervertebral foramen. (Lippincott Williams et al , 2007).

2-7 Meninges and related spaces

The meninges consist of 3 layers: the pia, arachnoid, and dura mater. Together, they enhance the protection of the spinal cord and roots. The dura is the most superficial but resilient layer. The pia and arachnoid, together termed the leptomeninges, are frail. The spinal cord, roots, and nerve rootlets are closely invested by the pia. The dura and arachnoid together form a loose sheath (termed dural/thecal sac) around these structures, separated from the canal walls by the epidural space (Kirkaldy WH et al , 1999).

2-8 Spinal cord

Other than the brain, the spinal cord is one of the 2 anatomic components of the central nervous system (CNS). It is the major reflex center and conduction pathway between the brain and the body. As noted earlier, the spinal cord normally terminates as the conus medullaris within the lumbar spinal canal at the lower margin of the L2 vertebra, although variability of the most caudal extension exists (Kirkaldy WH et al , 1999).

Figure 2:5 image shows lower lumbar spine (Pansky B et al , 1996)

In a cadaveric study of 129 cadaveric specimens, the spinal cord terminated at L2 in 60%, L1 in 30%, and L3 in 10% of specimens. Differential growth rates in the spinal cord and the vertebral canal are the cause of these disparities. Exceptions also include patients with congenital spinal deformities known as spina bifida. In such patients, the conus medullaris can be displaced downward to the middle or lower lumbar spine (Wong DA et al ,2007).

2-9 Lumbar spine MRI

An MRI uses magnets and radio waves to capture images inside your body without making a surgical incision. The scan allows your doctor to see the soft tissue of the body, like muscles and organs, in addition to your bones. An MRI can be performed on any part of your body. However, a lumbar MRI specifically examines the lumbar section of your spine a region from where back problems commonly originate , The lumbosacral spine is made up of the five lumbar vertebral bones (L1 thru L5), the sacrum (the bony "shield" at the bottom of your spine), and the coccyx (tailbone). In addition to bones, the lumbosacral spine is made up of large blood vessels, nerves, tendons, ligaments, and cartilage (Wong DA et al ,2007).

An MRI provides a different kind of image than other imaging tests, such as X-ray, ultrasonography, or CT scan. An MRI of the lumbar spine shows the bones, disks, and spinal cord, as well as the spaces between the vertebral bones where nerves pass through. How a Lumbar MRI Is Performed an MRI machine looks like a large metal-and-plastic doughnut with a bench that slowly glides you into the center of the opening. So long as you've followed your doctor's instructions and removed all metal, you'll be completely safe in and around the machine. The entire process can take from 30 to 90 minutes (Kirkaldy WH et al ,1999).

If contrast dye is being used, a nurse or doctor will inject it through an intravenous tube. In some cases, you may need to wait up to an hour for the dye to work its way through your bloodstream and into your spine. The technician will have you lie on the bench, either on your back, side, or stomach. You may receive a pillow or blanket if you have trouble lying on the bench. The technician will control the movement of the bench using a remote control from another room. They'll be able to communicate with you through a speaker in the machine. The machine will make some loud humming and thumping noises as the images are being taken. Many hospitals offer earplugs, while others have televisions or headphones to help you pass the time. As the images are being taken, the technician will ask you to hold your breath for a few seconds. You won't feel anything during the test as the magnets and radio frequencies can't be felt (Kirkaldy WH et al ,1999).

2-10 Ultrasound imaging

Ultrasound imaging of the spine has recently been proposed to facilitate identification of the epidural space. In this study, we assessed the accuracy and precision of the transverse approach, using a "single-screen" method, to facilitate labor epidurals. They found a good level of success in the ultrasound-determined insertion point, and very good agreement between UD(ultra sound depth) and ND (needle depth). This suggests that our proposed ultrasound single-screen method, using the transverse approach, can be a reliable guide to facilitate labor epidural insertion (Hall ECB et al ,2009)

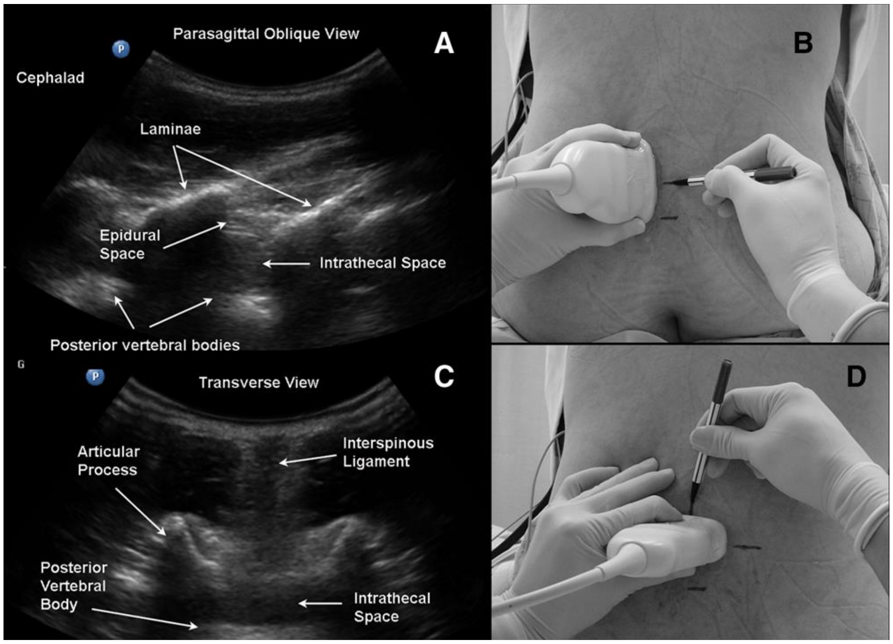


Fig.(1.1) : Ultra Sound Measurement (Kirkaldy WH et al ,1999).

2-11 Lumbar Spine CT Scan

A computed tomography (CT) scan, commonly referred to as a CAT scan, is a type of X-ray that produces cross-sectional images of a specific part of the body. In the case of a lumbar spine CT scan, your doctor can see a cross-section of your lower back. The scanning machine circles the body and sends images to a computer monitor, where they are reviewed by a technician , CT scan is one of many imaging tests your doctor may use to investigate problems with your spine, such as pain due to injuries, disease, or infection. Reasons your doctor might order a lumbar CT scan include:

back pain accompanied by fever birth defects affecting the spine a herniated disk infection injury to the lower spine A CT scan is not the same as an MRI (magnetic resonance imaging) scan. An MRI of the lumbar spine shows the bones, disks, and spinal cord, as well as the spaces between the vertebral bones that nerves pass through. (RadiologyInfo.org) Performed a Lumbar Spine CT Scan , CT scans are performed in a hospital's radiology department or a clinic that specializes in diagnostic procedures. A technician will ask you to lie on your back during the test. He or she may use pillows or straps to ensure that you stay in the correct position long enough to get a quality image. You may also have to hold your breath during brief individual scans. The CT technician will move the table—via remote from a separate room—into the CT machine. You may go through the machine several times (Rosse C et al , 1997).

Depending on the reason for your scan, you may be hooked up to an IV so that contrast dye can be injected into your veins during the test. This dye helps the machine take clear images of your blood vessels and organs. After a round of scans, you may be asked to wait while the technician reviews the images to ensure they are clear enough that your doctor can read them correctly. A typical CT scan takes between 30 and 45 minutes to complete (Rosse C et al , 1997).

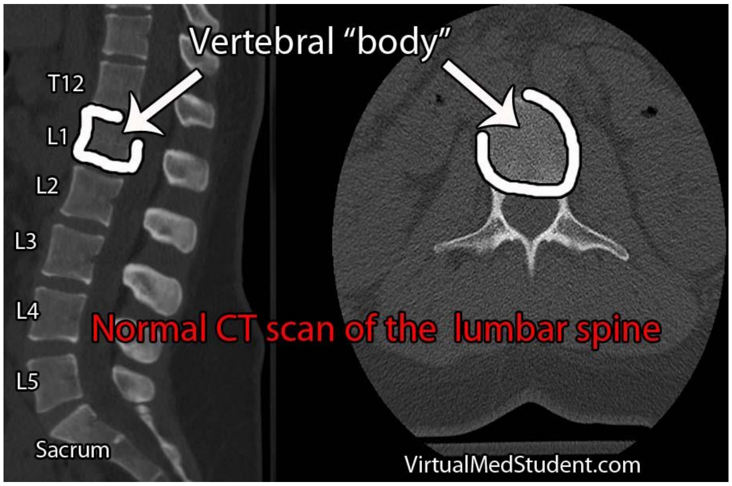


Fig.(1.2) : Normal CT of Lumbar spine (Pansky B , et al 1996)

2-12 Previous study

Previous study done to MEASUREMENTS OF THE NORMAL ADULT LUMBAR SPINAL CANAL by Muhammad Zahoor Janjua (Department of Anatomy, Basic Medical Sciences Institute, Jinnah Postgraduate Medical Centre, Karachi.) and Fida Muhammad (Khyber Medical College, Peshawar.) To assess the normal dimensions of the lumbar spinal canal, 100 normal healthy subjects of either sex between 25 and 45 years old were x-rayed for lumber vertebral column in both postero anterior and lateral views and the canal was measured by Jones and Thomson methods.1 The lumbar spinal canal showed constant dimensions in both sexes in all age groups when studied separately in the male and female subjects. However, no change in relative dimensions was observed between 25 and 45 years. The canal showed gradual decrease in measurement from Li to L5 vertebral levels in both sexes but relative width of the canal was more in the females than in the males of the same age group. The normal values of the canal to vertebral body ratio (C/B) varies between 1:2.0 and 1:5.0. The ratio 1:2.0 indicates a wider canal whereas any ratio beyond 1:5.0 would be conclusive of stenosis of the lumbar vertebral canal (JPMA 39: 264, 1989).

Another study of a Prospective Analysis of Magnetic Resonance Imaging Findings in Patients With Sciatica and Lumbar Disc Herniation: Correlation of Outcomes With Disc Fragment and Canal Morphology, by Carragee, Eugene J. MD; Kim, David H. MD. (http://journals.lww.com). The study designed of a two-part observational study. In Part 1, consecutive lumbar magnetic resonance imaging scans in patients with sciatica meeting enrollment criteria were prospectively and blindly analyzed by a set protocol. In Part 2, further clinical findings at the time of the magnetic resonance imaging were obtained by retrospective chart review and outcome assessment done at follow-up of more than 2 years.

Objectives. To determine the quantitative magnetic resonance findings of disc and canal measures in patients with sciatica and to analyze the predictive values of these magnetic resonance imaging and clinical variables on outcomes.

Methods. Part 1: Consecutive patients with a primary diagnosis of sciatica who came to lumbar magnetic resonance imaging were enrolled, and magnetic resonance imaging dimensions of discs and canal at the herniated level were collected. Part 2: Of 186 patients in Part 1, 135 were followed for more than 2 years; 87 were treated conservatively, and 48 were treated surgically. Outcomes were judged on satisfaction, activity level, medication intake, and reported pain at follow up (mean, 2.6 years).

Results. Part 1: Wide ranges of disc and canal measurements were seen in all parameters. Significant differences in all magnetic resonance parameters were noted between male and female patients. Men had proportionately greater canal compromise by the affected disc than women. Positive sciatic tension signs and short duration of symptoms correlated with large disc herniation. Right sided symptomatic herniation were usually larger than left. Part 2: At follow up, predictors of outcome were determined independently for the surgery and the non-operative groups. In the nonoperative group, a shorter duration of sciatica was the most significant predictor of a good outcome ($P = 0.0018$). Moreover, a duration of symptoms less than 6 months, no involvement with litigation, and younger age were also correlated with a favorable outcome. The only magnetic resonance parameter associated with good outcome was a small ratio of disc hemiarea to remaining canal hemiarea ($P = 0.045$). For the surgical group, a larger anteroposterior disc length was the most significant independent predictor of a positive outcome ($P < 0.0001$). Larger ratios of disc area to canal area are also significantly associated with good outcomes ($P < 0.0001$), as are large disc areas and small remaining canal areas. Large right-left canal widths and small disc widths are also identified as predictors of a favorable outcome. Of the clinical parameters, concurrent medical illness, workers' compensation involvement, and female gender appear to be the most significantly correlated with poor outcome. All fair or poor surgical outcomes were in patients with smaller (<6 mm) disc herniation.

Conclusions. Quantitative measurements by magnetic resonance imaging of disc and canal morphology of 188 patients with sciatica indicate a wide range of herniation and canal sizes, with significant differences between men and women. In a cohort of 135 patients followed for more than 2 years, demographic and clinical features appeared to predict outcomes of nonoperative treatment, whereas morphometric features of disc herniation and the spinal canal seen on magnetic resonance imaging were much more powerful predictors of surgical outcomes.

Chapter three

3. MATERIALS AND METHODS

3-1 Materials

3-1-1 Patients:

The study included 52 patients 27 mal & 25 female and the range of age 13-60 years .

3-1-2 Machine :

Alamal hospital : TOSHIBA Model CXXG-012A , SN : 1AA09242256 , Manufacture date 11/2009 , 120Kv-600mA , 135Kv-530mA

3-1-3 Included criteria:

All normal spine patients.

3-1-4 Excluded Criteria:

Patients with abnormalities in lumbar spine and patients with any neurological disease.

3-1-5 Area of the study :

Was done in Royal Care Hospital.

3-2 Method

3-2-1 Technique :

- position : Supine

- Positioned Landmark :

Supine head first or feet Zero at Xyphoid

Scan Type helical

KV/mA / Rotation time (sec) Pitch/Speed (mm/rotation) SD: 120kv/Sure Exposure(100-450)/ .75 sec

Scan Start / End locations :

mid body of T12 to mid body S3

Volume thin cuts to make Mbr reconstruction Co. so ax

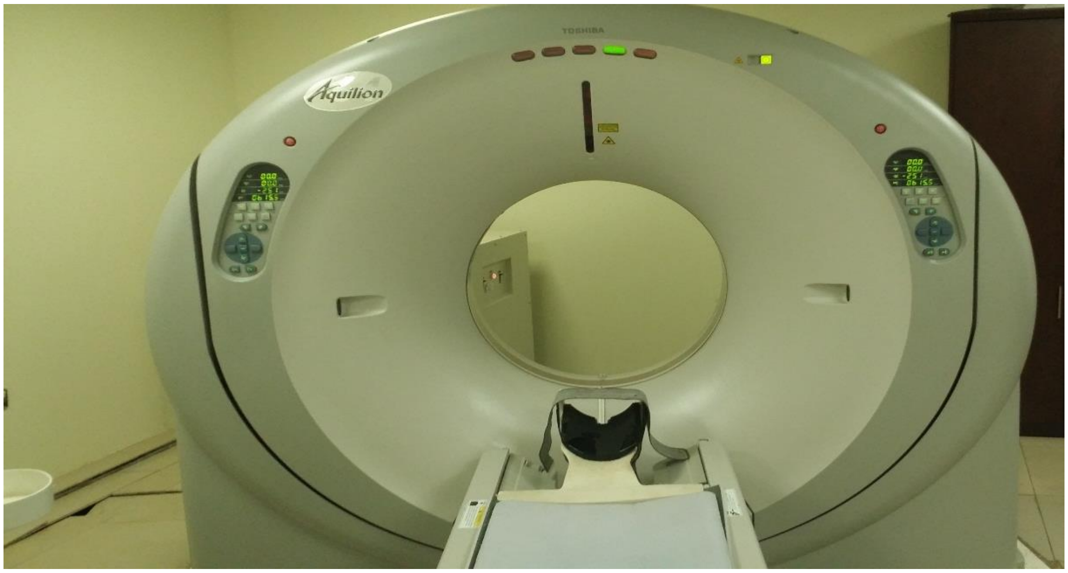


Fig. 3-1 Computed Tomography (CT), 64 slice (Toshiba)

Chapter Four

Table 4-1 Shows frequency distribution of gender among the sample of study

Gender	Frequency Distribution	%
Male	27	51,9 %
Female	25	48,1 %
Total	**52**	**100,0 %**

Table 4-2 Shows age frequency distribution

Age range	No of PT	%
less than 15	6	11,5 %
15 to 25	10	19,2 %
26 to 35	13	25,0 %
36 to 45	14	26,9 %
46 to 55	7	13,5 %
56 & above	2	3,8 %
Total	52	100,0 %

Table 4-3 Shows the test of equality of means between male and female AP and lateral diameter of lumbar spine of the five lumbar

Lumbar spine		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
L1 AP	Equal variances assumed	0.33	0.568	6.326	50	0	6.1009	0.96447	4.1637	8.03808
	Equal variances not assumed			6.341	49.983	0	6.1009	0.9622	4.16823	8.03354
L1 LAT	Equal variances assumed	0.008	0.93	6.145	50	0	6.5056	1.05863	4.3793	8.63196
	Equal variances not assumed			6.129	48.932	0	6.5056	1.06152	4.37235	8.63891
L2 AP	Equal variances assumed	0.166	0.686	5.118	50	0	5.824	1.138	3.53822	8.10969
	Equal variances not assumed			5.128	49.962	0	5.824	1.13573	3.54273	8.10518
L2 LAT	Equal variances assumed	0.052	0.82	5.88	50	0	6.7883	1.1545	4.46941	9.10718
	Equal variances not assumed			5.854	48.284	0	6.7883	1.15952	4.45728	9.11932
L3 AP	Equal variances assumed	3.273	0.076	1.524	50	0.134	3.3757	2.21546	-1.07418	7.82559
	Equal variances not assumed			1.482	31.292	0.148	3.3757	2.27847	-1.26952	8.02093
L3	Equal variances	0.025	0.876	5.993	50	0	7.1704	1.19643	4.76728	9.57346

LAT	assumed									
	Equal variances not assumed			5.979	49.043	0	7.1704	1.19931	4.76032	9.58042
L4 AP	Equal variances assumed	0.089	0.767	4.638	50	0	6.4222	1.38466	3.64106	9.20339
	Equal variances not assumed			4.632	49.375	0	6.4222	1.38651	3.63647	9.20798
L4 LAT	Equal variances assumed	0.058	0.811	5.387	50	0	6.3495	1.17868	3.98204	8.71692
	Equal variances not assumed			5.39	49.79	0	6.3495	1.17805	3.98305	8.71592
L5 AP	Equal variances assumed	0.451	0.505	4.812	50	0	7.1	1.47548	4.13641	10.06359
	Equal variances not assumed			4.788	48.025	0	7.1	1.48273	4.11881	10.08119
L4 LAT	Equal variances assumed	0.642	0.427	5.53	50	0	7.3316	1.32585	4.66851	9.99461
	Equal variances not assumed			5.561	49.779	0	7.3316	1.31836	4.68326	9.97985

Table 4-4 Shows the independence Chi-Square test and according to the result above the value of sig is less than 0.05 which indicated to strongly relationship between the lumber canal diameter and the gender.

			L1AP		Total
			less than 14.8 mm	(14.8 - 21.9) mm	
The gender	male	Count	15	12	27
		% within gender	55.6%	44.4%	100.0%
		% within L1AP	39.5%	85.7%	51.9%
		% of Total	28.8%	23.1%	51.9%
	female	Count	23	2	25
		% within GENDER	92.0%	8.0%	100.0%
		% within L1AP	60.5%	14.3%	48.1%
		% of Total	44.2%	3.8%	48.1%
Total		Count	38	14	52
		% within GENDER	73.1%	26.9%	100.0%
		% within L1AP	100.0%	100.0%	100.0%
		% of Total	73.1%	26.9%	100.0%

	Value	Df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	8.763	1	0.003		

Table 4-5 Shows the independence Chi-Square test and according to the result above the value of sig is less than 0.05 which indicated to strongly relationship between the lumber canal diameter and the gender.

			L1 LAT				Total
			less than 14.8 mm	(14.8 - 21.9) mm	(22-29.1) mm	(29.2-36.3) mm	
GENDER	male	Count	0	15	11	1	27
		% within GENDER	0.0%	55.6%	40.7%	3.7%	100.0%
		% within L1 LAT	0.0%	68.2%	78.6%	100.0%	51.9%
		% of Total	0.0%	28.8%	21.2%	1.9%	51.9%
	female	Count	15	7	3	0	25
		% within GENDER	60.0%	28.0%	12.0%	0.0%	100.0%
		% within L1 LAT	100.0%	31.8%	21.4%	0.0%	48.1%
		% of Total	28.8%	13.5%	5.8%	0.0%	48.1%
Total		Count	15	22	14	1	52
		% within GENDER	28.8%	42.3%	26.9%	1.9%	100.0%
		% within L1 LAT	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	28.8%	42.3%	26.9%	1.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	23.438	3	0.000

Table 4-6 Shows the independence Chi-Square test and according to the result above the value of sig is less than 0.05 which indicated to strongly relationship between the lumber canal diameter and the gender.

			L2 AP			Total
			less than 14.8 mm	(14.8 - 21.9) mm	(22-29.1) mm	
GENDER	male	Count	13	13	1	27
		% within GENDER	48.1%	48.1%	3.7%	100.0%
		% within L2 AP	36.1%	86.7%	100.0%	51.9%
		% of Total	25.0%	25.0%	1.9%	51.9%
	female	Count	23	2	0	25
		% within GENDER	92.0%	8.0%	0.0%	100.0%
		% within L2 AP	63.9%	13.3%	0.0%	48.1%
		% of Total	44.2%	3.8%	0.0%	48.1%
Total		Count	36	15	1	52
		% within GENDER	69.2%	28.8%	1.9%	100.0%
		% within L2 AP	100.0%	100.0%	100.0%	100.0%
		% of Total	69.2%	28.8%	1.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	11.785	2	0.003

Table 4-7 Shows the independence Chi-Square test and according to the result above the value of sig is less than 0.05 which indicated to strongly relationship between the lumber canal diameter and the gender.

			L2 LAT				Total
			less than 14.8 mm	(14.8 - 21.9) mm	(22-29.1) mm	(29.2-36.3) mm	
GENDER	male	Count	0	13	12	2	27
		% within GENDER	0.0%	48.1%	44.4%	7.4%	100.0%
		% within L2 LAT	0.0%	56.5%	80.0%	100.0%	51.9%
		% of Total	0.0%	25.0%	23.1%	3.8%	51.9%
	female	Count	12	10	3	0	25
		% within GENDER	48.0%	40.0%	12.0%	0.0%	100.0%
		% within L2 LAT	100.0%	43.5%	20.0%	0.0%	48.1%
		% of Total	23.1%	19.2%	5.8%	0.0%	48.1%
Total		Count	12	23	15	2	52
		% within GENDER	23.1%	44.2%	28.8%	3.8%	100.0%
		% within L2 LAT	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	23.1%	44.2%	28.8%	3.8%	100.0%

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	19.744	3	0.000

Table 4-8 Shows the independence Chi-Square test and according to the result above the value of sig is less than 0.05 which indicated to strongly relationship between the lumber canal diameter and the gender.

			L3 AP				Total
			less than 14.8 mm	(14.8 - 21.9) mm	(22-29.1) mm	above 43.5	
GENDER	male	Count	15	10	2	0	27
		% within GENDER	55.6%	37.0%	7.4%	0.0%	100.0%
		% within L3 AP	41.7%	83.3%	100.0%	0.0%	51.9%
		% of Total	28.8%	19.2%	3.8%	0.0%	51.9%
	female	Count	21	2	0	2	25
		% within GENDER	84.0%	8.0%	0.0%	8.0%	100.0%
		% within L3 AP	58.3%	16.7%	0.0%	100.0%	48.1%
		% of Total	40.4%	3.8%	0.0%	3.8%	48.1%
Total		Count	36	12	2	2	52
		% within GENDER	69.2%	23.1%	3.8%	3.8%	100.0%
		% within L3 AP	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	69.2%	23.1%	3.8%	3.8%	100.0%

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10.272	3	0.016

Table 4-9 Shows the independence Chi-Square test and according to the result above the value of sig is less than 0.05 which indicated to strongly relationship between the lumber canal diameter and the gender.

			L3 LAT				Total
			less than 14.8 mm	(14.8 - 21.9) mm	(22-29.1) mm	(29.2-36.3) mm	
GENDER	male	Count	0	9	13	5	27
		% within GENDER	0.0%	33.3%	48.1%	18.5%	100.0%
		% within L3 LAT	0.0%	42.9%	72.2%	100.0%	51.9%
		% of Total	0.0%	17.3%	25.0%	9.6%	51.9%
	female	Count	8	12	5	0	25
		% within GENDER	32.0%	48.0%	20.0%	0.0%	100.0%
		% within L3 LAT	100.0%	57.1%	27.8%	0.0%	48.1%
		% of Total	15.4%	23.1%	9.6%	0.0%	48.1%
Total		Count	8	21	18	5	52
		% within GENDER	15.4%	40.4%	34.6%	9.6%	100.0%
		% within L3 LAT	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	15.4%	40.4%	34.6%	9.6%	100.0%

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	16.932	3	0.001

Table 4-10 Shows the independence Chi-Square test and according to the result above the value of sig is less than 0.05 which indicated to strongly relationship between the lumber canal diameter and the gender.

			L4 AP			Total
			less than 14.8 mm	(14.8 - 21.9) mm	(22-29.1) mm	
GENDER	male	Count	11	10	6	27
		% within GENDER	40.7%	37.0%	22.2%	100.0%
		% within L4 AP	36.7%	62.5%	100.0%	51.9%
		% of Total	21.2%	19.2%	11.5%	51.9%
	female	Count	19	6	0	25
		% within GENDER	76.0%	24.0%	0.0%	100.0%
		% within L4 AP	63.3%	37.5%	0.0%	48.1%
		% of Total	36.5%	11.5%	0.0%	48.1%
Total		Count	30	16	6	52
		% within GENDER	57.7%	30.8%	11.5%	100.0%
		% within L4 AP	100.0%	100.0%	100.0%	100.0%
		% of Total	57.7%	30.8%	11.5%	100.0%

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9.070	2	0.011

Table 4-11 Shows the independence Chi-Square test and according to the result above the value of sig is less than 0.05 which indicated to strongly relationship between the lumber canal diameter and the gender.

			L4 LAT				Total
			less than 14.8 mm	(14.8 - 21.9) mm	(22-29.1) mm	(29.2-36.3) mm	
GENDER	male	Count	0	5	16	6	27
		% within GENDER	0.0%	18.5%	59.3%	22.2%	100.0%
		% within L4 LAT	0.0%	26.3%	69.6%	100.0%	51.9%
		% of Total	0.0%	9.6%	30.8%	11.5%	51.9%
	female	Count	4	14	7	0	25
		% within GENDER	16.0%	56.0%	28.0%	0.0%	100.0%
		% within L4 LAT	100.0%	73.7%	30.4%	0.0%	48.1%
		% of Total	7.7%	26.9%	13.5%	0.0%	48.1%
Total		Count	4	19	23	6	52
		% within GENDER	7.7%	36.5%	44.2%	11.5%	100.0%
		% within L4 LAT	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	7.7%	36.5%	44.2%	11.5%	100.0%

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	17.734	3	0.000

Table 4-9

Table 4-12 Shows the independence Chi-Square test and according to the result above the value of sig is less than 0.05 which indicated to strongly relationship between the lumber canal diameter and the gender.

			L5 AP		
			less than 14.8 mm	(14.8 - 21.9) mm	(22-29.1) mm
GENDER	male	Count	9	10	8
		% within GENDER	33.3%	37.0%	29.6%
		% within L5 AP	32.1%	62.5%	100.0%
		% of Total	17.3%	19.2%	15.4%
	female	Count	19	6	0
		% within GENDER	76.0%	24.0%	0.0%
		% within L5 AP	67.9%	37.5%	0.0%
		% of Total	36.5%	11.5%	0.0%
Total		Count	28	16	8
		% within GENDER	53.8%	30.8%	15.4%
		% within L5 AP	100.0%	100.0%	100.0%
		% of Total	53.8%	30.8%	15.4%

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	12.513	2	0.002

Table 4-13 Shows the independence Chi-Square test and according to the result above the value of sig is less than 0.05 which indicated to strongly relationship between the lumber canal diameter and the gender.

			L5 LAT				Total
			(14.8 - 21.9) mm	(22-29.1) mm	(29.2-36.3) mm	(36.4-43.5) mm	
GENDER	male	Count	3	11	11	2	27
		% within GENDER	11.1%	40.7%	40.7%	7.4%	100.0%
		% within L5 LAT	16.7%	55.0%	91.7%	100.0%	51.9%
		% of Total	5.8%	21.2%	21.2%	3.8%	51.9%
	female	Count	15	9	1	0	25
		% within GENDER	60.0%	36.0%	4.0%	0.0%	100.0%
		% within L1AP0	83.3%	45.0%	8.3%	0.0%	48.1%
		% of Total	28.8%	17.3%	1.9%	0.0%	48.1%
Total		Count	18	20	12	2	52
		% within GENDER	34.6%	38.5%	23.1%	3.8%	100.0%
		% within L5 LAT	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	34.6%	38.5%	23.1%	3.8%	100.0%

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	18.484	3	0.000

Table 4-14 Shows the Comparison per mean according to the result which indicated strongly relationship between the lumber canal diameter and the gender.

	Male	female
L1 AP	20.28889	14.19
L1 LAT	27.22963	20.72
L2 AP	20.25556	14.43
L2 LAT	28.0963	21.31
L3 AP	20.6037	17.23
L3 LAT	29.87037	22.70
L4 AP	21.72222	15.30
L4 LAT	31.08148	24.73
L5 AP	23	15.90
L5 LAT	34.75556	27.42

Figure 4.1 show male vs female

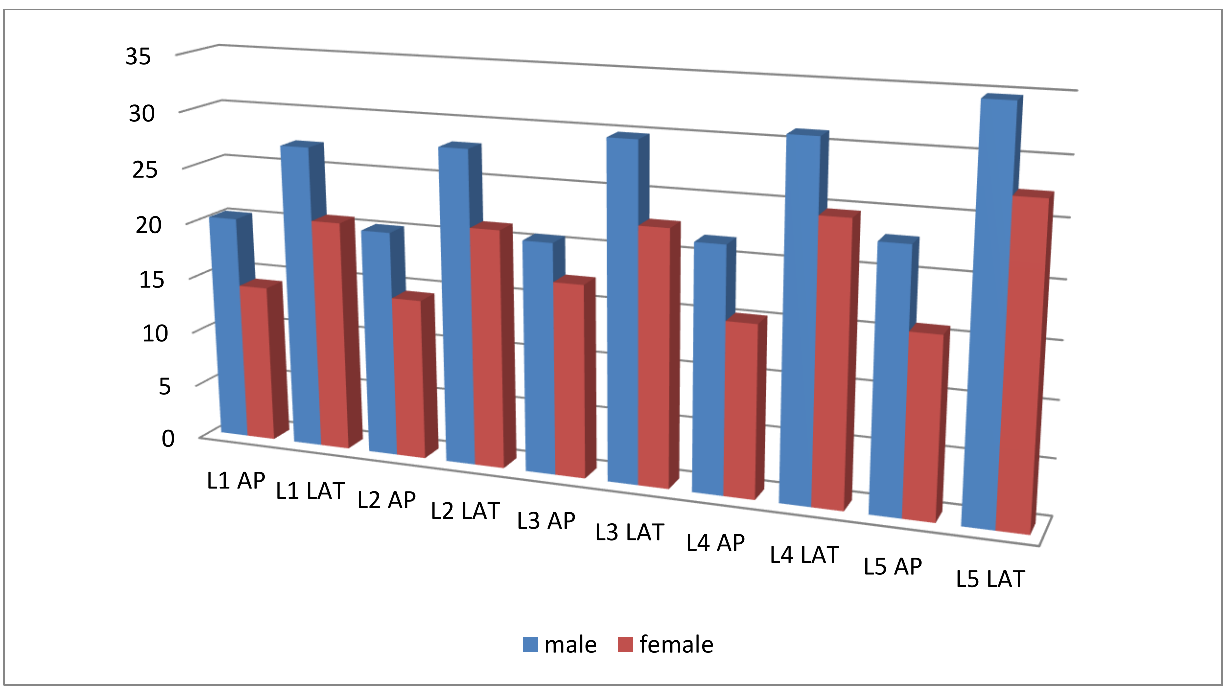


Table 4-15 Shown from table above the independence Chi-Square test and according to the result above the value of sig is greater than 0.05 which indicated to no relationship between the diameter of spinal canal and the age.

			L1AP		Total
			less than 14.8 mm	14.8 - 21.9 mm	
AGEAGEST	Less than 15	Count	2	4	6
		% within AGEAGEST	33.3%	66.7%	100.0%
		% within L1AP	5.3%	28.6%	11.5%
		% of Total	3.8%	7.7%	11.5%
	15 - 25	Count	8	2	10
		% within AGEAGEST	80.0%	20.0%	100.0%
		% within L1AP	21.1%	14.3%	19.2%
		% of Total	15.4%	3.8%	19.2%
	26 - 35	Count	11	2	13
		% within AGEAGEST	84.6%	15.4%	100.0%
		% within L1AP	28.9%	14.3%	25.0%
		% of Total	21.2%	3.8%	25.0%
	36 - 45	Count	9	5	14
		% within AGEAGEST	64.3%	35.7%	100.0%
		% within L1AP	23.7%	35.7%	26.9%
		% of Total	17.3%	9.6%	26.9%
	46 - 55	Count	6	1	7
		% within AGEAGEST	85.7%	14.3%	100.0%
		% within L1AP	15.8%	7.1%	13.5%
		% of Total	11.5%	1.9%	13.5%
	55 and above	Count	2	0	2
		% within AGEAGEST	100.0%	0.0%	100.0%
		% within L1AP	5.3%	0.0%	3.8%
		% of Total	3.8%	0.0%	3.8%
Total		Count	38	14	52
		% within AGEAGEST	73.1%	26.9%	100.0%
		% within L1AP	100.0%	100.0%	100.0%
		% of Total	73.1%	26.9%	100.0%

Table 4-16 Shown from table above the independence Chi-Square test and according to the result above the value of sig is greater than 0.05 which indicated to no relationship between the diameter of spinal canal and the age.

			L1AT				Total
			less than 14.8 mm	14.8 - 21.9 mm	22 - 29.1 mm	29.2 - 36.3 mm	
AGEAGEST	Less than 15	Count	1	1	3	1	6
		% within AGEAGEST	16.7%	16.7%	50.0%	16.7%	100.0%
		% within L1AT	6.7%	4.5%	21.4%	100.0%	11.5%
		% of Total	1.9%	1.9%	5.8%	1.9%	11.5%
	15 - 25	Count	5	2	3	0	10
		% within AGEAGEST	50.0%	20.0%	30.0%	0.0%	100.0%
		% within L1AT	33.3%	9.1%	21.4%	0.0%	19.2%
		% of Total	9.6%	3.8%	5.8%	0.0%	19.2%
	26 - 35	Count	4	6	3	0	13
		% within AGEAGEST	30.8%	46.2%	23.1%	0.0%	100.0%
		% within L1AT	26.7%	27.3%	21.4%	0.0%	25.0%
		% of Total	7.7%	11.5%	5.8%	0.0%	25.0%
	36 - 45	Count	2	8	4	0	14
		% within AGEAGEST	14.3%	57.1%	28.6%	0.0%	100.0%
		% within L1AT	13.3%	36.4%	28.6%	0.0%	26.9%
		% of Total	3.8%	15.4%	7.7%	0.0%	26.9%
	46 - 55	Count	3	3	1	0	7
		% within AGEAGEST	42.9%	42.9%	14.3%	0.0%	100.0%
		% within L1AT	20.0%	13.6%	7.1%	0.0%	13.5%
		% of Total	5.8%	5.8%	1.9%	0.0%	13.5%
	55 and above	Count	0	2	0	0	2
		% within AGEAGEST	0.0%	100.0%	0.0%	0.0%	100.0%
		% within L1AT	0.0%	9.1%	0.0%	0.0%	3.8%
		% of Total	0.0%	3.8%	0.0%	0.0%	3.8%
Total		Count	15	22	14	1	52
		% within AGEAGEST	28.8%	42.3%	26.9%	1.9%	100.0%
		% within L1AT	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	28.8%	42.3%	26.9%	1.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	18.343	15	0.245

Table 4-17 Shown from table above the independence Chi-Square test and according to the result above the value of sig is greater than 0.05 which indicated to no relationship between the diameter of spinal canal and the age.

			L2AP			Total
			less than 14.8 mm	14.8 - 21.9 mm	22 - 29.1 mm	
AGEAGEST	Less than 15	Count	2	3	1	6
		% within AGEAGEST	33.3%	50.0%	16.7%	100.0%
		% within L2AP	5.6%	20.0%	100.0%	11.5%
		% of Total	3.8%	5.8%	1.9%	11.5%
	15 - 25	Count	8	2	0	10
		% within AGEAGEST	80.0%	20.0%	0.0%	100.0%
		% within L2AP	22.2%	13.3%	0.0%	19.2%
		% of Total	15.4%	3.8%	0.0%	19.2%
	26 - 35	Count	11	2	0	13
		% within AGEAGEST	84.6%	15.4%	0.0%	100.0%
		% within L2AP	30.6%	13.3%	0.0%	25.0%
		% of Total	21.2%	3.8%	0.0%	25.0%
	36 - 45	Count	8	6	0	14
		% within AGEAGEST	57.1%	42.9%	0.0%	100.0%
		% within L2AP	22.2%	40.0%	0.0%	26.9%
		% of Total	15.4%	11.5%	0.0%	26.9%
	46 - 55	Count	5	2	0	7
		% within AGEAGEST	71.4%	28.6%	0.0%	100.0%
		% within L2AP	13.9%	13.3%	0.0%	13.5%
		% of Total	9.6%	3.8%	0.0%	13.5%
	55 and above	Count	2	0	0	2
		% within AGEAGEST	100.0%	0.0%	0.0%	100.0%
		% within L2AP	5.6%	0.0%	0.0%	3.8%
		% of Total	3.8%	0.0%	0.0%	3.8%
Total		Count	36	15	1	52
		% within AGEAGEST	69.2%	28.8%	1.9%	100.0%
		% within L2AP	100.0%	100.0%	100.0%	100.0%
		% of Total	69.2%	28.8%	1.9%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	13.518	10	0.196

Table 4-18 Shown from table above the independence Chi-Square test and according to the result above the value of sig is greater than 0.05 which indicated to no relationship between the diameter of spinal canal and the age.

			L2AT				Total
			less than 14.8 mm	14.8 - 21.9 mm	22 - 29.1 mm	29.2 - 36.3 mm	
AGEAGEST	Less than 15	Count	0	2	3	1	6
		% within AGEAGEST	0.0%	33.3%	50.0%	16.7%	100.0%
		% within L2AT	0.0%	8.7%	20.0%	50.0%	11.5%
		% of Total	0.0%	3.8%	5.8%	1.9%	11.5%
	15 - 25	Count	4	3	2	1	10
		% within AGEAGEST	40.0%	30.0%	20.0%	10.0%	100.0%
		% within L2AT	33.3%	13.0%	13.3%	50.0%	19.2%
		% of Total	7.7%	5.8%	3.8%	1.9%	19.2%
	26 - 35	Count	3	6	4	0	13
		% within AGEAGEST	23.1%	46.2%	30.8%	0.0%	100.0%
		% within L2AT	25.0%	26.1%	26.7%	0.0%	25.0%
		% of Total	5.8%	11.5%	7.7%	0.0%	25.0%
	36 - 45	Count	2	7	5	0	14
		% within AGEAGEST	14.3%	50.0%	35.7%	0.0%	100.0%
		% within L2AT	16.7%	30.4%	33.3%	0.0%	26.9%
		% of Total	3.8%	13.5%	9.6%	0.0%	26.9%
	46 - 55	Count	3	3	1	0	7
		% within AGEAGEST	42.9%	42.9%	14.3%	0.0%	100.0%
		% within L2AT	25.0%	13.0%	6.7%	0.0%	13.5%
		% of Total	5.8%	5.8%	1.9%	0.0%	13.5%
	55 and above	Count	0	2	0	0	2
		% within AGEAGEST	0.0%	100.0%	0.0%	0.0%	100.0%
		% within L2AT	0.0%	8.7%	0.0%	0.0%	3.8%
		% of Total	0.0%	3.8%	0.0%	0.0%	3.8%
Total		Count	12	23	15	2	52
		% within AGEAGEST	23.1%	44.2%	28.8%	3.8%	100.0%
		% within L2AT	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	23.1%	44.2%	28.8%	3.8%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	14.360	15	0.498

Table 4-19 Shown from table above the independence Chi-Square test and according to the result above the value of sig is greater than 0.05 which indicated to no relationship between the diameter of spinal canal and the age.

AGEAGEST * L3AP Crosstabulation							
			L3AP				Total
			less than 14.8 mm	14.8 - 21.9 mm	22 - 29.1 mm	above than 43.5 mm	
AGEAGEST	Less than 15	Count	1	4	0	1	6
		% within AGEAGEST	16.7%	66.7%	0.0%	16.7%	100.0%
		% within L3AP	2.8%	33.3%	0.0%	50.0%	11.5%
		% of Total	1.9%	7.7%	0.0%	1.9%	11.5%
	15 - 25	Count	7	0	2	1	10
		% within AGEAGEST	70.0%	0.0%	20.0%	10.0%	100.0%
		% within L3AP	19.4%	0.0%	100.0%	50.0%	19.2%
		% of Total	13.5%	0.0%	3.8%	1.9%	19.2%
	26 - 35	Count	11	2	0	0	13
		% within AGEAGEST	84.6%	15.4%	0.0%	0.0%	100.0%
		% within L3AP	30.6%	16.7%	0.0%	0.0%	25.0%
		% of Total	21.2%	3.8%	0.0%	0.0%	25.0%
	36 - 45	Count	10	4	0	0	14
		% within AGEAGEST	71.4%	28.6%	0.0%	0.0%	100.0%
		% within L3AP	27.8%	33.3%	0.0%	0.0%	26.9%
		% of Total	19.2%	7.7%	0.0%	0.0%	26.9%
	46 - 55	Count	5	2	0	0	7
		% within AGEAGEST	71.4%	28.6%	0.0%	0.0%	100.0%
		% within L3AP	13.9%	16.7%	0.0%	0.0%	13.5%
		% of Total	9.6%	3.8%	0.0%	0.0%	13.5%
	55 and above	Count	2	0	0	0	2
		% within AGEAGEST	100.0%	0.0%	0.0%	0.0%	100.0%
		% within L3AP	5.6%	0.0%	0.0%	0.0%	3.8%
		% of Total	3.8%	0.0%	0.0%	0.0%	3.8%
Total		Count	36	12	2	2	52
		% within AGEAGEST	69.2%	23.1%	3.8%	3.8%	100.0%
		% within L3AP	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	69.2%	23.1%	3.8%	3.8%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	24.779	15	0.053

Table 4-20 Shown from table above the independence Chi-Square test and according to the result above the value of sig is greater than 0.05 which indicated to no relationship between the diameter of spinal canal and the age.

AGEAGEST * L3AT Crosstabulation							
			L3AT				Total
			less than 14.8 mm	14.8 - 21.9 mm	22 - 29.1 mm	29.2 - 36.3 mm	
AGEAGEST	Less than 15	Count	0	2	3	1	6
		% within AGEAGEST	0.0%	33.3%	50.0%	16.7%	100.0%
		% within L3AT	0.0%	9.5%	16.7%	20.0%	11.5%
		% of Total	0.0%	3.8%	5.8%	1.9%	11.5%
	15 - 25	Count	2	5	2	1	10
		% within AGEAGEST	20.0%	50.0%	20.0%	10.0%	100.0%
		% within L3AT	25.0%	23.8%	11.1%	20.0%	19.2%
		% of Total	3.8%	9.6%	3.8%	1.9%	19.2%
	26 - 35	Count	3	4	5	1	13
		% within AGEAGEST	23.1%	30.8%	38.5%	7.7%	100.0%
		% within L3AT	37.5%	19.0%	27.8%	20.0%	25.0%
		% of Total	5.8%	7.7%	9.6%	1.9%	25.0%
	36 - 45	Count	1	5	7	1	14
		% within AGEAGEST	7.1%	35.7%	50.0%	7.1%	100.0%
		% within L3AT	12.5%	23.8%	38.9%	20.0%	26.9%
		% of Total	1.9%	9.6%	13.5%	1.9%	26.9%
	46 - 55	Count	2	3	1	1	7
		% within AGEAGEST	28.6%	42.9%	14.3%	14.3%	100.0%
		% within L3AT	25.0%	14.3%	5.6%	20.0%	13.5%
		% of Total	3.8%	5.8%	1.9%	1.9%	13.5%
	55 and above	Count	0	2	0	0	2
		% within AGEAGEST	0.0%	100.0%	0.0%	0.0%	100.0%
		% within L3AT	0.0%	9.5%	0.0%	0.0%	3.8%
		% of Total	0.0%	3.8%	0.0%	0.0%	3.8%
Total		Count	8	21	18	5	52
		% within AGEAGEST	15.4%	40.4%	34.6%	9.6%	100.0%
		% within L3AT	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	15.4%	40.4%	34.6%	9.6%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10.095	15	0.814

Table 4-21 Shown from table above the independence Chi-Square test and according to the result above the value of sig is greater than 0.05 which indicated to no relationship between the diameter of spinal canal and the age.

AGEAGEST * L4AP Crosstabulation						
			L4AP			Total
			less than 14.8 mm	14.8 - 21.9 mm	22 - 29.1 mm	
AGEAGEST	Less than 15	Count	1	3	2	6
		% within AGEAGEST	16.7%	50.0%	33.3%	100.0%
		% within L4AP	3.3%	18.8%	33.3%	11.5%
		% of Total	1.9%	5.8%	3.8%	11.5%
	15 - 25	Count	7	1	2	10
		% within AGEAGEST	70.0%	10.0%	20.0%	100.0%
		% within L4AP	23.3%	6.3%	33.3%	19.2%
		% of Total	13.5%	1.9%	3.8%	19.2%
	26 - 35	Count	9	4	0	13
		% within AGEAGEST	69.2%	30.8%	0.0%	100.0%
		% within L4AP	30.0%	25.0%	0.0%	25.0%
		% of Total	17.3%	7.7%	0.0%	25.0%
	36 - 45	Count	6	6	2	14
		% within AGEAGEST	42.9%	42.9%	14.3%	100.0%
		% within L4AP	20.0%	37.5%	33.3%	26.9%
		% of Total	11.5%	11.5%	3.8%	26.9%
	46 - 55	Count	5	2	0	7
		% within AGEAGEST	71.4%	28.6%	0.0%	100.0%
		% within L4AP	16.7%	12.5%	0.0%	13.5%
		% of Total	9.6%	3.8%	0.0%	13.5%
	55 and above	Count	2	0	0	2
		% within AGEAGEST	100.0%	0.0%	0.0%	100.0%
		% within L4AP	6.7%	0.0%	0.0%	3.8%
		% of Total	3.8%	0.0%	0.0%	3.8%
Total		Count	30	16	6	52
		% within AGEAGEST	57.7%	30.8%	11.5%	100.0%
		% within L4AP	100.0%	100.0%	100.0%	100.0%
		% of Total	57.7%	30.8%	11.5%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	12.831	10	0.233

Table 4-22 Shown from table above the independence Chi-Square test and according to the result above the value of sig is greater than 0.05 which indicated to no relationship between the diameter of spinal canal and the age.

c

			L4AT				Total
			less than 14.8 mm	14.8 - 21.9 mm	22 - 29.1 mm	29.2 - 36.3 mm	
AGEAGEST	Less than 15	Count	0	1	4	1	6
		% within AGEAGEST	0.0%	16.7%	66.7%	16.7%	100.0%
		% within L4AT	0.0%	5.3%	17.4%	16.7%	11.5%
		% of Total	0.0%	1.9%	7.7%	1.9%	11.5%
	15 - 25	Count	0	7	2	1	10
		% within AGEAGEST	0.0%	70.0%	20.0%	10.0%	100.0%
		% within L4AT	0.0%	36.8%	8.7%	16.7%	19.2%
		% of Total	0.0%	13.5%	3.8%	1.9%	19.2%
	26 - 35	Count	2	4	6	1	13
		% within AGEAGEST	15.4%	30.8%	46.2%	7.7%	100.0%
		% within L4AT	50.0%	21.1%	26.1%	16.7%	25.0%
		% of Total	3.8%	7.7%	11.5%	1.9%	25.0%
	36 - 45	Count	1	4	7	2	14
		% within AGEAGEST	7.1%	28.6%	50.0%	14.3%	100.0%
		% within L4AT	25.0%	21.1%	30.4%	33.3%	26.9%
		% of Total	1.9%	7.7%	13.5%	3.8%	26.9%
	46 - 55	Count	1	2	3	1	7
		% within AGEAGEST	14.3%	28.6%	42.9%	14.3%	100.0%
		% within L4AT	25.0%	10.5%	13.0%	16.7%	13.5%
		% of Total	1.9%	3.8%	5.8%	1.9%	13.5%
	55 and above	Count	0	1	1	0	2
		% within AGEAGEST	0.0%	50.0%	50.0%	0.0%	100.0%
		% within L4AT	0.0%	5.3%	4.3%	0.0%	3.8%
		% of Total	0.0%	1.9%	1.9%	0.0%	3.8%
Total		Count	4	19	23	6	52
		% within AGEAGEST	7.7%	36.5%	44.2%	11.5%	100.0%
		% within L4AT	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	7.7%	36.5%	44.2%	11.5%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9.918	15	0.825

Table 4-23 Shown from table above the independence Chi-Square test and according to the result above the value of sig is greater than 0.05 which indicated to no relationship between the diameter of spinal canal and the age.

AGEAGEST * L5AP Crosstabulation						
			L5AP			Total
			less than 14.8 mm	14.8 - 21.9 mm	22 - 29.1 mm	
AGEAGEST	Less than 15	Count	1	2	3	6
		% within AGEAGEST	16.7%	33.3%	50.0%	100.0%
		% within L5AP	3.6%	12.5%	37.5%	11.5%
		% of Total	1.9%	3.8%	5.8%	11.5%
	15 - 25	Count	7	1	2	10
		% within AGEAGEST	70.0%	10.0%	20.0%	100.0%
		% within L5AP	25.0%	6.3%	25.0%	19.2%
		% of Total	13.5%	1.9%	3.8%	19.2%
	26 - 35	Count	9	4	0	13
		% within AGEAGEST	69.2%	30.8%	0.0%	100.0%
		% within L5AP	32.1%	25.0%	0.0%	25.0%
		% of Total	17.3%	7.7%	0.0%	25.0%
	36 - 45	Count	5	6	3	14
		% within AGEAGEST	35.7%	42.9%	21.4%	100.0%
		% within L5AP	17.9%	37.5%	37.5%	26.9%
		% of Total	9.6%	11.5%	5.8%	26.9%
	46 - 55	Count	5	2	0	7
		% within AGEAGEST	71.4%	28.6%	0.0%	100.0%
		% within L5AP	17.9%	12.5%	0.0%	13.5%
		% of Total	9.6%	3.8%	0.0%	13.5%
	55 and above	Count	1	1	0	2
		% within AGEAGEST	50.0%	50.0%	0.0%	100.0%
		% within L5AP	3.6%	6.3%	0.0%	3.8%
		% of Total	1.9%	1.9%	0.0%	3.8%
Total		Count	28	16	8	52
		% within AGEAGEST	53.8%	30.8%	15.4%	100.0%
		% within L5AP	100.0%	100.0%	100.0%	100.0%
		% of Total	53.8%	30.8%	15.4%	100.0%

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	14.718	10	0.143

Table 4-24 Shown from table above the independence Chi-Square test and according to the result above the value of sig is greater than 0.05 which indicated to no relationship between the diameter of spinal canal and the age.

AGEAGEST * L5AT Crosstabulation

			L5AT				Total
			14.8 - 21.9 mm	22 - 29.1 mm	29.2 - 36.3 mm	36.4 - 43.5 mm	
AGEAGEST	Less than 15	Count	0	2	4	0	6
		% within AGEAGEST	0.0%	33.3%	66.7%	0.0%	100.0%
		% within L5AT	0.0%	10.0%	33.3%	0.0%	11.5%
		% of Total	0.0%	3.8%	7.7%	0.0%	11.5%
	15 - 25	Count	6	2	2	0	10
		% within AGEAGEST	60.0%	20.0%	20.0%	0.0%	100.0%
		% within L5AT	33.3%	10.0%	16.7%	0.0%	19.2%
		% of Total	11.5%	3.8%	3.8%	0.0%	19.2%
	26 - 35	Count	5	5	2	1	13
		% within AGEAGEST	38.5%	38.5%	15.4%	7.7%	100.0%
		% within L5AT	27.8%	25.0%	16.7%	50.0%	25.0%
		% of Total	9.6%	9.6%	3.8%	1.9%	25.0%
	36 - 45	Count	3	7	3	1	14
		% within AGEAGEST	21.4%	50.0%	21.4%	7.1%	100.0%
		% within L5AT	16.7%	35.0%	25.0%	50.0%	26.9%
		% of Total	5.8%	13.5%	5.8%	1.9%	26.9%
	46 - 55	Count	3	3	1	0	7
		% within AGEAGEST	42.9%	42.9%	14.3%	0.0%	100.0%
		% within L5AT	16.7%	15.0%	8.3%	0.0%	13.5%
		% of Total	5.8%	5.8%	1.9%	0.0%	13.5%
	55 and above	Count	1	1	0	0	2
		% within AGEAGEST	50.0%	50.0%	0.0%	0.0%	100.0%
		% within L5AT	5.6%	5.0%	0.0%	0.0%	3.8%
		% of Total	1.9%	1.9%	0.0%	0.0%	3.8%
Total		Count	18	20	12	2	52
		% within AGEAGEST	34.6%	38.5%	23.1%	3.8%	100.0%
		% within L5AT	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	34.6%	38.5%	23.1%	3.8%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	14.372	15	0.498

Chapter Five

5-1 Discussion

This study aimed to measure the normal diameter of the lumber spinal canal in Sudanese population.

So fifty two normal subject (27 male ,25 female) were selected to perform this study . All the subject scan by CT machine Toshiba Aquilion 64 slice data collection in sheet were include gender and age , for each subject related to AP and Lateral diameter of the spinal canal of all lumber spine and the result came out as :-

From table 4-1 which show the test of equality of means between male and female Lumber Spinal canal diameter.

There is no equal mean between the male and female result for all lumber spine readings except the L3 .

From table 4-2 which show the independence Chi –Squire test there is a strong relationship between the gender and lumber spine canal diameter in which there is always greater values in male group compare with the female group , so the lumber spinal canal in male is always wider than female except in L3 which showed nearby result in both group (male and female).

This result is disagreed with Muhammad Zahoor and Fida Muhammad whom their result showed the diameter of lumbar canal in female is greater than male. From table (4-13) to (4-22).Which show the independence Chi Squire test for relationship between subject age and lumber canal diameter , the is no relationship between the subject age and the lumber canal diameter .

But this study result agreed with the study of a Prospective Analysis of Magnetic Resonance Imaging Findings in Patients With Sciatica and Lumbar Disc Herniation: Correlation of Outcomes With Disc Fragment and Canal Morphology, by Carragee, Eugene J. MD; Kim, David H. MD. (http://journals.lww.com), on its Results. Part 1: Wide ranges of disc and canal measurements were seen in all parameters. Significant differences in all magnetic resonance parameters were noted between male and female patients. Men had proportionately greater canal compromise by the affected disc than women. Positive sciatic tension signs and short duration of symptoms correlated with large disc herniation. Right sided symptomatic herniation were usually larger than left.

The column number five included the calculated t-test value and number six the degree of freedom and the column number seven show the t-test p-value (sig) which interpreted as follow if the sig is less than 0.05 that means there are differences between the male and female means of variable investigated , the column number eight show the mean differences and if it is positive that means the length of male lumbar is greater than female one , column number nine show the stander error of means differences and the column number ten show 95% Confidence Interval of the Difference.

5-2 Conclusion

- The study concluded that CT is best modalities in measurement of lumbar spinal canal.
- The lumbar spinal canal was different in male and female .
- The normal range of spinal was different from vertebra itself.
- There is no variation in spinal canal indifferent aged. Spinal measurement was important to be as mirror to diagnosis any variation lea to complication.
- From this study we found that the normal spinal canal diameter in L1, L5 is mostly affected by gender factor.
- Male has wider canal than female, age factor has no effect in the diameter of lumber canal .
- This result is disagreed with Muhammad Zahoor and Fida Muhammad whom their result showed the diameter of lumbar canal in female is greater than male from table (4-13) to (4-22) Which show the independence Chi Squire test for relationship between subject age and lumber canal diameter, there is no relationship between the subject age and the lumber canal diameter.
- But this study result agreed with the study of a Prospective Analysis of Magnetic Resonance Imaging Findings in Patients With Sciatica and Lumbar Disc Herniation: Correlation of Outcomes With Disc Fragment and Canal Morphology, by Carragee, Eugene J. MD; Kim, David H. MD. (http://journals.lww.com), on its Results. Part 1 Men had proportionately greater canal compromise by the affected disc than women.

5-3 Recommendation

This study recommended :

- Keep the ideal weight .
- Construct number of Slimming centers.
- Using of medical belt so as to keep intervertebral series of natural form.
- The technologist should know the normal range of lumbar canal measurements to correct image interpretation.
- Another research with more sample.
- Put difference for Sudanese population.
- There must be sorry to maser lumbar canal by using different imaging modalities.
- All department must have guided for normal lumbar canal diameter.

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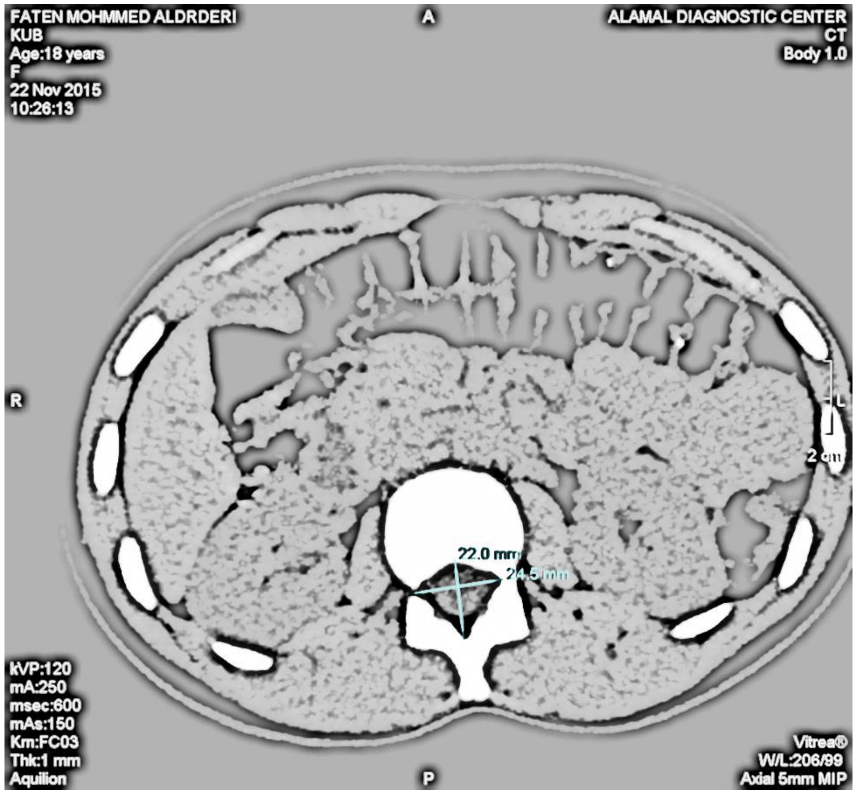
Appendices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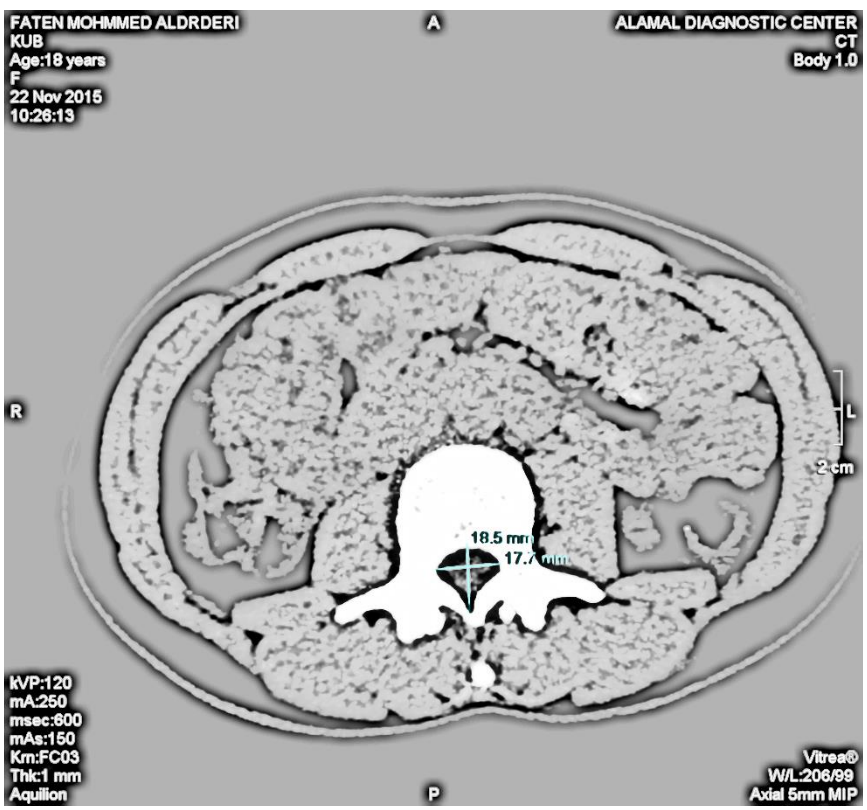
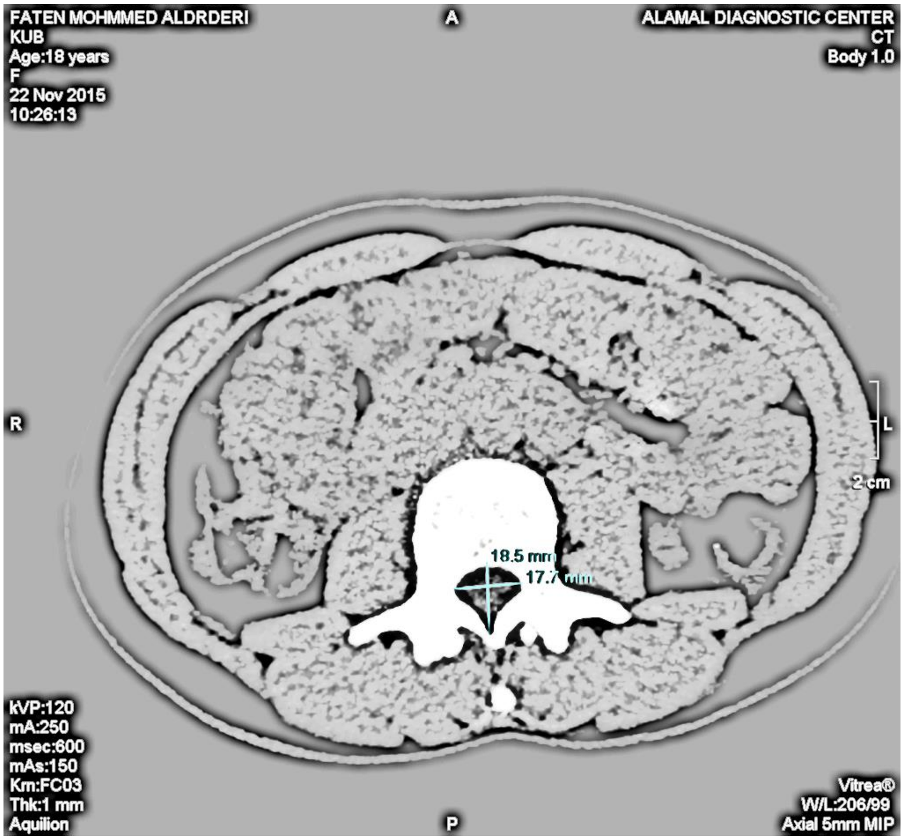
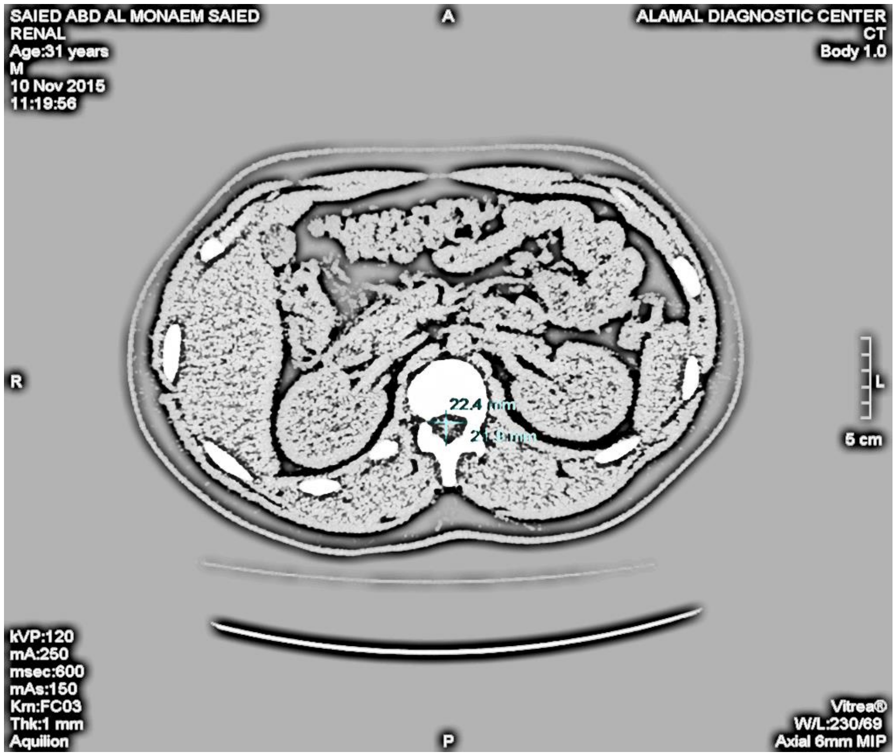
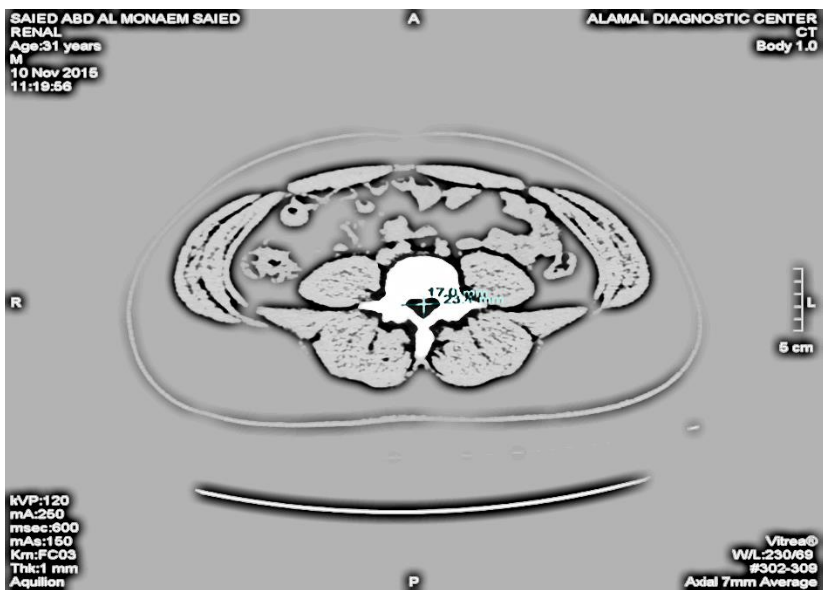
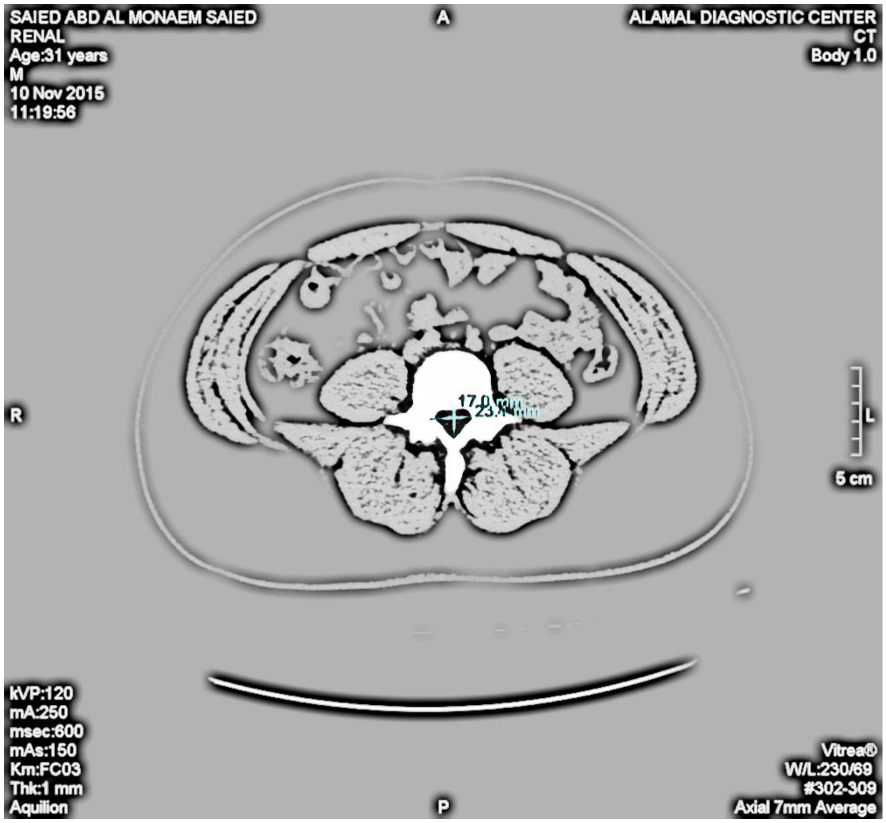
KUB
Age:18 years
F
22 Nov 2015
10:26:13
A
ALAMAL DIAGNOSTIC CENTER
CT
Body 1.0
R
L
2 cm
22.0 mm
24.5 mm
kVP:120
mA:250
msec:600
mAs:150
Km:FC03
Thk:1 mm
Aquilion
P
Vitrea®
W/L:206/99
Axial 5mm MIP

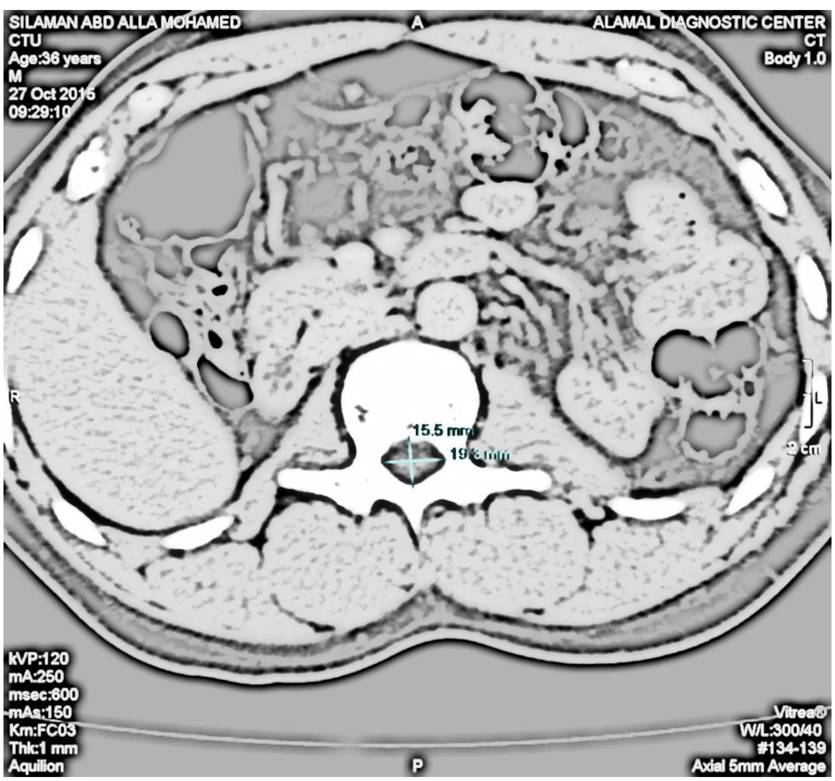

FATEN MOHMMED ALDRDERI
KUB
Age:18 years
F
22 Nov 2015
10:26:13
A
ALAMAL DIAGNOSTIC CENTER
CT
Body 1.0
R
L
2 cm
18.5 mm
17.7 mm
kVP:120
mA:250
msec:600
mAs:150
Km:FC03
Thk:1 mm
Aquilion
P
Vitrea®
W/L:206/99
Axial 5mm MIP

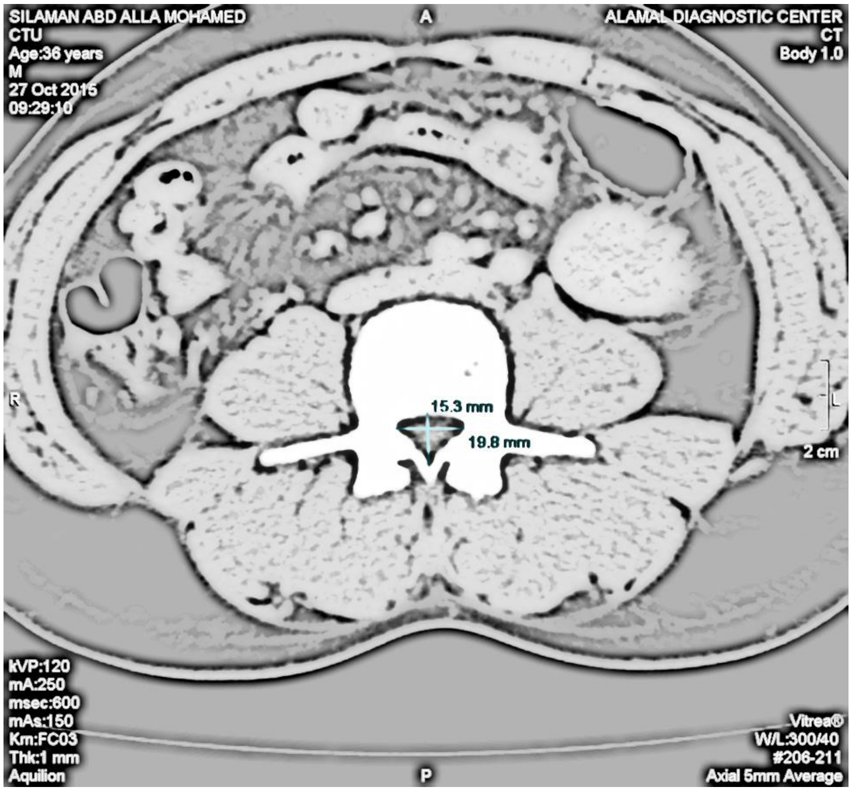

FATEN MOHMMED ALDRDERI
KUB
Age:18 years
F
22 Nov 2015
10:26:13
A
ALAMAL DIAGNOSTIC CENTER
CT
Body 1.0
R
L
2 cm
18.5 mm
17.7 mm
kVP:120
mA:250
msec:600
mAs:150
Km:FC03
Thk:1 mm
Aquilion
P
Vitrea®
W/L:206/99
Axial 5mm MIP

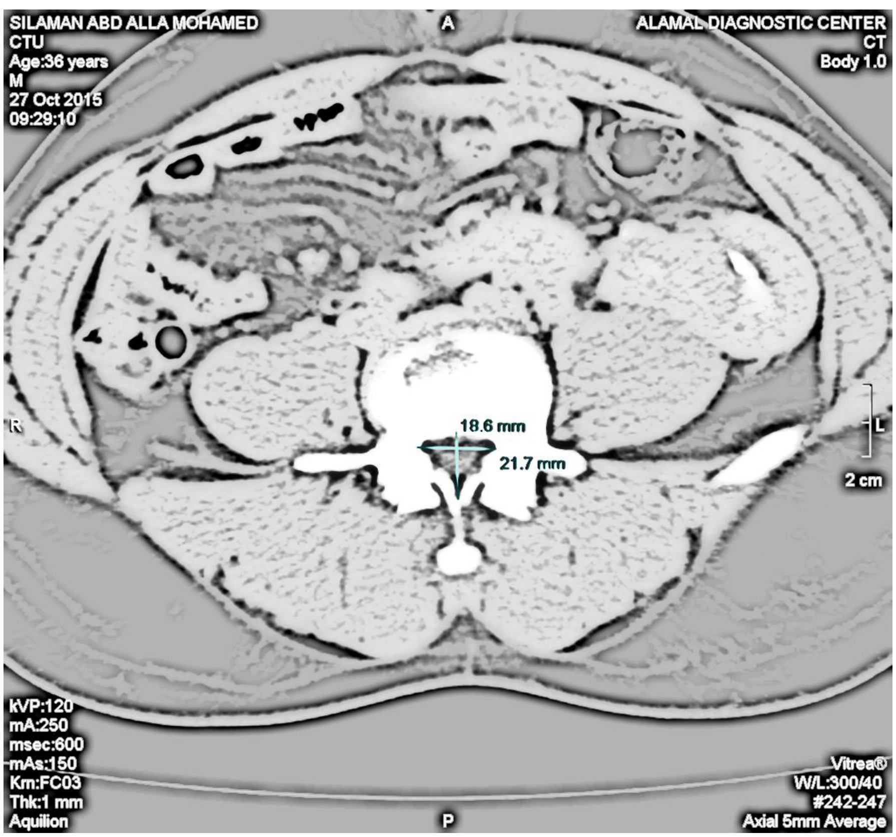

SAIED ABD AL MONAEM SAIED
RENAL
Age:31 years
M
10 Nov 2015
11:19:56
A
ALAMAL DIAGNOSTIC CENTER
CT
Body 1.0
R
L
5 cm
22.4 mm
kVP:120
mA:250
msec:600
mAs:150
Km:FC03
Thk:1 mm
Aquilion
P
Vitrea®
W/L:230/69
Axial 6mm MIP

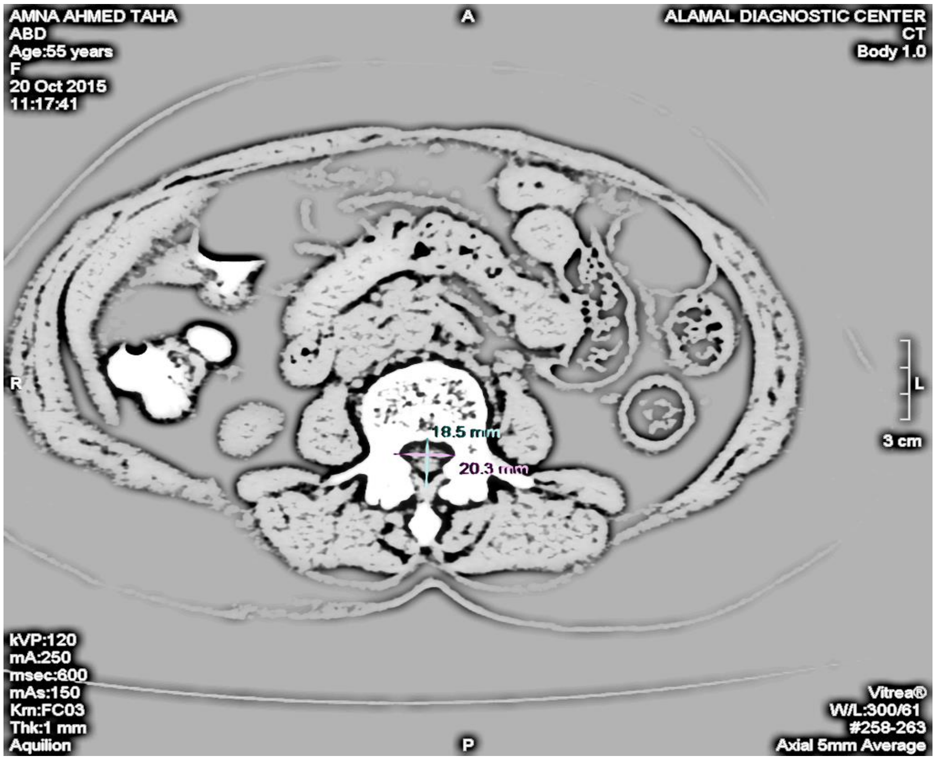

SAIED ABD AL MONAEM SAIED
RENAL
Age:31 years
M
10 Nov 2015
11:19:56
A
ALAMAL DIAGNOSTIC CENTER
CT
Body 1.0
R
L
5 cm
17.0 mm
kVP:120
mA:250
msec:600
mAs:150
Km:FC03
Thk:1 mm
Aquilion
P
Vitrea®
W/L:230/69
#302-309
Axial 7mm Average


SAIED ABD AL MONAEM SAIED
RENAL
Age:31 years
M
10 Nov 2015
11:19:56
A
ALAMAL DIAGNOSTIC CENTER
CT
Body 1.0
R
L
5 cm
kVP:120
mA:250
msec:600
mAs:150
Km:FC03
Thk:1 mm
Aquilion
P
Vitrea®
W/L:230/69
#302-309
Axial 7mm Average


SILAMAN ABD ALLA MOHAMED
CTU
Age:36 years
M
09:29:10
A
ALAMAL DIAGNOSTIC CENTER
CT
Body 1.0
R
15.5 mm
kVP:120
mA:250
msec:600
mAs:150
Km:FC03
Thk:1 mm
Aquilion
P
Vitrea®
W/L:300/40
#134-139
Axial 5mm Average


SILAMAN ABD ALLA MOHAMED
CTU
Age:36 years
M
27 Oct 2015
09:29:10
A
ALAMAL DIAGNOSTIC CENTER
CT
Body 1.0
R
L
2 cm
15.3 mm
19.8 mm
kVP:120
mA:250
msec:600
mAs:150
Km:FC03
Thk:1 mm
Aquilion
P
Vitrea®
W/L:300/40
#206-211
Axial 5mm Average


SILAMAN ABD ALLA MOHAMED
CTU
Age:36 years
M
27 Oct 2015
09:29:10
A
ALAMAL DIAGNOSTIC CENTER
CT
Body 1.0
R
L
2 cm
18.6 mm
21.7 mm
kVP:120
mA:250
msec:600
mAs:150
Km:FC03
Thk:1 mm
Aquilion
P
Vitrea®
W/L:300/40
#242-247
Axial 5mm Average


AMNA AHMED TAHA
ABD
Age:55 years
F
20 Oct 2015
11:17:41
A
ALAMAL DIAGNOSTIC CENTER
CT
Body 1.0
R
L
3 cm
18.5 mm
20.3 mm
kVP:120
mA:250
msec:600
mAs:150
Km:FC03
Thk:1 mm
Aquilion
P
Vitrea®
W/L:300/61
#258-263
Axial 5mm Average


AMNA AHMED TAHA
ABD
Age:55 years
F
20 Oct 2015
11:17:41
A
ALAMAL DIAGNOSTIC CENTER
CT
Body 1.0
R
L
3 cm
16.4 mm
23.3 mm
kVP:120
mA:250
msec:600
mAs:150
Km:FC03
Thk:1 mm
Aquilion
P
Vitrea®
W/L:300/61
#300-305
Axial 5mm Average


AMNA AHMED TAHA
ABD
Age:55 years
F
20 Oct 2015
11:17:41
A
ALAMAL DIAGNOSTIC CENTER
CT
Body 1.0
R
L
3 cm
16.4 mm
23.3 mm
kVP:120
mA:250
msec:600
mAs:150
Km:FC03
Thk:1 mm
Aquilion
P
Vitrea®
W/L:300/61
#300-305
Axial 5mm Average

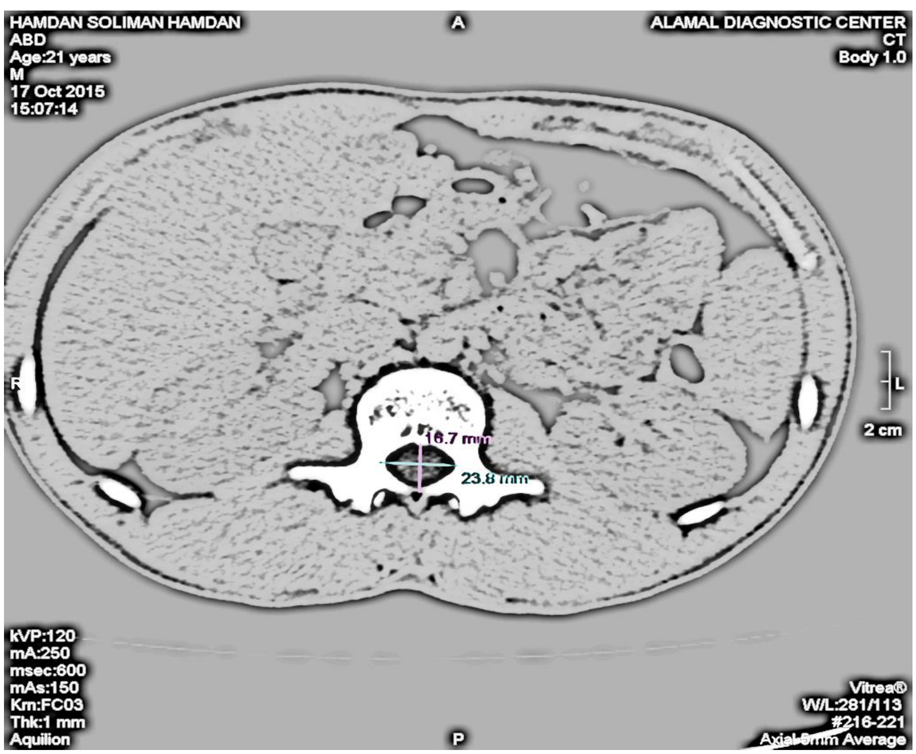
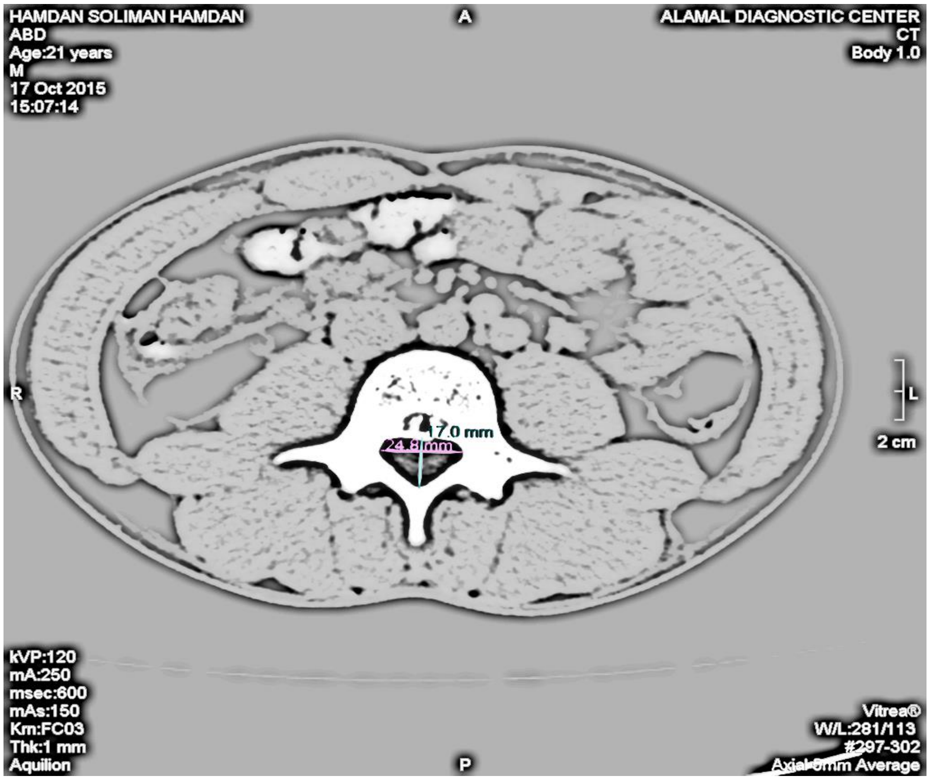
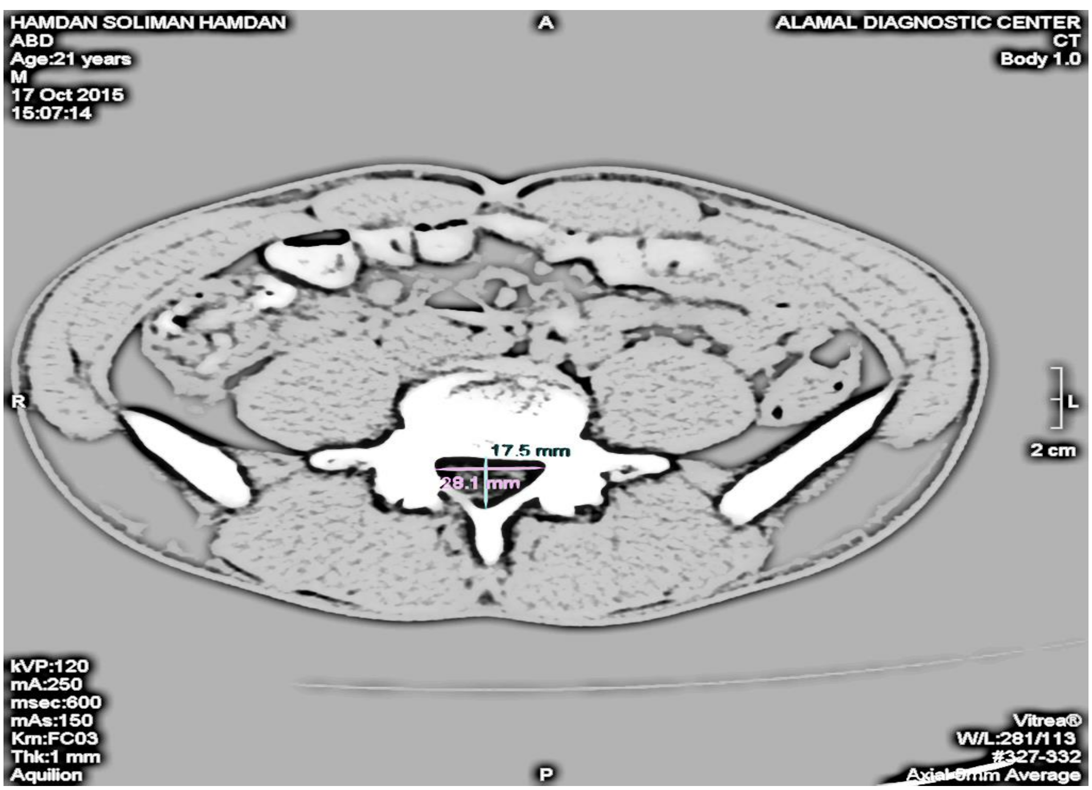

HAMDAN SOLIMAN HAMDAN
ABD
Age:21 years
M
17 Oct 2015
15:07:14
A
ALAMAL DIAGNOSTIC CENTER
CT
Body 1.0
R
L
2 cm
16.7 mm
23.8 mm
kVP:120
mA:250
msec:600
mAs:150
Km:FC03
Thk:1 mm
Aquilion
P
Vitrea®
W/L:281/113
#216-221

image (5-1)


HAMDAN SOLIMAN HAMDAN
ABD
Age:21 years
M
17 Oct 2015
15:07:14
A
ALAMAL DIAGNOSTIC CENTER
CT
Body 1.0
R
L
2 cm
17.0 mm
24.8 mm
kVP:120
mA:250
msec:600
mAs:150
Km:FC03
Thk:1 mm
Aquilion
P
Vitrea®
W/L:281/113
#297-302
Axial 5mm Average


HAMDAN SOLIMAN HAMDAN
ABD
Age:21 years
M
17 Oct 2015
15:07:14
A
ALAMAL DIAGNOSTIC CENTER
CT
Body 1.0
R
L
2 cm
17.5 mm
28.1 mm
kVP:120
mA:250
msec:600
mAs:150
Km:FC03
Thk:1 mm
Aquilion
P
Vitrea®
W/L:281/113
#327-332
Axial 5mm Average