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Sudan University of Science and Technology

College of Graduate Studies

Evaluation of Lumber Canal Diameter using Computed Tomography

تقييم قطر القناة القطنية باستخدام التصوير المقطعي

A thesis submitted in partial fulfillment for the requirements

of Master degree in Diagnostic Radiology

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الآية

بِسۡمِ ٱللَّهِ ٱلرَّحۡمَٰنِ ٱلرَّحِيمِ

(قُل لَّئِنِ اجْتَمَعَتِ الْإِنسُ وَالْجِنُّ عَلَىٰ أَن يَأْتُوا بِمِثْلِ

هَٰذَا الْقُرْآنِ لَا يَأْتُونَ بِمِثْلِهِ وَلَوْ كَانَ بَعْضُهُمْ لِبَعْضٍ

ظَهِيرًا)

سورة الاسراء: الآية 88

صدق الله العظيم

DEDICATION

To my father soul

To my mother

To my teachers

To my family

To my friends

ACKNOWLEDGMENTS

First and foremost, I have to thank my parents for their love and support throughout my life. Thank you both for giving me strength to reach for the stars and chase my dreams. My lovely sisters deserves my wholehearted thanks as well for her continuously support.

I would like to sincerely thank my supervisor Dr. Iklas Abd Al Aziz , for her guidance and support throughout this study and especially for her everlasting collaboration and trusting in me.

Abstract

This study aimed to evaluate the lumber canal diameter using computed tomography in Khartoum state in period from march to October 2018. The data were collected from Yastabshiroon medical center using CT machine model GE optima 16 slice. The scan parameter 5mm slice ,120 kv, 200 mA.

The results presented in statistical parameters as mean, median, stander deviation , minimum and maximum. Were the mean ± standard deviation for age was 44.71±15.38, for Mid-sagittal of body, Transverse of body, Mid-sagittal of canal and Transverse of canal was 29.89 ± 3.84, 40.05 ± 3.89, 15.21 ± 2.31 and 22.56 ± 2.84 respectively. using linear regression equation showed that the correlate with age and Mid-sagittal of body showed the mid-sagittal of body increase with the age by rate 0.0931 for each year. correlate between age and transverse of body showed the transverse of body increase with the age by rate 0.1137 for each year. correlate between age and mid-sagittal of canal showed the mid-sagittal of body decrease with the age by rate 0.023 for each year. correlate between age and transverse of canal showed the transverse of canal increase with the age by rate 0.0242 for each year.

المستخلص

هدفت هذه الدراسة إلى تقييم قطر القناة القطنية باستخدام التصوير بالاشعة المقطعية المحوسبة بولاية الخرطوم في الفترة من مارس إلى أكتوبر 2018. تم جمع البيانات من مركز يستبشيرون الطبي باستخدام آلة التصوير المقطعي المحوسب .GE optima 16 شريحة معلمة المسح 5 مم ، 120 كيلو فولت ، 200 مللي أمبير.

عرضت النتائج في المعلمات الإحصائية مثل المتوسط ، الوسط الحسابي والانحراف معياري. كان المتوسط ± الانحراف المعياري للعمر هو 44.71 ± 15.38 ، بالنسبة للوسط السهمي من الجسم ، وعرض الجسم ، والوسط السهمي للقناة وعرض القناة كان 29.89 ± 3.84 ، 40.05 ± 3.89 ، 15.21 ± 2.31 و 22.56 ± 2.84 على التوالي . باستخدام معادلة الانحدار الخطي بينت أن الارتباط مع العمر ومتوسط السهمي للجسم أظهر أن منتصف السهمي يزداد مع تقدم العمر بمعدل 0.0931 لكل عام. أظهر الارتباط بين العمر وعرض الجسم زيادة عرضية للجسم مع تقدم العمر بمعدل 0.1137 لكل عام. أظهر الارتباط بين العمر ومنتصف القوس للقناة انخفاضًا في منتصف السهمي للجسم مع تقدم العمر بمعدل 0.023 لكل عام. الارتباط بين العمر وعرض القناة أظهر عرضية زيادة القناة مع العمر بمعدل 0.0242 لكل عام.

List of Contents

List of tables

List of figures

List of abbreviation

CT	Computed Radiography
MRI	Magnetic Resonance Imaging
ALL	anterior longitudinal ligament
PLL	posterior longitudinal ligament
annulus fibrosus	annulus fibrosus
ISL	interspinous ligament
LF	ligamentum flavum
NP	nucleus pulposus
SSL	supraspinous ligament
PSIS	posterior superior iliac spine
CSF	cerebrospinal fluid
CNS	central nervous system
AS	Ankylosing spondylitis

Chapter One

Introduction

Chapter One

Introduction

1.1 Introduction:

One of the simplest descriptors of spinal anatomy is often overlooked: vertebral numbering. Having a consistent method of vertebral labeling is important in developing a detailed description of both normal and altered spinal anatomy. In the normal spine the cervical region consists of the skull base (C0) and seven mobile segments: C1-C7. The thoracic spine has 12 mobile segments: T1-T12. Each thoracic segment has a pair of ribs that articulate with the named vertebral body. The ribs from T1-T10 are usually joined anteriorly at the costochondral junction or sternum. T11 and T12 usually have “floating ribs,” which are not connected anteriorly to the rib cage. The normal lumbar spine has five mobile segments: L1-L5. The sacropelvic unit consists of the sacrum/coccyx and the bilateral ilium. The sacrum is comprised of five fused segments that articulate with the ilium through the SI joints bilaterally (Michael F. et al 2008) (see Figures 1.1).

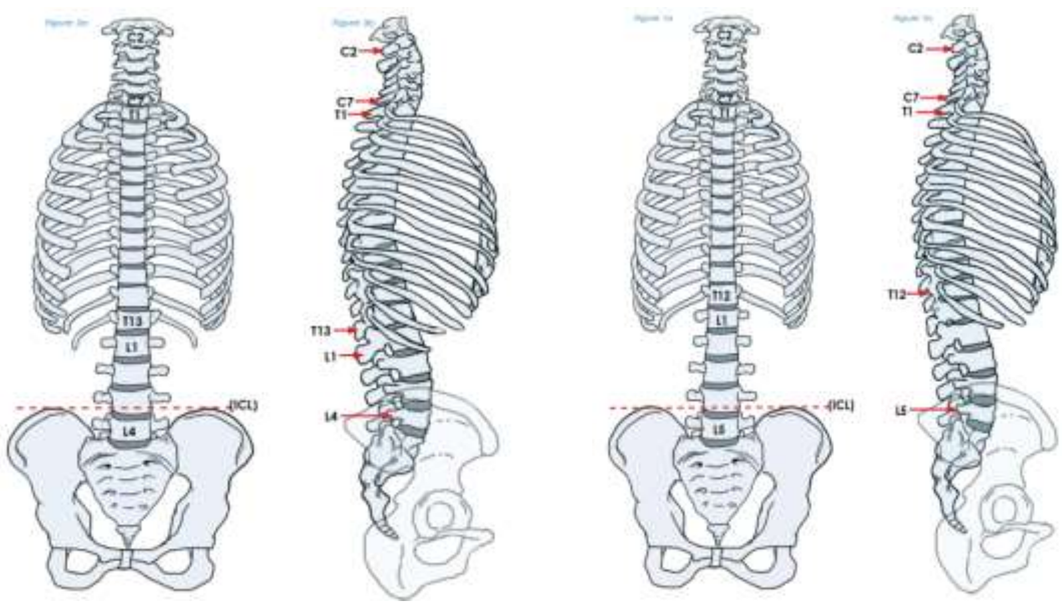

Figure 1.1 show spine cord

In different studies performed in several counties, minimum and maximum ranges of spinal canal diameters were different for each population. By determining normal ranges of spinal canal diameters we can make initial diagnosis in persons who have lower diameters of spinal canal. These persons are predisposed to spinal canal stenosis, which is the major cause of spinal radiculopathies. Low back pain is the major cause of disability, poor quality of life and societal costs (Michael F. et al 2008).

1.2 Problem of the study :-

The structure of the lumbar spine is complex. To diagnose and treat this area effectively, one must have a clear knowledge of the normal anatomy. Following is an introduction of anatomy of lumbar spine. The size of lumber canal differ with different races .and these is no standard measurement for normal spinal canal size

1.3 Objectives of the study :

1.3.1 General Objective: to evaluate of lumber canal diameter using computed tomography.

1.3.2 Specific objective :

- ❖ To measure the diameter of midsagittal of body and transverse of body, in order to fined normative data.
- ❖ To measure the diameter of midsagittal of canal and transverse of canal.
- ❖ To evaluate the significant difference between gender.
- ❖ To correlate lumber canal diameter with body characteristics.

1.4 Over view:-

These research contain five chapters :chapter one include introduction ,statement of the problem ,objectives significant of the study and over view .

Chapter two include lumber spine anatomy ,lmber spine stenosis ,diagnosis and literature review ,chapter three material and methodology ,chapter four include result of the study and chapter five include the discussion, conclusion ,reference and appendix.

Chapter Two

Theoretical Background and previous studies

Chapter Two

Theoretical Background and previous studies

2.1. Lumbar Vertebrae:

The lumbar vertebrae are, in human anatomy, the five vertebrae between the rib cage and the pelvis. They are the largest segments of the vertebral column and are characterized by the absence of the foramen transversarium within the transverse process (as it is only found in the cervical region), and by the absence of facets on the sides of the body. They are designated L1 to L5, starting at the top. The lumbar vertebrae help support the weight of the body, and permit movement (Michael F et al 2008).

2.2 anatomy of the lumbar spine

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

The vertebral body, designed to bear weight, The vertebral (neural) arch, designed to protect the neural elements and The bony processes (spinous and transverse), which function to increase the efficiency of muscle action.

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 (Michael F et al 2008).

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 (Michael F et al 2008).

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.

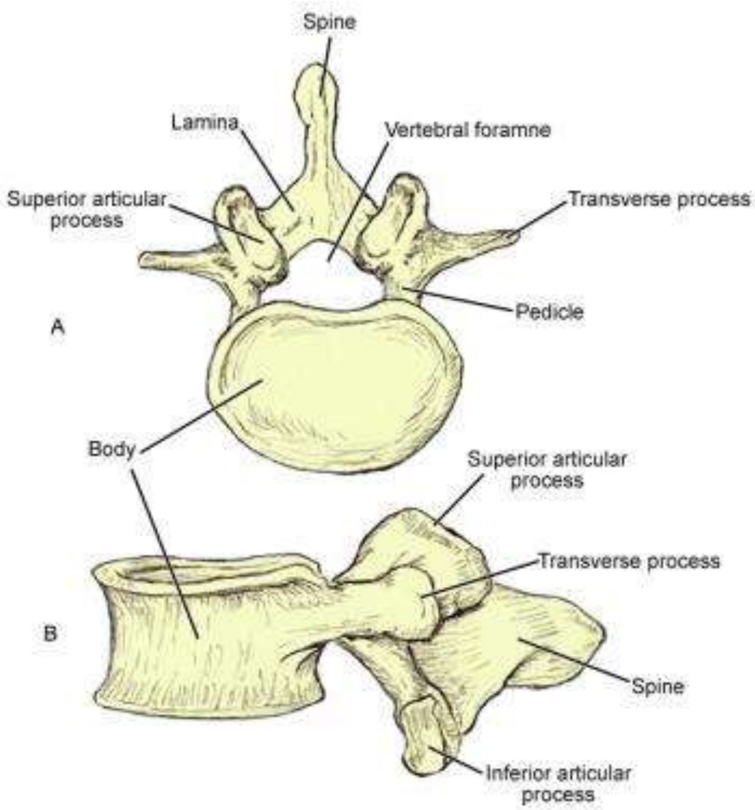

Fig 2.1 Lumbar vertebrae are characterized by massive bodies and robust spinous and transverse processes. (Obrain MF et al 2000).

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. 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 (Zindrick M et al 1987).

The two 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 (see the image below).

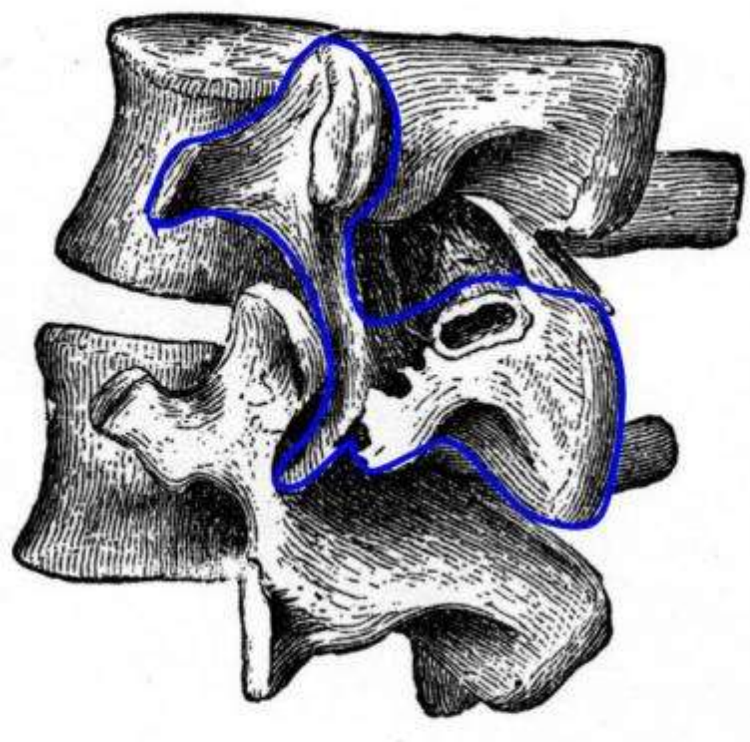

Fig 2.2 Drawing of two lumbar segments viewed from an oblique angle.

The outline of the facets and the pars interarticularis has the appearance of the "neck" of a Scottie dog. 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 (Obrain MF et al 2000).

The lumbar spine has an anterior, middle, and posterior column that is pertinent for lumbar spine fractures (see the following images).

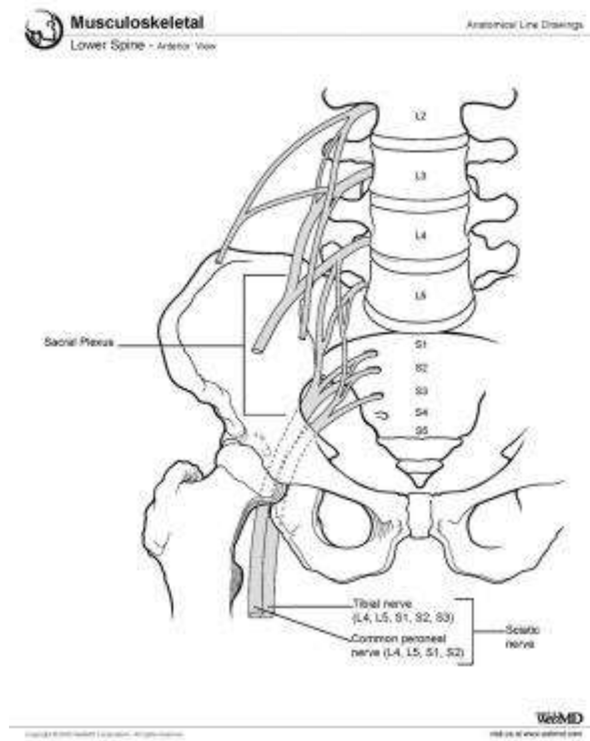

Fig 2.3 Lower spine, anterior view. (Obrain MF et al 2000).

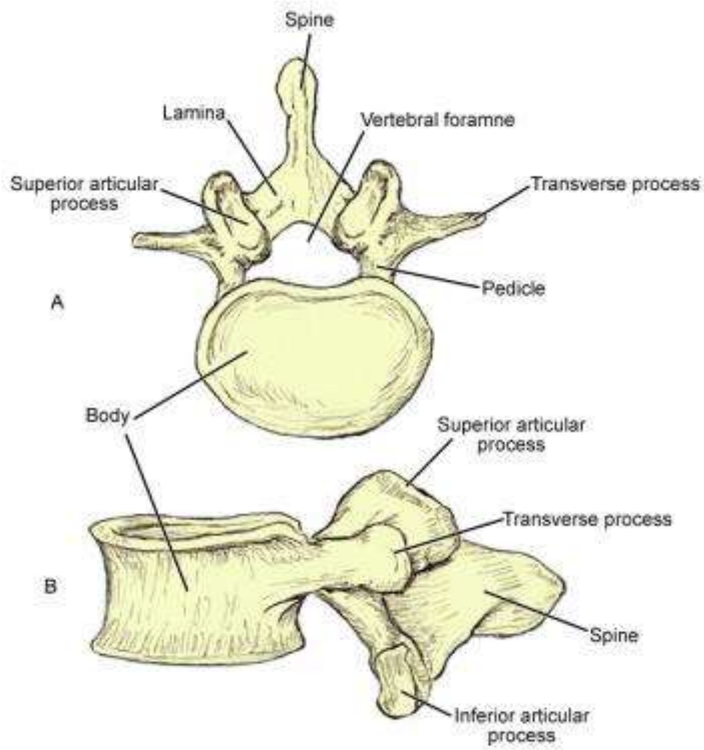

Fig 2.4 Lumbar vertebrae are characterized by massive bodies and robust spinous and transverse processes. (Obrain MF et al 2000).

Their articular facets are oriented somewhat parasagittally, which is thought to contribute the large range of anteroposterior bending possible between lumbar vertebrae. Lumbar vertebrae also contain small mammillary and accessory processes on their bodies. These bony protuberances are sites of attachment of deep lumbosacral muscles(Obrain MF et al 2000).

2.2.2 Lumbar vertebral joints

The mobility of the vertebral column is provided by the symphyseal joints between the vertebral bodies, formed by a layer of hyaline cartilage on each vertebral body and an intervertebral disc between the layers.

The synovial joints between the superior and inferior articular processes on adjacent vertebrae are termed the facet joints (also known as zygapophysial joints or Z-joints). They permit simple gliding movements. The movement of the lumbar spine is largely confined to flexion and extension with a minor degree of rotation (see the image below). The region between the superior articular process and the lamina is the pars interarticularis. A spondylolysis occurs if ossification of the pars interarticularis fails to occur.

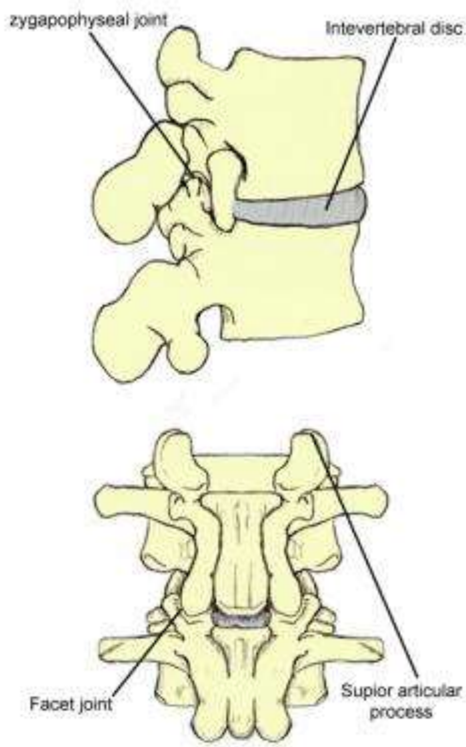

Fig 2.5 The joint complex is formed between 2 lumbar vertebrae. Joint 1: Disc between 2 vertebral bodies; Joint 2: Left facet (zygapophyseal) joint; Joint 3: Right facet (zygapophyseal) joint (Obrain MF et al 2000).

2.2.3 Lumbar intervertebral discs

Discs form the main connection between vertebrae. They bear loading during axial compression and allow movement between the vertebrae. Their size varies depending on the adjacent vertebrae size and comprises approximately one quarter the length of the vertebral column.

Each disc consists of the nucleus pulposus, a central but slightly posterior mucoid substance embedded with reticular and collagenous fibers, surrounded by the annulus fibrosus, a fibrocartilaginous lamina. The annulus fibrosus can be divided into the outermost, middle, and innermost fibers. The anterior fibers are strengthened by the powerful anterior longitudinal ligament (ALL). The posterior longitudinal ligament (PLL) affords only weak midline reinforcement, especially at L4-5 and L5-S1, as it is a narrow structure attached to the annulus. The anterior and middle fibers of the annulus are most numerous anteriorly and laterally but deficient posteriorly, where most of the fibers are attached to the cartilage plate (Castelvi et al 2004).

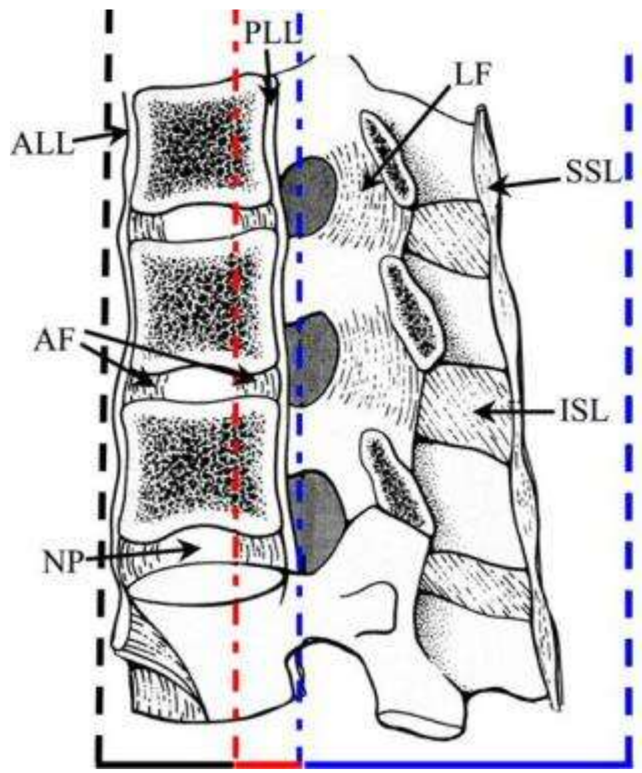

Fig 2.6 Lateral drawing of the 3 spinal columns of the thoracolumbar junction. The anterior column (black dotted line) includes the anterior spinal ligament, the anterior annulus fibrosus (AF), the intervertebral disc, and the anterior two thirds of the vertebral bodies. The middle column (red dotted line) includes the posterior aspect of the vertebral bodies, the posterior annulus fibrosus, and the posterior longitudinal ligament (PLL). The posterior column (thick blue dotted line) includes the entire spine posterior to the longitudinal ligament (thick blue dotted line). ALL

= anterior longitudinal ligament; ISL = interspinous ligament; LF = ligamentum flavum; NP = nucleus pulposus; SSL = supraspinous ligament. The annular fibers are firmly attached to the vertebral bodies and are arranged in lamellae. This annular arrangement permits limiting vertebral movements, reinforced by investing ligaments (Castelvi et al 2004).

2.2.4 Lumbar vertebral ligaments

The ALL covers the ventral surfaces of lumbar vertebral bodies and discs. It is intimately attached to the anterior annular disc fibers and widens as it descends the vertebral column. The ALL maintains the stability of the joints and limits extension. The PLL is located within the vertebral canal over the posterior surface of the vertebral bodies and discs. It functions to limit flexion of the vertebral column, except at the lower L-spine, where it is narrow and weak.

The supraspinous ligament joins the tips of the spinous processes of adjacent vertebrae from L1-L3. The interspinous ligament interconnects the spinous processes, from root to apex of adjacent processes. Sometimes described together as the interspinous/supraspinous ligament complex, they weakly resist spinal separation and flexion. The ligamentum flavum (LF) bridges the interlaminar interval, attaching to the interspinous ligament medially and the facet capsule laterally, forming the posterior wall of the vertebral canal. It has a broad attachment to the undersurface of the superior lamina and inserts onto the leading edge of the inferior lamina. Normally, the ligament is taut, stretching for flexion and contracting its elastin fibers in neutral or extension. It maintains constant disc tension.

The intertransverse ligament joins the transverse processes of adjacent vertebrae and resists lateral bending of the trunk. The iliolumbar ligament arises from the tip of the L5 transverse process and connects to the posterior part of the inner lip of the iliac crest. It helps the lateral lumbosacral ligament and the ligaments mentioned above stabilize the lumbosacral joint.

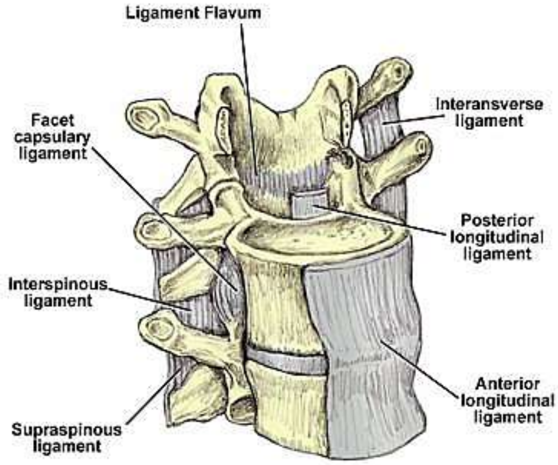

Fig 2.7 Anterolateral view of the lumbar spine demonstrating the multiple Ligaments of the lumbar spine (Castelvi et al 2004).

These ligaments include the following: ligamentum flavum (LF), anterior longitudinal ligament (ALL), posterior longitudinal ligament (PLL), intertransverse ligament, interspinous ligament, supraspinous ligament, and facet capsular ligament (Castelvi et al 2004).

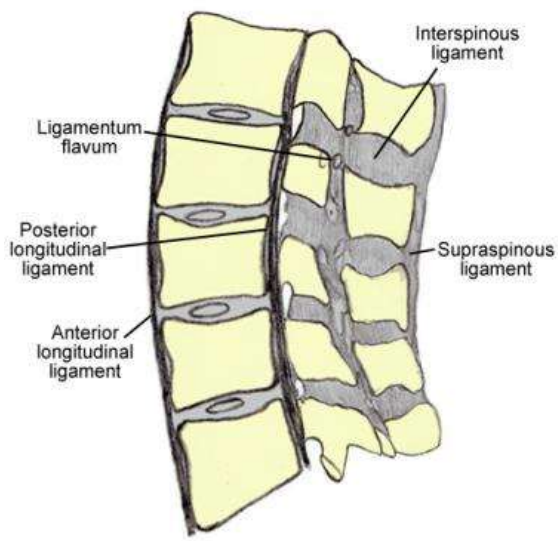

Fig 2.8 Lumbar spinal ligaments, lateral view. (Castelvi et al 2004).

2.2.5 Lumbar spine musculature

Four functional groups of muscles govern the lumbar spine and can be divided into extensors, flexors, lateral flexors, and rotators. Synergistic muscle action from both the left and right side muscle groups exist during flexion and extension of the L-spine. (See the image below.)

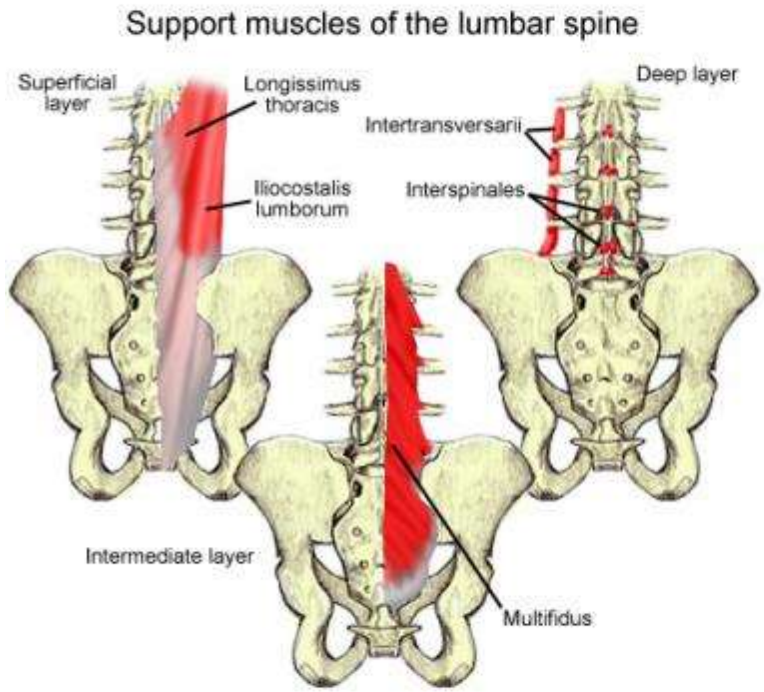

Fig 2.9 Lumbar spinal muscles. (Obrain MF et al 2000).

Extensors: The extensor muscles are arranged in 3 layers. The largest group of intrinsic back muscles and primary extensor is the erector spinae (or sacrospinalis). In the lower L-spine, the erector spinae appears as a single muscle. At the upper lumbar area, it divides into 3 vertical columns of muscles (iliocostalis, longissimus, spinalis). Located posterolateral to the vertebral column, they have a common origin from a thick tendon that is attached to the sacrum, the lumbar spinous processes, and the iliac crest. The iliocostalis is the most lateral, and the spinalis (smallest muscle) is the most medial. The longissimus (largest muscle) inserts on to the skull base, whereas the iliocostalis inserts onto the angles of the ribs and transverse processes of the lower cervical vertebrae. As these muscles ascend up the vertebral column, they divide regionally depending on where the muscle attaches superiorly.

A 3-layered fasciculated muscle, the transversospinal muscle group, lies deep to the erector spinae and originates on the mamillary processes in the lumbar spine. In the sacrum, it originates from the laminar area just medial to the posterior sacral foramina, from the tendinous origins on the erector spinae, and the medial surface of the posterior superior iliac spine (PSIS). Each fascicle is directed superomedially toward the inferior and medial margin of the lamina and adjacent spinous process. The superficial layer attaches from 3-4 levels above, the intermediate layer attaches 2 levels above, and the deep layer attaches 1 level above. The transversospinal muscle group acts both as an L-spine extensor and a rotator (Gelb D et al 2005).

A multitude of small, segmental muscles are the deepest layer of the lumbar extensors. They can be divided into 2 groups, both innervated by the dorsal rami of spinal nerves. The levatores costarum are not typically present in the lumbar spine. The second group contains the interspinales and intertransversarii. The interspinales consists of short fasciculi attached between the spinous processes of contiguous vertebrae. The intertransversarii consist of 2-3 slips of muscles, which pass between adjacent transverse processes. They are postural stabilizers and increase the efficiency of larger muscle group action.

2.2.6 Lumbar spine vasculature

Lumbar vertebrae are contacted anterolaterally by paired lumbar arteries that arise from the aorta, opposite the bodies of L1-L4. Each pair passes anterolaterally around the side of the vertebral body to a position immediately lateral to the intervertebral canal and leads to various branches. The periosteal and equatorial branches supply the vertebral bodies. Spinal branches of the lumbar arteries enter the intervertebral foramen at each level. They divide into smaller anterior and posterior branches, which pass to the vertebral body and the combination of vertebral arch, meninges, and spinal cord, respectively (Arcet V et al 2003).

These arteries give rise to ascending and descending branches that anastomose with the spinal branches of adjacent levels. Nutrient arteries from the anterior vertebral canal travel anteriorly and supply most of the red marrow of the central vertebral body. The larger branches of the spinal branches continue as radicular or segmental medullary arteries, distributed to the nerve roots and to the spinal cord, respectively.

Up to age 8 years, intervertebral discs have a good blood supply. Thereafter, their nutrition is dependent on diffusion of tissue fluids through 2 routes: (1) the bidirectional flow from the vertebral body to the disc and vice versa and (2) the diffusion through the annulus from blood vessels on its surface. As adults, the discs are generally avascular structures, except at their periphery (Arcet V et al 2003).

The venous drainage parallels the arterial supply. Venous plexuses are formed by veins along the vertebral column both inside and outside the vertebral canal (internal/epidural and external vertebral venous plexuses). Both plexuses are sparse laterally but dense anteriorly and posteriorly. The large basivertebral veins form within the vertebral bodies, emerge from the foramen on the posterior surfaces of the vertebral bodies, and drain into the internal vertebral venous plexuses, which may form large longitudinal sinuses. The intervertebral veins anastomose with veins from the cord and venous plexuses as they accompany the spinal nerves through the foramen to drain into the lumbar segmental veins (Arcet V et al 2003).

2.2.7 Leptomeninges

The pia and arachnoid are delicate membranes composed of loose connective tissue and separated from one another by the subarachnoid space. A layer of mesothelium covers all leptomeningeal surfaces bathed by cerebrospinal fluid (CSF). The arachnoid mater lines the entire dural sac and extends into the dural sleeves. It also sends trabeculae across the subarachnoid space to the pia, facilitating CSF mixing. Along the posterior midline, the trabeculae form a well-defined subarachnoid septum. Inferiorly, it lines the dural sac within the sacral canal and ends on termination of the sac at the S2 vertebral level.

The pia mater provides support for the vasculature and nerves in the subarachnoid space. It adheres intimately to the spinal cord. The pia forms a separate sheath for each nerve rootlet and root as far laterally as the foramen, blending with the epineurium. Caudally, the pia continues as the thin filum terminale internum. After reaching the lower end of the dural sac, the filum becomes enclosed within the filum terminale externum and continues to the coccyx (Weinstein SC et al 2001).

2.2.9 Subarachnoid space

The spinal subarachnoid space is spacious in the lumbar spine, and below the level of L2 it is termed the lumbar cistern. Its CSF content (20-35 mL) is only a fraction of the total CSF volume (120-150 mL). The lower third of the arachnoid sac contains only the filum terminale internum and the cauda equina, which contains lumbar, sacral, and coccygeal nerve roots that hang like a horse’s tail form the lower part of the spinal cord (conus medullaris) as they leave the vertebral canal below the lower third of the arachnoid sac.

2.3 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 (see the following image).

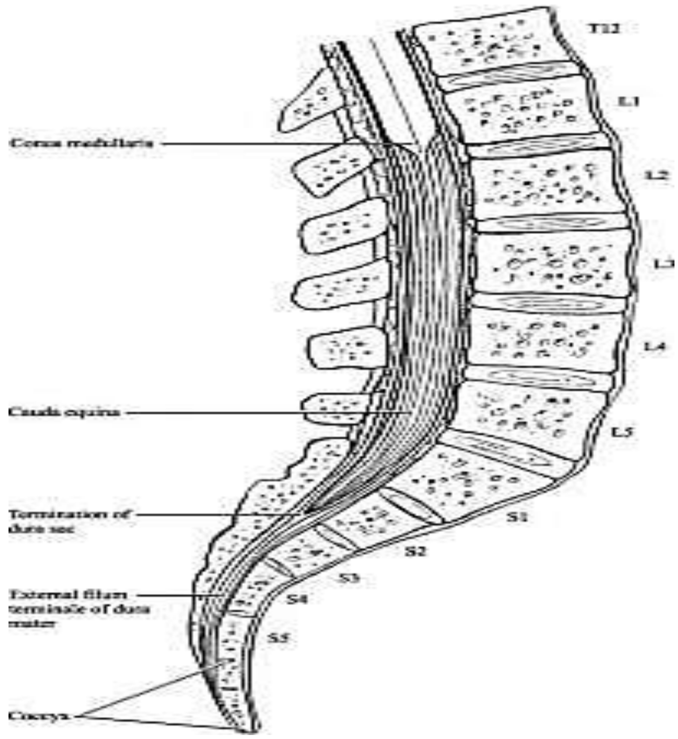

Fig 2.10 Illustration demonstrating the relevant anatomy of the cauda equina region. (Obrain MF et al 2000).

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 (Weinstein SC et al 2001).

2.3.1 Spinal nerves and roots

All lumbar spinal nerve roots originate at the T10 to L1 vertebral level, where the spinal cord ends as the conus medullaris. A dorsal or posterior (somatic sensory) root from the posterolateral aspect of the spinal cord and a ventral or anterior (somatic motor) root from the anterolateral aspect of the cord join in the spinal canal to form the spinal nerve root. The roots then course down through the spinal canal, forming the cauda equina, until they exit at their respective neural (intervertebral) foramina as a single pair of spinal nerves. Thus, the lumbar nerve roots exit the spinal canal at a lower level than where they arise.

Since early in development, these roots proceed independently toward their respective foramen, traversing the subarachnoid space within the dural sac/sleeves. They pierce the dura separately before they blend with each other at the foramen. In the lateral portion, they travel in the dural sleeve. There may be separate dural sleeves around the posterior and anterior roots for a given spinal nerve, or the 2 sleeves may be fused. Each root is bathed by CSF from a separate arachnoid sheath around it. The dural sleeves in the lumbar region are longer and travel in a more inferolateral route upon exiting (Netter FLT 2009).

Cell bodies of the motor nerve fibers are located in the ventral or anterior horns of the spinal cord, whereas those of the sensory nerve fibers are in a dorsal root ganglion (spinal ganglion) at each lumbar and sacral level. Dorsal root ganglia (DRG) tend to be located within the neural foramina and are, therefore, not strictly speaking within the lumbar canal. However, at the low lumbar (and sacral), levels, the DRG tends to reside proximal to the neural foramina, within the spinal canal, as found in 11-38% of cases at L5 and 71% at S1.[8, 9] The dorsal root ganglia are attached to the margins of the intervertebral foramina (Netter FLT 2009).

2.3.2 Exit levels of spinal nerves

Lumbar spinal nerves exit the vertebral canal by passing inferior to the pedicles of the corresponding vertebrae since early in development. In the lumbar region, the first division of the spinal nerve takes place within the intervertebral foramen, resulting in the posterior and anterior (dorsal and ventral) rami. The posterior rami pass posteriorly, skirting the articular processes at that level, whereas the anterior rami proceed laterally to supply the body wall and the lower limbs.

2.3.3 Relations of the roots and spinal nerves

In the lumbar vertebral canal, the posterior and anterior roots of a given nerve (enclosed in their dural sacs) cross the intervertebral disc that is located above the pedicle below which the nerve exits. For example, the L2 nerve roots cross the disc between L1 and L2 vertebrae before reaching the appropriate foramen, below the pedicle of the L2 vertebra (Netter FLT 2009).

2.4. physiology of the lumber spine

The lumbar spine consists of five lumbar vertebrae. There are elastic inter vertebral discs between each vertebra that allow the vertebrae to move while also acting as springs and shock absorbers Bony processes keep the lumbar vertebrae in close contact with each other. Their act surfaces have a cartilaginous layer,allowing them to function as joints. The nerve roots extend through nerve root canals located between the lumbar vertebrae.

The lumbar spine allows the trunk to bend, stretch and tilt sideways. Longitudinal turning on anaxis(rotation) is limited, as this kind of movement is done in Thethoracicand cervical spine area. Owing to the load that they have to support, th elumbar vertebrae are by far the largest of the entire spinal column (Jackson R et al 2000).

2.5 Pathology of the lumber spine

Spinal neoplasm: Tumors of the spine are easily classified as extradural, intradural/extramedullary, and intramedullary. Regarding spinal tumors in general, extradural lesions occur most commonly and most are metastatic. Of the intradural lesions (which are rare), 84% are extramedullary, the majority being nerve sheath tumors or meningiomas. Approximately 16% of intradural tumors are intramedullary, the most common being ependymoma followed by astrocytoma.

A primary spinal tumor means it comes from cells within or near the spine. They can involve the spinal cord, nerve roots, and/or the vertebrae (bones of the spine) and pelvis. They can be benign (non-cancerous) or malignant (cancerous). In general, benign tumors do not invade other tissues. Malignant tumors may invade other tissues and organs in the body. Although primary spinal tumors often contain a number of abnormal genes their cause remains unknown. In some cases, the tumors run in families. Tumors in the spine become a problem when they compress the spinal cord or nerves. This can lead to serious complications such as paralysis and loss of bladder and bowel control. Others can destroy the vertebral bone that supports the spinal cord making it unstable (Jackson R et al 2000).

A secondary spinal tumor is more common. This means that the tumor traveled there from cancer somewhere else in the body. These secondary or metastasized tumors are always cancerous. These cancer cells travel and cause tumors that usually involve the vertebrae or bony portion of the spine. They may come from melanoma (skin cancer), cancer in the lung, breast, prostate, kidney, or thyroid gland for example Malignant Spinal tumors (Jackson R et al 2000).

2.5.1 Multiple Myeloma

Myeloma is the most common primary malignant tumor of bone. It typically affects adults greater than 40 years of age. It tends to be generalized, involving multiple bones, but back pain and involvement of the spine is the most common presenting complaint. Treatment is palliative; meaning that disease can be controlled, but not completely cured. Chemotherapy is used to control the pain and slow the progression of the disease. Surgery may be required if pathological fractures develop or there is compression of the spinal cord. Cancer in the bone marrow is called multiple myeloma. Bone tissue is destroyed by excessive growth of plasma cells in the bone marrow. When X-rayed it appears that holes have been taken out of the bone. These are called osteolytic lesions. Plasma cells are part of the immune system and in multiple myeloma they grow uncontrolled forming tumors in the bone marrow. The spine is the most common site of involvement with multiple myeloma. Extradural compressive lesions are a well known complication of this disease (Legaye et al 1998).

2.5.2 Benign Spinal tumors

Osteoma: Osteoid osteoma is the most common of the benign tumors involving the bone of the spine. It is usually found during adolescence. It may be discovered because of scoliosis or curvature of the spine. It may cause pain that does not ease up, and is worse at night. Anti-inflammatory medications are used for treatment. Sometimes removal of the tumor by surgery is necessary. A newer, less invasive treatment is called radio-frequency ablation. These tumors rarely recur.

2.5.3 Osteoblastomas

Osteoblastomas are larger versions of osteoid osteomas. They tend to be found in people under the age of 30. They may cause scoliosis or curvature of the spine. Osteoblastomas tend to be more aggressive and require surgery to remove the tumor. There is a 10% chance that the tumor may recur.

2.5.4 Enchondromas & Osteochondroma

Enchondromas are tumors involving cartilage. They may grow into the spinal canal or press on the spinal nerve roots. When they cause paralysis, bowel or bladder incontinence, or other neurological symptoms they are surgically removed. They rarely can become chondrosarcomas, which are malignant tumors that can spread to other parts of the body. Osteochondroma is a slow growing tumor of the cartilage usually affecting adolescents. It is uncommon and is usually found in the posterior (rear) spine.

2.5.5 Hemangioma

Hemangiomas are tumors involving blood vessels that affect the vertebral body of a spinal segment. They are most commonly found in the thoracic or lumbar portion of the spine. They occur more frequently during mid-life. They are found more often in women than men. They can be a source of pain but often do not cause pain. They may be large enough to cause collapse of the vertebral body which could affect the spinal cord or nerve roots.

2.6 Spinal Inflammatory Disorders

Inflammatory disorders of the spine can be caused by a wide range of conditions, including arthritis, osteoporosis, and infection. Inflammation in the spine is rare but can be a significant source of pain and disability, especially if these hard-to-diagnose conditions go untreated (Bernhartdt M et al 2009).

2.6.1 Ankylosing spondylitis

Ankylosing spondylitis (AS) is an inflammatory condition that affects the joints in your spine. Spondylitis simply means inflammation of the spine. As part of the body's reaction to inflammation, calcium is laid down where the ligaments attach to the bones that make up the spine (vertebrae). This reduces the flexibility of your back and causes new bone to grow at the sides of the vertebrae. Eventually the individual bones of the spine may link up (fuse). This is called ankylosis and can be seen on x-rays. Ankylosing spondylitis typically starts in the joints between your spine and pelvis, but it may spread up your spine to your neck. It can sometimes affect other parts of the body, including your joints, tendons or eyes. Ankylosing spondylitis varies from person to person – your symptoms might be so mild that you can almost forget you have the condition, but if they're more serious it could have a big impact on your quality of life (Bernhartdt M et al 2009).

2.6.2 Arachnoiditis

Arachnoiditis describes a pain disorder caused by the inflammation of the arachnoid, one of the membranes that surround and protect the nerves of the spinal cord. The arachnoid can become inflamed because of an irritation from chemicals, infection from bacteria or viruses, as the result of direct injury to the spine, chronic compression of spinal nerves, or complications from spinal surgery or other invasive spinal procedures. Inflammation can sometimes lead to the formation of scar tissue and adhesions, which cause the spinal nerves to “stick” together. If arachnoiditis begins to interfere with the function of one or more of these nerves, it can cause a number of symptoms, including numbness, tingling, and a characteristic stinging and burning pain in the lower back or legs. Some people with arachnoiditis will have debilitating muscle cramps, twitches, or spasms. It may also affect bladder, bowel, and sexual function. In severe cases, arachnoiditis may cause paralysis of the lower limbs.

2.6.3 Discitis:

Is an inflammation of the vertebral disk space often related to infection. Infection of the disk space must be considered with vertebral osteomyelitis; these conditions are almost always present together, and they share much of the same pathophysiology, symptoms, and treatment. Although Discitis and associated vertebral osteomyelitis are uncommon conditions, they are often the causes of debilitating neurologic injury. Unfortunately, morbidity can be exacerbated by a delay in diagnosis and treatment of this condition. The lumbar region is most commonly affected, followed by the cervical spine and, lastly, the thoracic spine.

2.6.4 Congenital spinal anomalies:

Asomia (A genesis): Complete absence of the body of a vertebra may occur despite the presence of the posterior elements (Figure 2). This anomaly nesuIts from failure of ossification centers of the body to appear. One on more vertebral segments may be involved. Hemi-vertebra Unilateral wedge vertebra is due to lack of ossification of one-half of the body. A right on left hemi-vertebra may thus occur. The hemi-vertebra assumes a wedge-shaped configuration with the apex of the wedge reaching the midplane. Scoliosis is often present at birth. Dorsal and ventral hemi-vertebrae occur because of failure of the ventral or dorsal half of the vertebral body to ossify. The failure of ossification is believed to be secondary to ischemia during the developmental stage. A kyphotic deformity is seen at the site of a dorsal hemivertebra. A ventral hemivertebra is extremely rare and results from failure of ossification of the dorsal half of the vertebral body. Hemivertebra secondary to hemimetametric segmental displacement or persistence of the night and left halves of the vertebral body leads to the hemiventebnae being separated from each other in the sagittal plane. One such hemivertebra may fuse with the body of a yentebnal segment above or below the affected segment

2.6.5 Coronal clefts:

This anomaly results from a failure of fusion of the anterior and posterior ossification centens which remain separated by a cartilage plate. It represents a delay in normal vertebral maturation; in most cases clefts disappear by six months after birth. Coronal clefts are usually seen in the lower thonacic on lumbar vertebral bodies. The deformity is most often seen in premature male infants and can be recognized in utero. Cleft vertebrae may also occur in infants with chondrodystrophia calcificans congenita. Radiographically, a vertical radiolucent band is seen just behind the midportion of the body on the latenial view of the spine. Butterfly Vertebra (Sagittal Cleft Vertebra) Butterfly vertebrae result from the failure of fusion of the lateral halves of the vertebral body because of persistent notochondal tissue between them. The involved vertebral body is widened, and the bodies above and below the butterfly vertebra adapt to the altered intervertebral discs on either side by showing concavities along the adjacent end plates. Some bone bridging may occur across the defect which is usually seen in the thoracic on lumbar segments of the spine. Anterior spina bifida, with on without anterior meninogocele, may be associated with a butterfly vertebra. The intervertebral fonamma of block vertebrae become ovoid and narrowed. Congenital vertebral fusion usually occurs in the lumbar and cervical segments. Abnormal Size: An abnormality in the size of a vertebra is most often due to a compression deformity of the body. Certain diseases, however, may affect the normal vertebral growth resulting in altened size.Small Vertebral Body: Radiation-induced vertebral hypoplasia may result from irradiation of the spine during early childhood (Figure 10). The effect is dose dependent and, in general, does not occur with doses of less than 1000 rads. Unilateral radiation may cause scoliosis because of unequal growth of the affected bodies, the concavity of the scoliosis occurring on the irradiated side. Osteoporosis and vertebral collapse may be seen in adults following irradiation.

2.7 methods of lumber spine imaging

2.7.1 conventional x-ray

X-rays are a form of radiation, like light or radio waves, that are focused into a beam, much like a flashlight beam. X-rays can pass through most objects, including the human body. X-rays make a picture by striking a detector that either exposes a film or sends the picture to a computer. Dense tissues in the body, such as bones, block (absorb) many of the X-rays and look white on an X-ray picture. Less dense tissues, such as muscles and organs, block fewer of the X-rays (more of the X-rays pass through) and look like shades of gray on an X-ray. X-rays that pass only through air, such as through the lungs, look black on the picture (Michael F et al 2008).

Spinal X-rays are pictures of the spine. They may be taken to find injuries or diseases that affect the discs or joints in your spine. These problems may include spinal fractures, infections, dislocations, tumors, bone spurs, or disc disease. Spinal X-rays are also done to check the curve of your spine (scoliosis) or for spinal defects.

2.7.2 Computed Tomography:

Computed tomography (CT scan or CAT scan) is a noninvasive diagnostic imaging procedure that uses a combination of X-rays and computer technology to produce horizontal, or axial, images (often called slices) of the body. A CT scan shows detailed images of any part of the body, including the bones, muscles, fat, and organs. CT scans are more detailed than standard X-rays.

Computed tomography (CT) of the spine is a diagnostic imaging test used to help diagnose—or rule out—spinal column damage in injured patients. CT scanning is fast, painless, noninvasive and accurate. In emergency cases, it can reveal internal injuries and bleeding quickly enough to help save lives. A CT scan of the spine may be performed to assess the spine for a herniated disk, tumors and other lesions, the extent of injuries, structural anomalies such as spina bifida (a type of congenital defect of the spine), blood vessel malformations, or other conditions, particularly when another type of examination, such as X-rays or physical examination, is not conclusive. CT of the spine may also be used to evaluate the effects of treatment of the spine, such as surgery or other therapy (Michael F et al 2008).

2.7.3 Magnetic Resonance Imaging:

An MRI uses magnets and radio waves to capture images inside the body without making a surgical incisionMagnetic resonance imaging (MRI) of the lumbar spine is a safe and painless test that uses a magnetic field and radio waves to produce detailed pictures of the lumbar spine (the bones, disks, and other structures in the lower back).An MRI differs from a CAT scan because it does not use radiation. An MRI scanner consists of a large doughnut-shaped magnet that often has a tunnel in the center. Patients are placed on a table that slides into the tunnel. Some centers have open MRI machines that have larger openings and are helpful for patients with claustrophobia.

An MRI examination of the spine shows the anatomy of the vertebrae that make up the spine, ligaments that hold the vertebrae together, as well as the disks, spinal cord and the spaces between the vertebrae through which nerves pass. Currently, MRI is the most sensitive imaging test of the spine in routine clinical practice (Michael F et al 2008).

2.7.3 Nuclear Medicine:

Nuclear medicine examinations hold an important position in the diagnosis of diseases of the spine. During the last decade, decisive progress has been made in the field of instrumentation and radiopharmaceutical techniques: the use of high-resolution collimators and the introduction of emission computer tomography as examples of improved instrumentation as well as 99m-Technetium red blood cell labelling as a new radiopharmaceutical technique. These present some of the developments responsible for the growing importance of scintigraphical diagnosis. Inflammatory processes of the vertebrae and the surrounding soft tissues can be detected or excluded with high reliability by the use of radionuclide-labelled granulocytes. The important role of bone scintigraphy in the differential diagnosis of neoplastic bone disease relies on its high sensitivity combined with the quantitative analysis of increased bone metabolism. Furthermore, it provides exact information about the extent and a possible metastatic spread of bone tumours. In the field of orthopaedy and surgery, skeletal scintigraphy is of growing importance as a highly sensitive procedure in the detection of special traumatic lesions such as acute vertebral compression fractures and in the follow-up of patients after bone surgical interventions. Despite the progress of other imaging modalities such as computer tomography and magnetic resonance imaging, nuclear medicine today is well-established in the assessment of diseases of the vertebral column. Among all scintigraphical diagnostic procedures, bone scintigraphy and the different techniques of inflammation imaging are of special importance.

2.8 Previous studies:

D Geeta Anasuya 2015, Studied the Lumbar canal stenosis occurs due to narrowing of spinal canal diameter and is usually diagnosed by MRI. Aims and

Objectives of the study: To study and compare the lumbar canal diameters (Antero Posterior) and Cross sectional areas in symptomatic and asymptomatic patients with Lumbar canal stenosis diagnosed using MRI.

Materials and Methods: It is a prospective observational study. A total of 100 patients were subjected to MRI and canal diameters were measured. Among them 60 patients were symptomatic with low back pain and 40 patients were asymptomatic without any back pain. Fifty five patients were males and 45 were females. Majority (31%) were in the age group of 20-30 years.

Results: In symptomatic cases, 41 (68%) cases were stenosed. Stenosis at all the three levels was seen in 5 (12%) cases. At L3-L4, L4- L5 stenosis was seen in 6 (14%) cases, L4-L5, L5-S1 stenosis was seen in 22(53%) cases, L3L4, L5-S1 Stenosis was seen in 8(19%) cases. In asymptomatic cases, stenosis at all the three Levels was seen in 5 (13%) cases and at L4-L5; L5-S1 stenosis was seen in 5(12.5%) cases, L3-L4, L5-S1stenosis was seen in 2(5%) cases.

Conclusion: Even in symptomatic Patients, normal diameter of the spinal canal was noticed in 19 (32%) cases. Even in asymptomatic cases canal narrowing was noticed. Most of the symptomatic cases had normal Cross sectional area. Detailed history and clinical examination of the patient along with the radiological investigation of stenosis with MRI scan, will establish the diagnosis.

Andrew Hughes 2008, Lumbar spinal stenosis is a pathological condition of the spinal channel with its concentric narrowing with presence of specific clinical syndrome. Absence of the clear unified radiological signs is the one of the basic problems of the lumbar spinal stenosis. Purpose he authors seek to create method of assessment of the spinal canal narrowing degree, based on anatomical aspects of lumbar spinal stenosis. Study Design Development of diagnostic criteria based on analysis of a consecutive patients group and a control group.

Methods Thirty seven patients (73 stenotic segments) with mean age 62,4 years old were involved in the study. Severity of clinical symptoms has been estimated by the measuring scales: Oswestry Disability Index (ODI) and Swiss Spinal Stenosis Questionnaire (SSQ). Mean number of the stenotic segments was 1.97. For all patients 8 radiological criteria have been measured. In the control group have been included 37 randomly selected patients (volunteers) in mean age of 53,4 years old without stenosis signs and narrowing of the spinal canal on the MRI imaging (73 segments total). Measurements were performed at the middle of intervertebral disc and facet joints level.

Results For description of the state of spinal canal we offer the coefficient: ratio of the lateral canals total area to the crosssectional area of the dural sac ("coefficient of stenosis"). Comparison of mean values of "coefficient of stenosis" for main and control groups showed statistically significant differences ($t = -12,5$; $p < 0.0001$). Strong statistically significant correlation with the ODI and SSS scales was revealed For the obtained coefficient ($p <0.05$).

Conclusions In our study new method of assessment of the spinal canal narrowing degree has been applied. Promising results have been obtained in a small group of patients. It is necessary to check the data on a large sample of recommendations For its clinical application.

Roxana ToRRes 2008, conduct a descriptive study to find measures of central tendency in the vertebral bodies L3, L4, and L5 in the Mexican population. Methods: Fifty patients were considered, 33 male and 17 female, aged between 30 and 55 years. Measurements were performed at the levels L3, L4 and L5 taking the interpedicular distance (A), mid-sagittal diameter (B), anteroposterior distance (AP) and the depth of lateral recess (R) in axial 2-mm sections of CT scans (Somaton Emotion, SIEMENS, 2 sections) in a Mexican population with healthy vertebral bodies, with no history of lumbar pathology.

Results: Overall, the measures obtained were mean interpedicular distance of 22.80 in L3, range of 16.34/28.72. In L4, mean of 23.83, range of 17.62/27.92. In L5, mean of 25.28, range of 21.88/31.29.

Conclusions: This study managed to make a database that did not exist in Mexico, using measures of central tendency. Therefore, it opens the way for it to be possible, in future studies, to identify predictive factors or even developing implants.

M. Midia et al 2007, By determining normal ranges of spinal canal diameters we can make early diagnosis in persons who have lower diameters of spinal canal. These persons are predisposed to spinal canal stenosis that is a major cause of spinal radiculopathies. In different studies performed in several countries, minimum and maximum ranges of spinal canal diameters were different for each population.

In this study, we tried to determine the mean values of normal spinal canal diameters and areas in Tabriz and its suburb. 39 healthy, young to mid-age cases were selected. Our study was focused on L3L4 and L4-L5.

The following parameters were measured: the area of cross-section of the vertebral body, the area of cross-section of the dural sac, interarticular diameter, interligamentous diameter, antero-posterior diameter of the lumbar canal, inter-pedicular diameter, and the area of cross-section of the vertebral canal. A correlation between the parameters studied and the height of subjects was significant for interligamentous diameter (for L3/L4 and L4/L5) and interarticular diameter (only at L3/L4), cross-section area of the vertebrae (both L3 and L4), cross-section area of vertebral canal (only at L5 level), area of dural sac (at L3/L4 and L4). It was suggested that these diameters and areas should be interpreted as a unction of height of the subject. This can be attributed to differences between populations and it can be interpreted as predisposition to spinal canal stenosis in our population.

Mukesh Mallik et al 2014 The study was conducted with the objectives to establish the measurements of spinal canal and lumbar vertebra at L3 to L5 region in Nepalese population. Methodology: It is a crosssectional study among 36 patients (17 males and 19 females) having age variation from 20-60years whose abdomen was scanned by GE bright speed 16 slice CT scanner with slice thickness 10mm and then reconstructed at 1.2mm for images in different body plains for the measurement of spinal canal. Results: Almost all the parameters increase from L3 to L4 to L5 but the difference is more between L4 and L5 than between L3 and L4 except in vertebral body width (VBW) where it increases smoothly, however canal body ratio (CBR) remained constant at 0.6. All the parameters were larger in males than in females except antero-posterior dimension of canal in transverse section (APT)

which is larger in females. It also shows that none of the parameters vary significantly depending upon sex except vertebral body width (VBW) at L3 which is 39.041 ± 4.1334 in males and 36.474 ± 2.8509 in females (p=0.036).Conclusion: Antero- posterior dimension in transverse and sagittal is almost identical but the chances of measurement error is higher in transverse due to trigonal shape of canal so AP diameter should be done in sagittal section as this is consistent and measures 14mm at L3, 14mm at L4 and 15 mm at L5 hence defining average antero-posterior Canal dimension in sagittal section to be 14 mm but CBR constant at 0.6.

Chapter three

Materials and Methods

Chapter three

Materials and Methods

3.1 Materials Used:

Computed Tomography (CT)

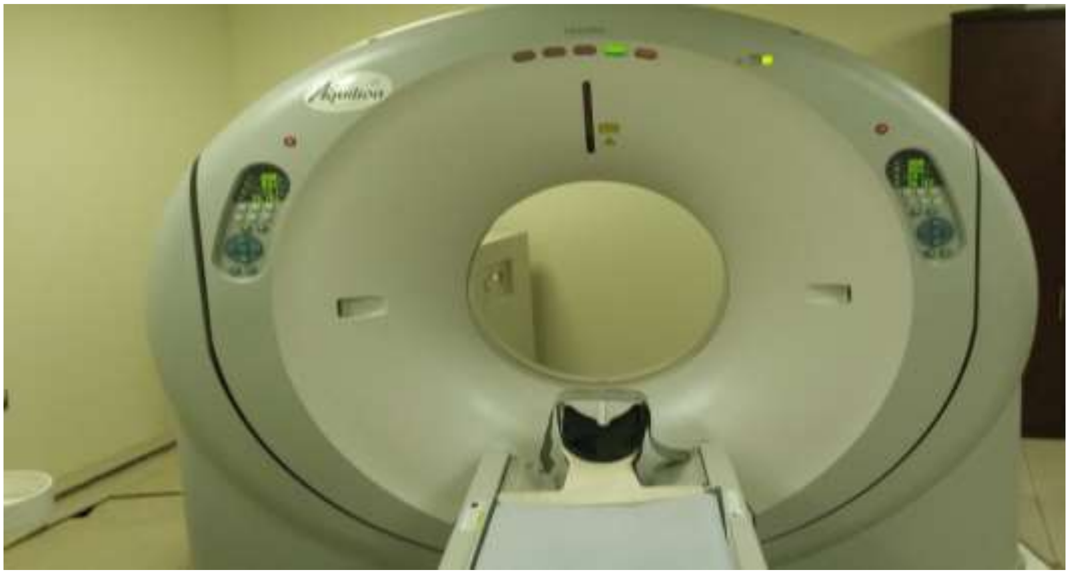

Figure 3-1 (gantry computer tomography)

Figure 3-2 (control computer tomography)

3.2 Study population:

This study was performed on 63 patients (male and female) with age range between 20 to 87 years. Study cases were selected from patient referred to CT department for KUB,CTU,ABDOMEN CT image and have no back pain and image include pathology in the spine was excluded.

3.3 Design of the study:

This is an analytical study where selected the patient's selected conventionally.

3.4 Place and duration of study:

This study was performed at Radiology department of Yastabshiroon medical center, during the period from march to November.

3.5 Study sample:

This study included 63 patients all selected from patients referred to perform CT scan of other parts of the body and had no low back pain or other problem attributable to lumber spine.

3.6 Study variables:

The variable that were collected from each subject included; gender, age, midsagittal of body, transverse of body, midsagittal of canal, transverse of canal

3.7 Data collection:

The data were collected from yastabshiroon medical center using CT machine model GE optima 16 slice. The scan parameter 5mm slice ,120 kv, 200 mA, and the demographic information was age and the patient's gender.

using data collection sheets which contain different variable the demographic information was gender and age of patients and the second part measurement information which was midsagittal of body, transverse of body, midsagittal of canal, transverse of canal**.**

patients referred to perform CT scan of other parts of the body and had no low back pain or other problem attributable to lumber spine. Examination will be made by using CT scanner and focusing on L3-L4 and L4-L5 levels.

3.8 Patients position and technique of measurements:

From sagittal reformate ct image of each subject ,single axial slice was made in the middle of L4 body ,perpendicular to the posterior wall of lumber spine and parallel to the body of L4 . The axial slice were reconstructed in high resolution with window for bony structure (widow level =1000, window width=3000).

3.9 Data Analysis:

The data were analysed by using SPSS program version 20 and excel data sheet, variables using descriptive tables, frequency, percentage distribution tables, cross tabulation between the variables and then all data were presented in graphs as bar graph and scatter plot diagram.

Chapter four

Results

Chapter four

Results

Table 4.1 show statistical parameters for all patients:

	Mean	Median	STD	Min	max
Age (yrs)	44.71	46	15.38	20	87
Midsagittal of body	29.89	30	3.84	23	47
Transverse of body	40.05	41	3.89	29	47
Midsagittal of canal	15.21	15	2.31	10	22
Transverse of canal	22.56	23	2.84	15	29

Table 4.2 show frequency distribution for patients according to their gender:

Gender	Frequency	Percent
Female	25	39.7
Male	38	60.3
Total	63	100.0

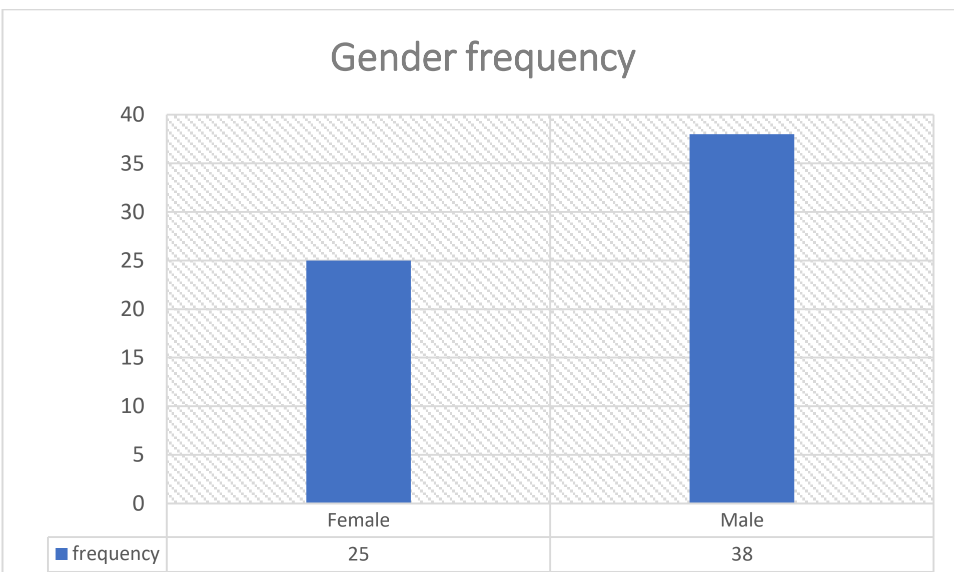

Figure 4.1 show frequency distribution for patients according to their gender

Table 4.3 show statistical parameters for male:

	Age	Midsagittal of body	Transverse of body	Midsagittal of canal	Transverse of canal
Mean	48.87	31.05	41.84	15.16	22.87
Median	49.50	31.00	42.00	16.00	23.00
STD	12.779	3.594	3.124	2.666	2.896
Minimum	25	25	33	10	15
Maximum	77	47	47	22	29

Table 4.4 show statistical parameters for female:

	Age	Midsagittal of body	Transverse of body	Midsagittal of canal	Transverse of canal
Mean	38.40	28.12	37.32	15.28	22.08
Median	34.00	28.00	37.00	15.00	22.00
STD	17.044	3.563	3.351	1.696	2.737
Minimum	20	23	29	12	18
Maximum	87	38	43	19	27

Table 4.5 show cross-tabulation between gender and Midsagittal of body

Correlation Midsagittal of body * Gender

Midsagittal of body	Gender		Total
	Female	Male	
23	1	0	1
24	2	0	2
25	4	1	5
26	3	2	5
27	2	0	2
28	2	4	6
29	4	5	9
30	2	6	8
31	1	4	5
32	1	5	6
33	1	7	8
34	1	1	2
35	0	2	2
38	1	0	1
47	0	1	1
Total	25	38	63

Table 4.6 show correlate between gender and Transverse of body

Correlation Transverse of body * Gender

Transverse of body	Gender		Total
	Female	Male	
29	1	0	1
33	3	1	4
34	1	1	2
36	5	0	5
37	3	0	3
38	4	1	5
39	2	4	6
40	0	5	5
41	3	6	9
42	2	3	5
43	1	5	6
44	0	4	4
45	0	4	4
46	0	2	2
47	0	2	2
Total	25	38	63

Table 4.7 show correlate between gender with Midsagittal of canal

Correlate Midsagittal of canal * Gender

Midsagittal of canal	Gender		Total
	Female	Male	
10	0	2	2
12	1	4	5
13	1	7	8
14	6	3	9
15	9	2	11
16	3	8	11
17	2	6	8
18	1	2	3
19	2	3	5
22	0	1	1
Total	25	38	63

Table 4.8 shoe correlation between gender with Transverse of canal

Transverse of canal * Gender Crosstabulation

Transverse of canal	Gender		Total
	Female	Male	
15	0	1	1
18	4	1	5
19	1	2	3
20	2	3	5
21	4	5	9
22	3	3	6
23	3	8	11
24	2	6	8
25	3	3	6
26	2	2	4
27	1	2	3
29	0	2	2
Total	25	38	63

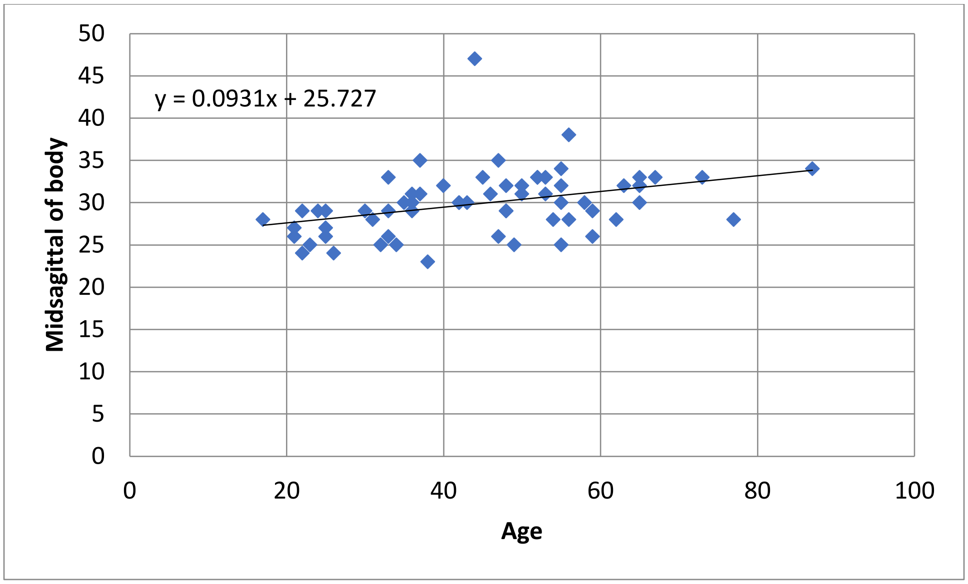

Figure 4.2 show correlate between age and Midsagittal of body

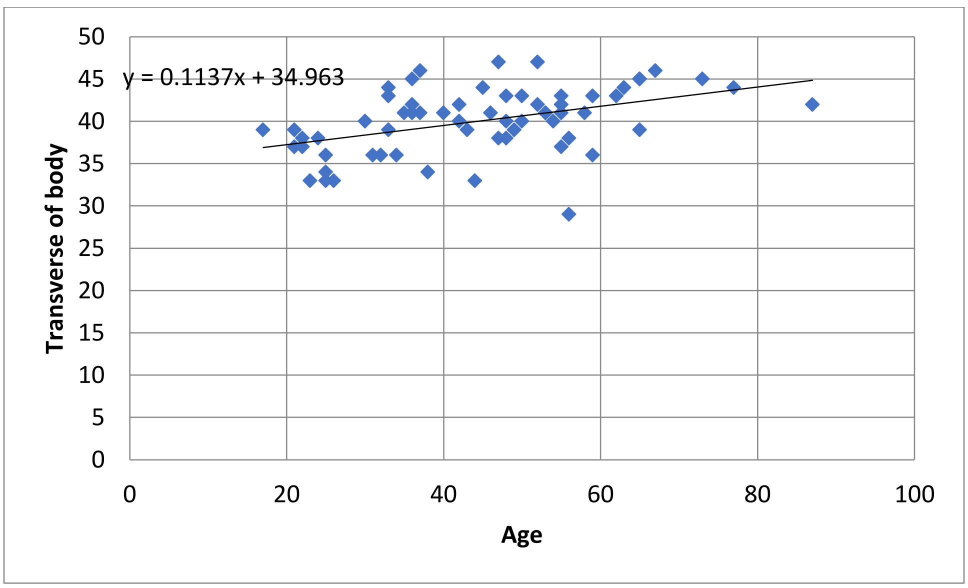

Figure 4.3 show correlate between age and Transverse of body

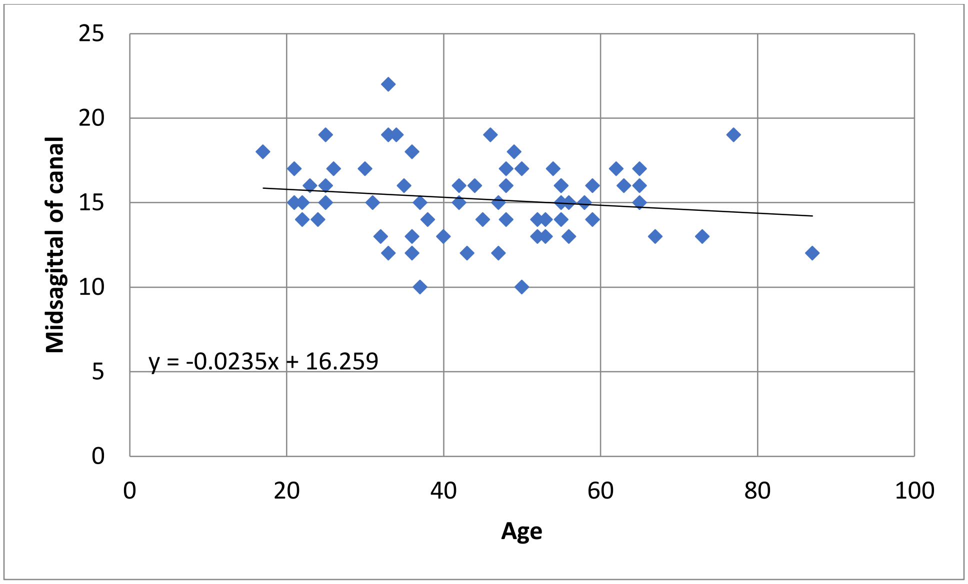

Figure 4.4 show correlate between age and Midsagittal of canal

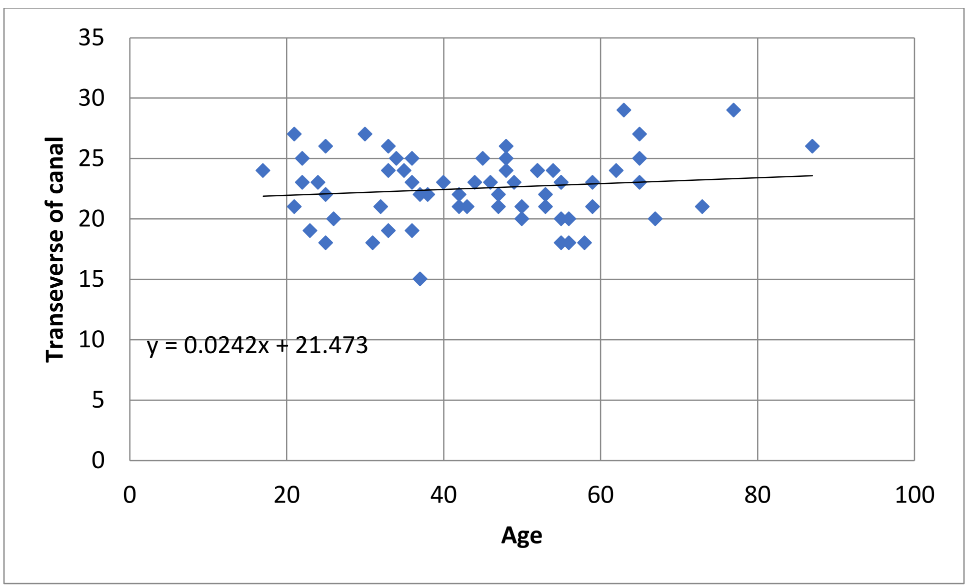

Figure 4.5 show correlate between age and Transverse of canal

Chapter Five

Discussion, Conclusion and Recommendation

Chapter Five

Discussion, Conclusion and Recommendation

5.1 Discussion:

Statistical parameters presented as mean, median, STD, minimum and maximum. Were the mean ± standard deviation for age was 44.71±15.38, for Midsagittal of body, Transverse of body, Midsagittal of canal and Transverse of canal was 29.89 ± 3.84, 40.05 ± 3.89, 15.21 ± 2.31 and 22.56 ± 2.84 respectively as shown in table 4.1.

Table 4.2 show frequency distribution for patients according to their gender were the number of male was 38 with percentage 60.3% while the number of female was 25 with percentage 39.7% as shown in figure 4.1.

Statistical parameters presented as mean, median, STD, minimum and maximum. Were the mean ± standard deviation for age was 48.87±12.78, for Midsagittal of body, Transverse of body, Midsagittal of canal and Transverse of canal was 31.05 ± 3.59, 41.84 ± 3.12, 15.16 ± 2.66 and 22.87 ± 2.89 respectively as shown in table 4.3.

Statistical parameters presented as mean, median, STD, minimum and maximum. Were the mean ± standard deviation for age was 38.71±17, for Midsagittal of body, Transverse of body, Midsagittal of canal and Transverse of canal was 28.12 ± 3.56, 37.32 ± 3.35, 15.28 ± 1.69 and 22.08 ± 2.74 respectively as shown in table 4.4.

correlate between gender and Midsagittal of body were the correlate between gender and Midsagittal show large variation started from 23 till 47 were the value 29 was more frequently with 9 patients then 30 and 33 with 8 patient for each while the value 1 was lowest at 23, 38 and 47 as shown in table 4.5.

correlate between gender and Midsagittal of body were the correlate between gender and Midsagittal show large variation started from 29 till 47 were the value 41 was more frequently with 9 patients 6 male and 3 female while the value 1 was lowest at 29 as shown in table 4.6.

correlate between gender with Midsagittal of canal were started from 10 to 22 were the value 15 and 16 was more frequently with 11 patients for each then 14 with 9 patients while the value 1 was lowest at 22 as shown in table 4.7.

correlate between gender with Transverse of canal were started from 15 to 29 were the value 23 was more frequently with 11 patients with 3 female and 8 male then 21 with 9 patients while the value 1 was lowest at 15 as shown in table 4.8.

correlate between age and Midsagittal of body showed the midsagittal of body increase with the age by rate 0.0931 for each year. correlate between age and transverse of body showed the transverse of body increase with the age by rate 0.1137 for each year. correlate between age and midsagittal of canal showed the midsagittal of body decrease with the age by rate 0.023 for each year. correlate between age and transverse of canal showed the transverse of canal increase with the age by rate 0.0242 for each year.

5.2 Conclusion:

Evaluation of lumber canal diameter using computed tomography in Khartoum state in period from march to October 2018. The data were collected from yastabshiroon medical center using CT machine model GE optima 16 slice. The scan parameter 5mm slice ,120 kv, 200 mA.

The results presented in statistical parameters as mean, median, STD, minimum and maximum. Were the mean ± standard deviation for age was 44.71±15.38, for Midsagittal of body, Transverse of body, Midsagittal of canal and Transverse of canal was 29.89 ± 3.84, 40.05 ± 3.89, 15.21 ± 2.31 and 22.56 ± 2.84 respectively.

using linear regression equation showed that the correlate between age and Midsagittal of body showed the midsagittal of body increase with the age by rate 0.0931 for each year. correlate between age and transverse of body showed the transverse of body increase with the age by rate 0.1137 for each year. correlate between age and midsagittal of canal showed the midsagittal of body decrease with the age by rate 0.023 for each year. correlate between age and transverse of canal showed the transverse of canal increase with the age by rate 0.0242 for each year.

5.3 Recommendation:

- ❖ Increase the number of patients to get more samples and get more accurate results.
- ❖ Increase the centers to cover whole country to do base line of lumber canal diameter to Sudanese population
- ❖ Future projects could pay more attention to the use a new methods of measurements.

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Appendices

Appendix A

جامعه السودان للعلوم والتكنولوجيا
كليه الدراسات العليا

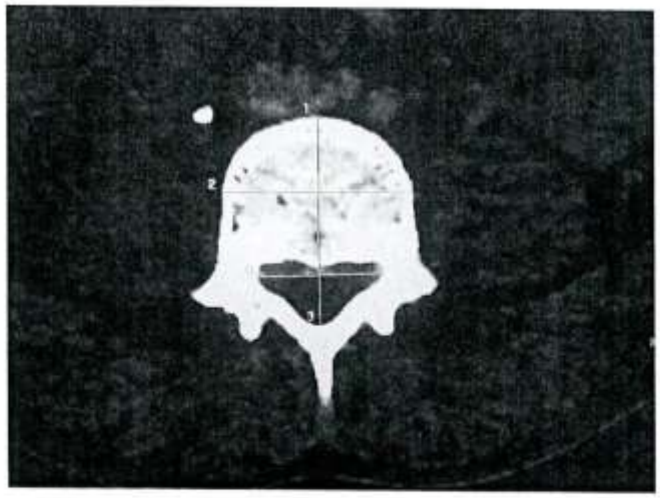
collage of graduated studies and scientific research

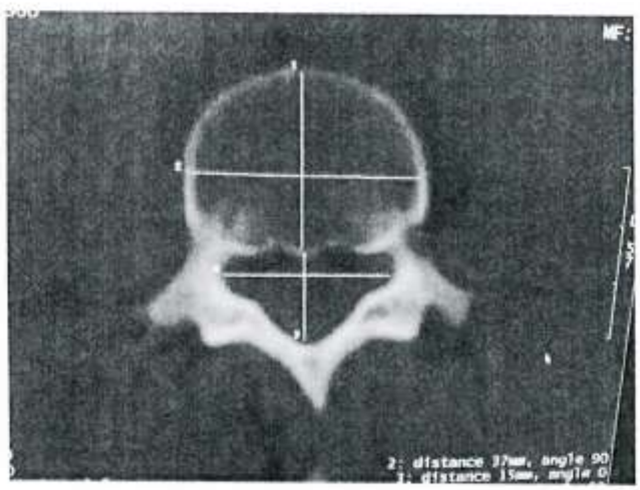
No	Age	Gender

measurement in mm

Med sagittal of the body	
Transvers of the body	
Transvers of the canal	
Med sagittal of the canal	

Appendix B

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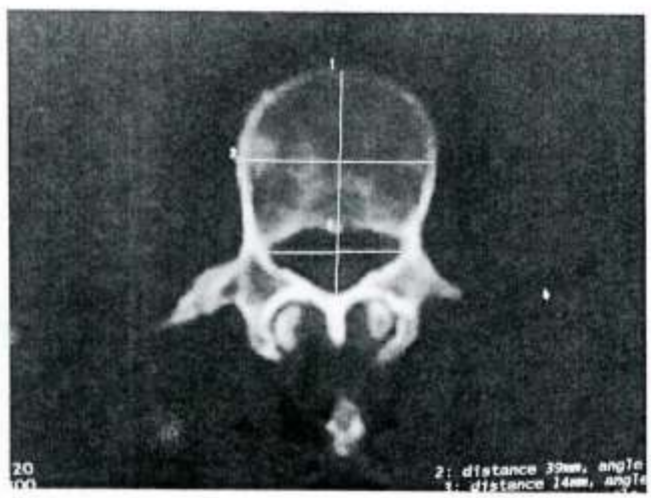
distance 15mm, angle 0


20
2: distance 39mm, angle
distance 14mm, angle