Sudan University of Science and Technology

College of Graduate Studies

A Study of MRI Findings in Lumber Spine among Sudanese Patients at Khartoum State

دراسة نتائج التصوير بالرنين المغناطيسي في العمود الفقري القطني لدى المرضى السودانيين بولاية الخرطوم

A Research submitted for partial fulfillment for the Requirements of M.Sc. degree in Diagnostic Radiologic Technology

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الآية

بِسۡمِ ٱللَّهِ ٱلرَّحۡمَٰنِ ٱلرَّحِيمِ

قال تعالى :

﴿وَقُل رَّبِّ زِدْنِي عِلْمًا﴾

صدق الله العظيم

سورة طه (114)

Dedication

To my family

To my friends and my colleagues

I dedicate this work

Acknowledgement

Firstly, I would like to express my gratitude and appreciation to the Almighty Allah from whom I have power and aid.

I would also like to express my sincere gratitude to my supervisor **Dr. Saida Abdelkreem Omer Mohamed** for her suggestions, patience, guidance, encouragement, cooperation and supervision of this work.

Finally, I would like to thanks every person who helped me ingathering different information, collecting data and guiding me from time to time in making this study.

Abstract

This was descriptive cross sectional study aimed to study MRI findings in lumbar spine among Sudanese patients at Khartoum state, the problem of the study was the importance of lumbar spine as it supports most of body weight; any pain in lumbar region can affect the function of the spine. In Sudanese population there is high prevalence of back pain for that we need to assess the suspected causes of this pain. MRI can provide information and determining the sources of the pain and help in guided diagnoses, but there is a wide variability in the reported prevalence of different MRI findings and limited knowledge is available to inform the clinician about what should be expected of MRI findings at a certain age and how this relates to back pain in different populations. The study was carried out at Khartoum state hospitals and medical centers which have MRI department (Abdon Seed Ahmed Medical Complex, Alzaytona Hospital), conducted in period from July 2021 to March 2022, 104 patients who came to MRI department with spinal pain were enrolled in the study, aged between (11-80) years.

The results showed that most patients had disc bulge was 65 (67.6%), loss of lordosis was 47 (48.9%), there was statistically insignificant correlation between MRI findings and age groups (p-value = 0.62), between MRI findings and gender (p-value = 0.11), on other hand there was statistically significant correlation between MRI findings and BMI (p-value = 0.00), between MRI findings and occupation (p-value = 0.001)

The study concluded that MRI are helpful in cases of lumbar spine, the L4-L5 was the most level of spine affected by diseases, there was statistically significant correlation between MRI findings and BMI, and between MRI findings and occupation

The study recommended before doing MRI it is necessary to complete history to determine the site, position and necessity factor for radiological examination.

المستخلص

هذه الددراسة المقطعية الوصفية هدفت إلى دراسة نتائج التصوير بالرنين المغناطيسي في العمود الفقري القطني لدى المرضى السودانيين بولاية الخرطوم، كانت مشكلة الدراسة أهمية العمود الفقري القطني لأنه يدعم معظم وزن الجسم. و يمكن أن يؤثر أي ألم في منطقة أسفل الظهر على وظيفة العمود الفقري. يوجد في السودان انتشار كبير لآلام الظهر لذلك نحتاج إلى تقييم الأسباب المشتبه بها لهذا الألم. يمكن أن يوفر التصوير بالرنين المغناطيسي معلومات وتحديد مصادر الألم والمساعدة في التشخيصات الموجهة، ولكن هناك تباينا واسعا في الانتشار لنتائج التصوير بالرنين المغناطيسي المختلفة ، كما تتوفر معرفة محدودة لإبلاغ الطبيب عما ينبغي توقعه من نتائج التصوير بالرنين المغناطيسي في عمر معين وكيف يرتبط ذلك بآلام الظهر في مجموعات سكانية مختلفة. أجريت الدراسة في مستشفيات ولاية الخرطوم والمراكز الطبية التي يوجد بها قسم التصوير بالرنين المغناطيسي (مجمع عبدون سيد أحمد الطبي ، مستشفى الزيتونة) ، أجريت في الفترة من من يوليو 2021 إلى مارس 2022، شملت الدراسة 104 مريض قدموا إلى قسم التصوير بالرنين المغناطيسي مصابين بالم في العمود الفقري ، و تتراوح أعمارهم بين (11−80) عاما.

أظهرت النتائج أن معظم المرضى لديهم انتفاخ القرص 65(67.6%) وفقدان القعس 47(48.9%) ، وكان هناك ارتباط غير ذي دلالة إحصائية بين نتائج التصوير بالرنين المغناطيسي والفئات العمرية (القيمة الاحتمالية = 0.62) ، بين نتائج التصوير بالرنين المغناطيسي والجنس (القيمة الاحتمالية = 0.11) ، بينما كان هناك ارتباط ذو دلالة إحصائية بين نتائج التصوير بالرنين المغناطيسي ومؤشر كتلة الجسم (القيمة الاحتمالية = 0.00) ، بين نتائج التصوير بالرنين المغناطيسي والوظيفة (القيمة الاحتمالية = 0.001)

خلصت الدراسة إلى أن التصوير بالرنين المغناطيسي مفيد في حالات العمود الفقري القطني ، وأن الفقرة ا لقطنية الرابعة والخامسة من أكثر مستويات العمود الفقري المتأثرة بالأمراض ، وكانت هناك علاقة ذات دلالة إحصائية بين نتائج التصوير بالرنين المغناطيسي ومؤشر كتلة الجسم ، بين نتائج التصوير بالرنين المغناطيسي والمهنة.

أوصت هذه الدراسة بانه قبل إجراء للتصوير بالرنين المغناطيسي لابد من معرفة التاريخ الكامل للمريض وذلك لتحديد الموقع والموضع وعامل الضرورة لاجراء الفحص.

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List of abbreviations

AF	Annulus Fibrosus
ALL	Anterior Longitudinal Ligament
BMI	Body Mass Index
CNS	Central Nervous System
DDD	Degenerative Disc Disease
DLSD	Degenerative Lumbar Spine Disease
HIZ	High Intensity Zones
ISL	Interspinous Ligament
L1	Lumber No 1
L2	Lumber No 2
L3	Lumber No 3
L4	Lumber No 4
L5	Lumber No 5
LBP	Lower Back Pain
LF	Ligamentumflavum
MRI	Magnetic Resonance Imaging
NP	Nucleus Pulposus
PLL	Posterior Longitudinal Ligament
RF	Radio Frequency
S1	Sacrum No 1
SPSS	Static Package for Social Science
SSL	Supraspinous Ligament

Chapter one

Introduction

Chapter one

Introduction

1.1 Introduction:

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. 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. (Drake et.al,2009).

Magnetic resonance imaging (MRI) is a medical imaging process that uses a magnetic field and radio frequency (RF) signals to produce images of anatomical structures, of the presence of disease and of various biological functions within the human body. MRI produces images that are distinctly different from the images produced by other imaging modalities. A primary difference is that MRI process can selectively image several different tissue characteristics (Sprawls, 2000).

MRI is the most effective method of imaging the spine and surrounding soft tissues and for many spinal disorders is now replacing CT and myelography as the imaging technique of choice. (Moore, 2012).

1.2. Problem of the study:

The lumbar spine supports most of body weight; any pain in lumbar region can affect the function of the spine. In Sudanese population there is high prevalence of back pain for that we need to assess the suspected causes of this pain. MRI can provide information and determining the sources of the pain and help in guided diagnoses, but there is a wide variability in the reported prevalence of different MRI findings and limited knowledge is available to inform the clinician about what should be expected of MRI findings at a certain age and how this relates to back pain in different populations. For that this study aims to identify the most common MRI findings in lumbar spine.

1.3. Objectives of the study:

1.3.1: General objective:

To study MRI findings in lumbar spine among Sudanese patients at Khartoum state.

1.3.2: Specific objectives:

- To identify the most common MRI findings on lumbar spine.
- To find out the relationship between the ages, gender, occupation, BMI and MRI findings on lumbar spine.
- To determine the most affected disc level.
- To compared between males and females MRI findings on lumbar spine.

1.4 Overview of the study:

The study consists of five chapters; chapter one: includes a brief introduction, problem statement, objectives of the study and the overview, chapter two highlights the theoretical background as well as the previous studies, and the third concerns with materials and methods. Chapter four shows the results whereas chapter five includes the discussion of the results, conclusion, and recommendations.

Chapter Two

Theoretical Background and Previous Study

Chapter Two

Theoretical Background and Previous Studies

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. 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. (Drake et.al, 2019)

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:

The vertebral body, designed to bear weight. The vertebral (neural) arch, designed to protect the neural elements. 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. (Drake et.al, 2019). The intervertebral discal surface of an adult vertebra contains a ring of cortical bone peripherally termed the epiphyseal 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 epiphyseal 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. (Drake et.al, 2019)

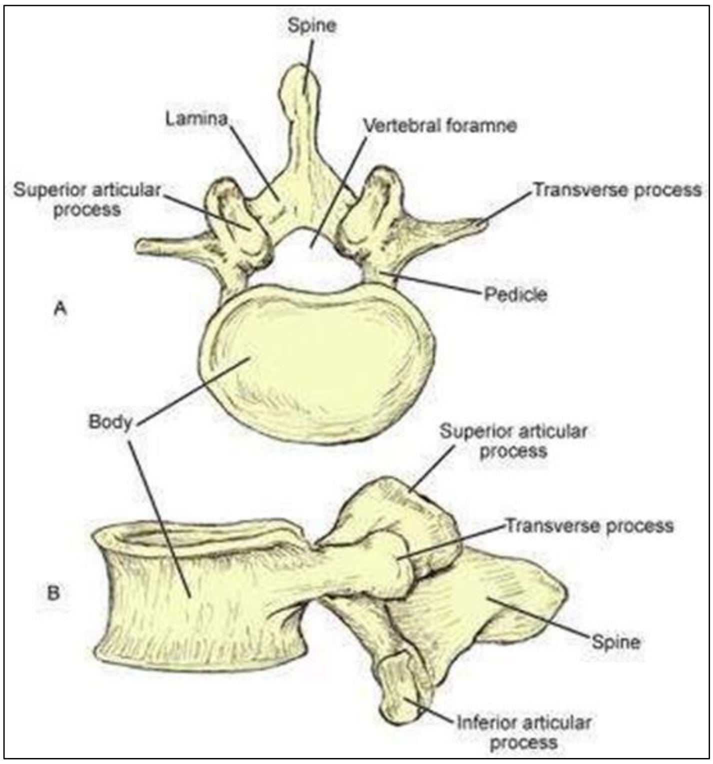

Figure (2.1): Anatomy of lumbar vertebra (Drake et.al, 2019)

Lumbar vertebrae are characterized by massive bodies and robust spinous and transverse processes. Their articular facets are oriented somewhat parasagittal, 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. This bony protuberance is sites of attachment of deep lumbosacral muscles. 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 caudaequina contents. The concavities in the cephalad and caudal surfaces of the pedicle are termed vertebral notches. (Drake et.al, 2019)

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. (Drake et.al, 2019). 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. 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. (Drake et.al, 2019). 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. (Drake et.al, 2019). 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. (Singh, 2014)

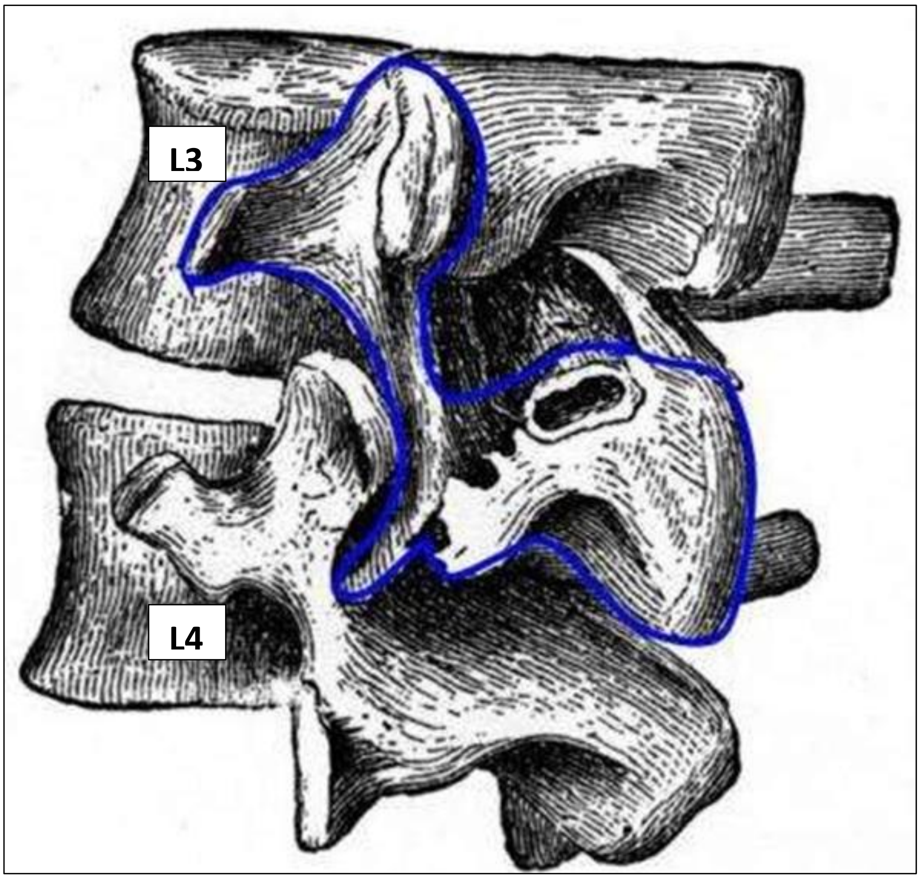

Figure (2.2): L3, L4 segments viewed from an oblique angle (Singh, 2014)

The outline of the facets and the pars interarticularis has the appearance of the "neck" of a Scottie dog. (Singh, 2014). 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. The lumbar spine has an anterior, middle, and posterior column that is pertinent for lumbar spine fractures. (Drake et.al, 2019)

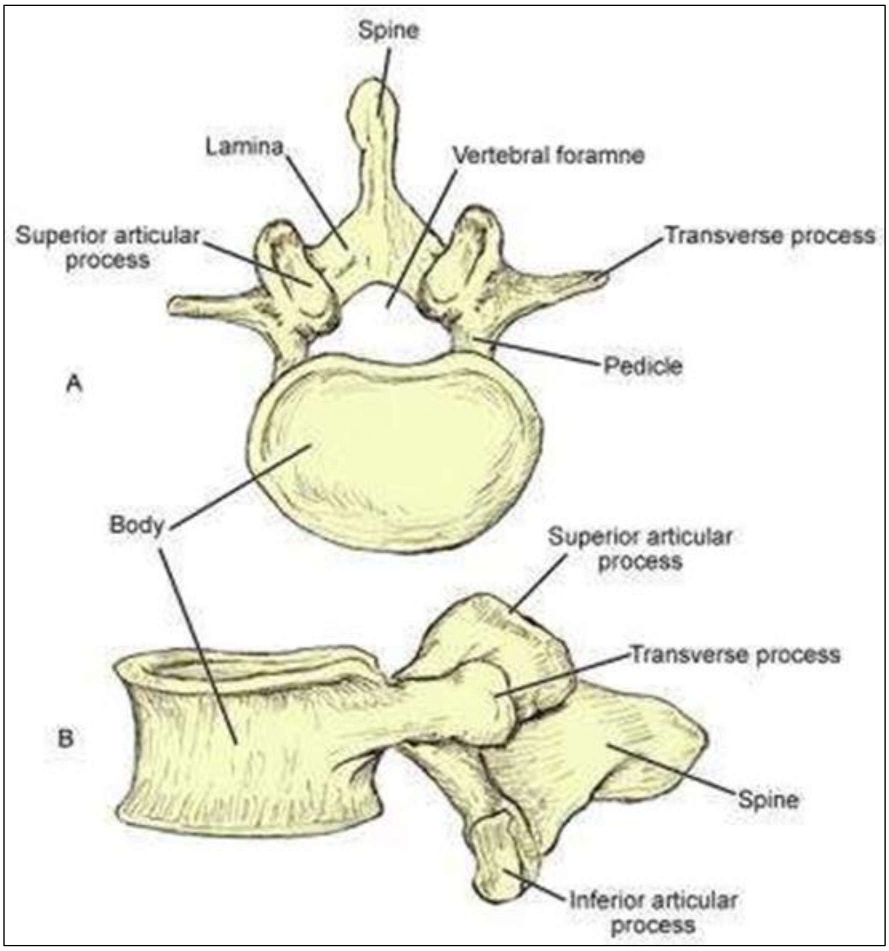

Figure (2.3): Anatomy of a vertebra (Drake et.al, 2019) .

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. These bony protuberances are sites of attachment of deep lumbosacral muscles. (Drake et.al, 2019)

2.1.2 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 spondylolysisoccurs if ossification of the pars interarticularis fails to occur. (Drake et.al, 2019)

2.1.3 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. (Drake et.al, 2019).

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 fibrosis 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. (Drake et.al, 2019)

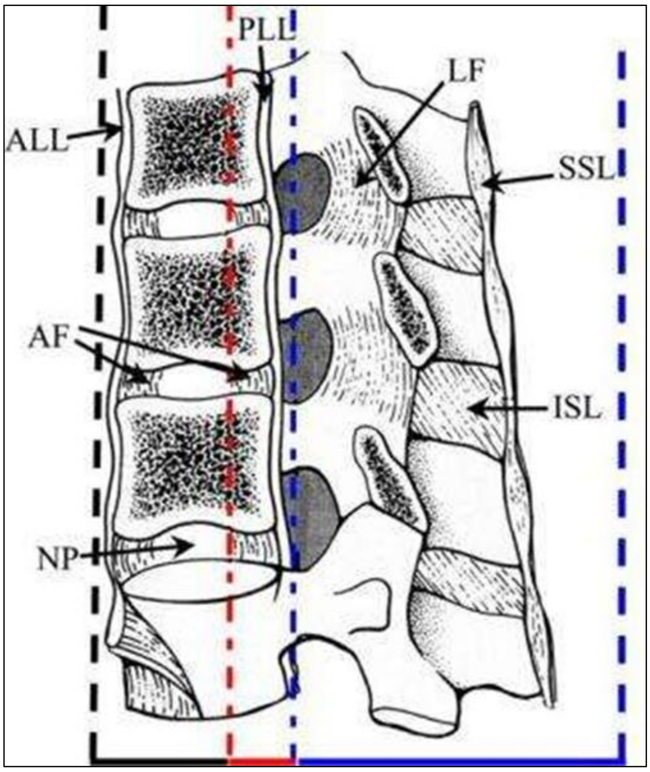

Figure (2.4): Lateral drawing of the 3 spinal columns of the thoracolumbar junction. (Drake et.al, 2019).

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 = ligamentumflavum; NP = nucleus pulposus; SSL = supraspinous ligament. (Drake et.al, 2019).

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. (Drake et.al, 2019).

2.1.4 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. (Drake et.al, 2019).

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. (Drake et.al, 2019).

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. (Drake et.al, 2019).

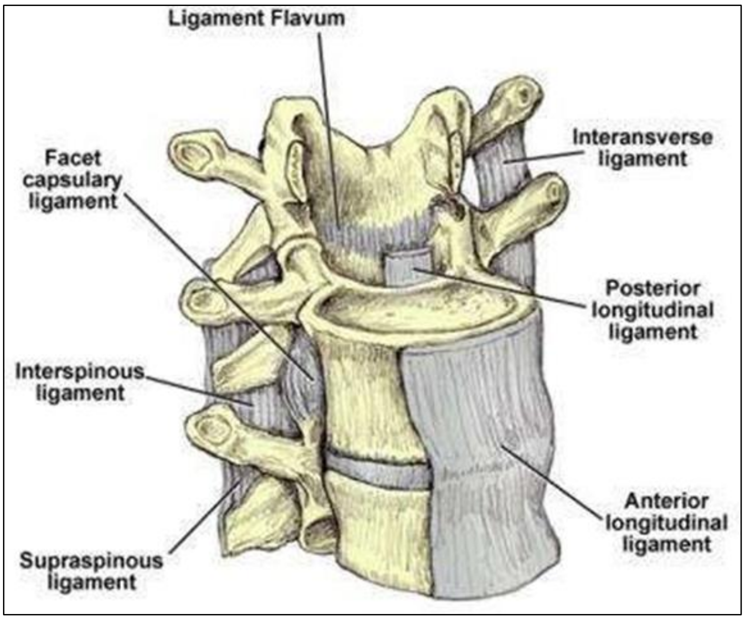

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Figure (2.5): Anterolateral view of the lumbar spine demonstrating the multiple ligaments of the lumbar spine. (Drake et.al, 2019).

These ligaments include the following: ligamentumflavum (LF), anterior longitudinal ligament (ALL), posterior longitudinal ligament (PLL), intertransverse ligament, interspinous ligament, supraspinous ligament, and facet capsular ligament. (Drake et.al, 2019).

2.1.5 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. (Drake et.al, 2019).

2.1.6 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. (Arslan et al., 2011)

2.1.7 Lumbar spine vasculature:

2.1.7.1 Arterial:

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. (Arslan et al., 2011)

2.1.7.2 Venous:

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. (Arslan et al., 2011)

2.1.8 Cross-sectional anatomy of lumbar spine:

On T1weighted image normal adult (yellow/fatty) bone marrow has" high signal (i.e. it is hyper intense or whitish in color) and c.s.f has a low signal (i.e.it is hypo intense or black in color). Neural tissue such as spinal cord or nerve roots it is intermediate in signal intensity. Cortical bone lacking mobile protons to produce asignal is hypo intense on all pulse sequence. On T2 weighted image bone marrow become lower in signal intensity, C.S.F become hyper intense and neural tissue maintains an intermediate signal intensity. (Shah et.al, 2011)

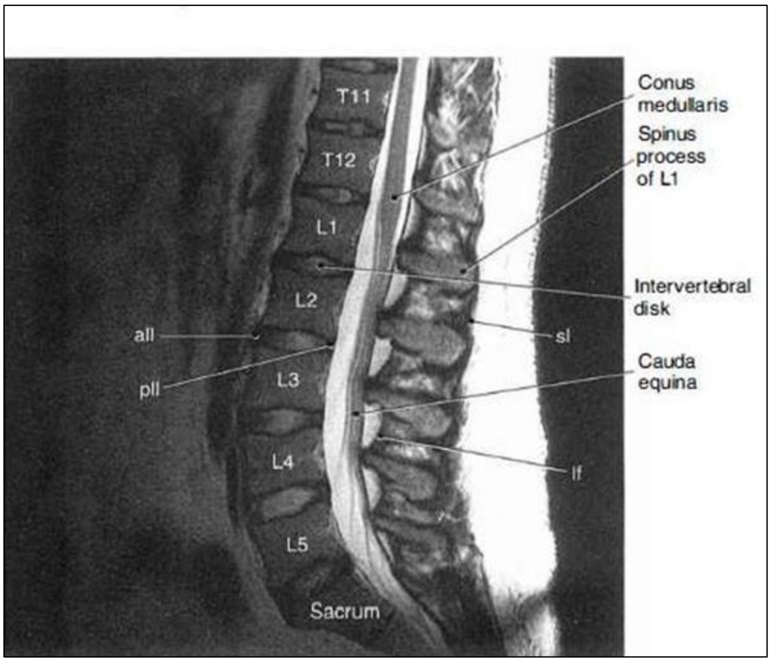

Figure (2.6): Midsagittal T2.wighted MR scan of lumber spine (Shah et.al, 2011)

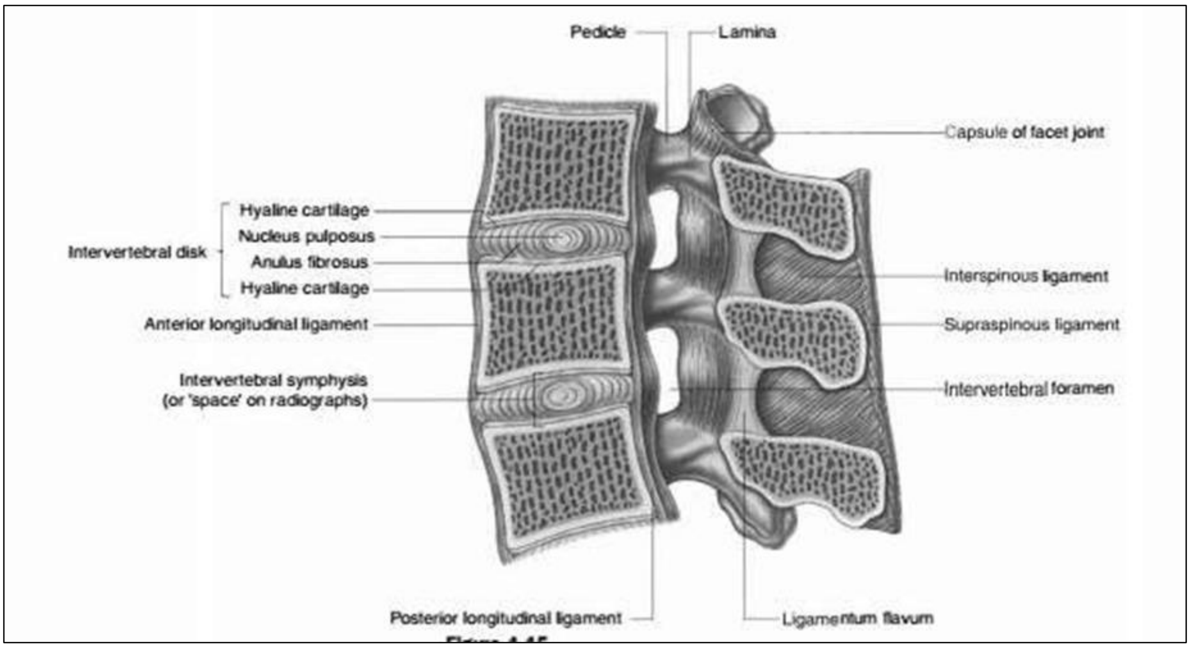

Figure (2.7): Midsagittal view of spinal ligaments. (Shah et.al, 2011)

Figure (2.8): Midsagittal, T2.weighted MR scan of lumbar spine demonstrating spinal ligaments. (Shah et.al, 2011)

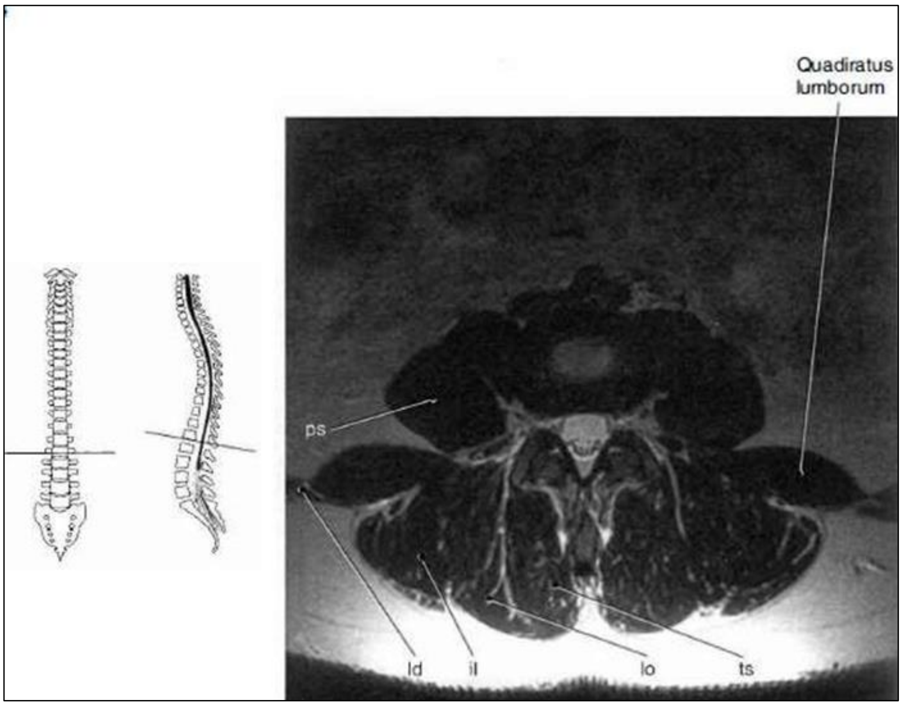

Figure (2.9): Axial, T2.weighted MR scan of lumbar spine with spinal muscles. (Shah et.al, 2011)

2.2 Physiology:

Lumbar spine is designed to protect the spinal cord, support the body and facilitate movement. (Arslan et al., 2011)

2.2.1 Vertebrae:

The vertebrae support the majority of the weight imposed on the spine. The body of each vertebra is attached to a bony ring consisting of several parts. A bony projection on either side of the vertebral body called the pedicle supports the arch that protects the spinal canal. The laminae are the parts of the vertebrae that form the back of the bony arch that surrounds and covers the spinal canal. There is a transverse process on either side of the arch where some of the muscles of the spinal column attach to the vertebrae. The spinous process is the bony portion of the vertebral body that can be felt as a series of bumps in the center of a person's neck and back. (Arslan et al., 2011)

2.2.2 Intervertebral Disc:

Between the spinal vertebrae are discs, which function as shock absorbers and joints. They are designed to absorb the stresses carried by the spine while allowing the vertebral bodies to move with respect to each other. Each disc consists of a strong outer ring of fibers called the annulus fibrosis, and a soft center called the nucleus pulposus. The outer layer (annulus) helps keep the disc's inner core (nucleus) intact. The annulus is made up of very strong fibers that connect each vertebra together. The nucleus of the disc has a very high water content, which helps maintain its flexibility and shock-absorbing properties. (Arslan et al., 2011)

2.2.3 Facet Joint:

The facet joints connect the bony arches of each of the vertebral bodies. There are two facet joints between each pair of vertebrae, one on each side. Facet joints connect each vertebra with those directly above and below it, and are designed to allow the vertebral bodies to rotate with respect to each other. (Arslan et al., 2011)

2.2.4 Neural Foramen:

The neural foramen is the opening through which the nerve roots exit the spine and travel to the rest of the body. There are two neural foramen located between each pair of vertebrae, one on each side. The foramen creates a protective passageway for the nerves that carry signals between the spinal cord and the rest of the body (Arslan et al., 2011)

2.2.5 Spinal cord and nerves:

The vertebral column surrounds the spinal cord. It travels within the spinal canal, a central hole within each vertebra. The spinal cord is part of the central nervous system that supplies nerves and receives information from the peripheral nervous system within the body. The spinal cord consists of grey matter and white matter and a central cavity. Adjacent to each vertebrae merge spinal nerves. The spinal nervous provide sympathetic nervous supply to the body, with nerves emerging forming the sympathetic trunk and the splanchnic nerves. The spinal canal follows the different curves of the column; it is large and triangular in those parts of the column which enjoy the greatest freedom of movement, such as the cervical and lumbar regions; and is small and rounded in the thoracic region, where motion is more limited. The spinal cord terminates in the conusmedullaris and caudaequine. (Lott et.al, 2019) .

2.3 Pathology:

In most patients DLSD is the result of "normal" wear and tear associated with the aging process or overuse. Other causes include a congenitally narrowed spinal canal, genetic predisposition to early disc disease, trauma, infection, inflammation and rarer conditions such as ossification of the posterior longitudinal ligament. (Standring, 2015)

2.3.1. Congenital lumbar spine abnormality:

2.3.1.1. Spinal stenosis:

Spinal stenosis is the narrowing of the spinal canal through which the spinal cord passes. Vertebral foramina enclose the spinal canal. Stenosis can be very serious if it compromises the spinal cord, resulting in pain, strange neural sensations, and even paralysis. It can be caused by a number of conditions, such as a ruptured disk or a dislocation of vertebrae, but here we will focus on the narrowing of the foramen because of vertebral degeneration with aging, the stability of the vertebrae, especially at the facet joints degenerates. To counter these stresses, the bone in the vertebrae thickens and the ligaments become thick and stiff. This results in a narrowing of the spinal canal. Stenosis can occur in the cervical, thoracic, lumbar, or all three regions. Treatment options include physical therapy to strengthen back and abdominal muscles and increase flexibility. Medications can provide relief from mild symptoms. Pain-blocking injections can temporarily reduce inflammation of the spinal nerves and nerve roots. (Ranjani, et al., 2015)

Surgery to remove pressure is usually recommended for patients with severe, persistent symptoms. Laminectomy is the most common surgical technique to relieve spinal cord or nerve branch compression due to stenosis. It involves the cutting of the vertebral lamina and the removal of the posterior portion of the vertebra. In the traditional "open" procedure, the muscles are cut in the approach, increasing recovery time. If done laparoscopically the muscles are merely pushed aside, reducing recovery. (Standring, 2015)

2.3.2. Genetic Component of Degeneration:

An undeniable genetic component to degenerative disc disease becomes evident when looking at results from twin studies and studies involving mice with a knockout for genes suspected to play a role in disc degeneration. (Taher et al., 2012)

Among the genes suggested to be involved in DDD, are genes that code for collagens I, IX, and XI, interleukin 1 (IL-1), aggrecan, the vitamin D receptor, matrix metalloproteinase 3 (MMP-3), and other proteins. It is well recognized that DDD is regulated by these and many other genes. Interactions among those genes, which in concert contribute substantially to DDD despite presumably small individual contributions, as well as gene- environment interactions, are very likely. (Taher et al., 2012)

2.3.3. Trauma to the spinal column:

Fractures occur when internal or external forces on the vertebrae exceed their structural strength. Common causes are vehicle accidents, sports, violence, and falls. Fractures can be further classified into two more groups: minor and major. When a posterior column element, such as the facet joint, is fractured it is "minor" because that structure is not vital to the stability of the spine. On the other hand, if the vertebral body is fractured (middle or anterior column), itis "major" because the stability of the spine may be at risk or damage to the spinal cord may occur. Vertebral body fractures may be further termed a stable or unstable. If a fracture is unstable, the bone fragments can damage the spinal cord and immediate intervention is necessary. (Standring, 2015)

2.3.4. Inflammatory spine diseases:

2.3.4.1Osteoarthritis (Degenerative Joint Disease):

Osteoarthritis is an extremely common generalized disorder characterized pathologically by loss of joint cartilage and reactive new bone formation. Part of the wear and tear of the aging process, degenerative joint disease tends to affect predominantly the weight bearing joints (spine, hip, knee, ankle) and the interphalangeal joints of the fingers. A secondary form of degenerative joint disease may develop in a joint that has been repeatedly traumatized or subjected to abnormal stresses because of orthopedic deformities, or it may be a result of a septic or inflammatory arthritis that destroys cartilage. (Ronald et al, 2012)

2.3.5. Infectious spine diseases:

2.3.5.1. Arthritis:

Pyogenic (pus-forming) organisms may gain entry into a joint by the hematogenous route, by direct extension from an adjacent focus of osteomyelitis, or from trauma to the joint (e.g., after surgery). The onset of bacterial arthritis usually occurs abruptly with a high fever, shaking chills, and one or a few severely tender and swollen joints. The most common type today is a migratory arthritis from Lyme disease. (Ronald et al, 2012).

2.3.5.2 Tuberculous Osteomyelitis:

Tuberculous osteomyelitis (which is rare today) most commonly involves the thoracic and lumbar spine. Pott's disease (tuberculosis of the spine) occurs in the mid-thoracic spine and thoracolumbar region. Irregular, poorly marginated bone destruction within the vertebral body is often associated with a characteristic paravertebral abscess, an accumulation of purulent material that produces a fusiform soft tissue mass about the vertebra. The spread of tuberculous osteomyelitis causes narrowing of the adjacent intervertebral disk and the extension of infection and bone destruction across the disk to involve the adjacent vertebral body. Unlike bacterial infection, tuberculous osteomyelitis is rarely associated with periosteal reaction or bone sclerosis. (Ronald et al, 2012)

2.3.6. Spinal injury:

The spinal cord contains the nerves that carry messages between your brain and body. The cord passes through your neck and back. A spinal cord injury is very serious because it can cause loss of movement (paralysis)below the site of the injury spinal cord injury may be caused by Bullet , stab wound Traumatic injury to the face, neck, head, chest, or back (for example, a car accident),Diving accident. Electric shock Extreme twisting of the middle of the body, Landing on the head during a sports injury, Fall from a great height. (Mai et al, 2011)

2.3.7 Lumbar spine tumors:

Spine tumors are examined under two subtitles called primary tumors which originate from the spine itself and its adjacent structures and secondary (metastatic) tumors of distant organs which spread hematogenously and lymphatically and are located in the spine and its surrounding tissues. As the spine is well vascularized and has close relationship with regional lymphatic and venous drainage systems (especially Batson’s venous plexus), it is generally susceptible to metastasis. Metastatic tumors are most common (97%) tumors of the spine. (Lewandrowski et al., 2011)

It is known that the adenocarcinomas which mostly originate from the lung, breast, prostate, kidney, gastrointestinal tract and thyroid tend to metastasize especially to the spine. It was found that the percentage of cancer patients who have had bone metastasis before death is between 50% and 70%, and especially in case of breast cancer this percentage rose up to 85%. Up to 10% of patients who have symptomatic spine metastases can be treated by surgery. The most common (70%) sites for spine metastasis are thoracic and thoracolumbar spine, and lumbar spine and sacrum have more than 20% of metastatic lesions. Cervical spine is a less frequent metastasis site. (Lewandrowski et al., 2011)

As primary tumors of the spine are rare and most of these lesions are asymptomatic, their real incidence is unknown. It is estimated that the incidence of hemangiomas and enostoses, which were accepted as the most common primary tumors of the spine, is between 11% and 14%. This ratio has been found to be dependent on lesions which have been detected incidentally in performing diagnostic procedures for other reasons. (Lewandrowski et al., 2011)

2.3.8 Paget's Disease:

Paget's disease (osteitis deformans) is one of the most common chronic metabolic diseases of the skeleton. Destruction of bone, followed by a reparative process, results in weakened, deformed, and thickened bony structures that tend to fracture easily. The disease, seen most commonly during middle life, affects men twice as often as women and has been reported to occur in about 3% of all persons older than 40 years. Although the destructive phase often predominates initially, there is more frequently a combination of destruction and repair in the pelvis and weight- bearing bones of the lower extremities. The reparative process may begin early and may be the prominent feature, often involving multiple bones. Paget's disease affects particularly the pelvis, femurs, skull, tibias, vertebrae, clavicles, and ribs. (Ronald et al, 2012).

2.3.9 Disc Bulge:

A disc bulge is a generalized displacement of disc material. ‘Generalized’ here implies a bulge that involves at least 50% of the circumference of the disc, but may involve up to 100%. Disc bulge is not considered to be a herniation, which is localized, and the terms should not be used interchangeably. (Lakkaraju, et al., 2011)

2.3.10 Disc Herniation:

A disc herniation is a localized displacement of disc material beyond the limits of the intervertebral disc space. ‘Localized’ here implies a displacement of less than 50% of the circumference of the disc, in contrast to the generalized displacement in a disc bulge. The disc space is confined by the vertebral endplates and peripherally by the outer edges of the vertebral ring apophyses. (Lakkaraju, et al., 2011)

2.3.11. Degenerative lumbar spine disease:

As a normal equal of aging, disc degeneration begins early in life due to loss of hydration resulting in disc height loss and diffuse bulging. Degenerative lumbar spine disease (DLSD) includes spondylotic (arthritic) and degenerative disc disease of the lumbar spine with or without neuronal compression or spinal instability. DLSD is common. Patients with DLSD often present with range of symptoms such as, lumbar back pain ,sciatica and claudication . In symptomatic patients, a significant proportion of symptoms are due to bony, discal or ligamentous compression of neural elements at the spinal canal or nerve root exit foramina. Caudaequina syndrome due to compression of the caudaequina by a herniated central lumbar disc is a specific condition requiring emergency neurosurgical attention. In terms of aetiology, in most patients DLSD is the result of "normal" wear and tear associated with the aging process or overuse. Other causes include a congenitally narrowed spinal canal, genetic predisposition to early disc disease, trauma, infection, inflammation and rarer conditions such as ossification of the posterior longitudinal ligament. (Ravindra, 2018)

2.3.11.1 Degenerative disc disease:

As normal sequel of aging .degenerative begin early in life due to loss of hydration result in disc loss and diffuse bulging .the degenerative disc may cause discogenic pain that usually cause pain felt in lower back pain. (Ravindra, 2018)

Findings on MRI scan include disc space narrowing, loss of T2 signal within the nucleus pulposus, endplate changes, and signs of internal disc derangement or tears. High Intensity Zones (HIZ) have been found in close to one third of patients undergoing MRIs for low back pain and have been used as a marker for internal disc derangement. (Kapural et al, 2011)

2.3.11.1.1 Degenerative (surgical lesion):

The loss of disc space height associate with degeneration result in misalignment and alter mechanical stress on the facet joint .In an attempt at stabilization ,facet joint, ligament and bone hypertrophidat adjacent end plat occurs . This together with diffuse canal later recesses and neural foramen. (Kapural et al, 2011)

2.3.11.1.2 Herniated disc (nucleus pulpous):

A herniated disc occurs when intervertebral disc outer fibers (the annuls are damage and the soft inner material of nucleus pulpous protrude out of it is normal space if the annulus tear near the spinal canal). A herniated disc is common on lumbar spine because of all pressure it supports herniated lumbar disc often produce sciatica a condition where the lower back pain and numbness radiated to back of leg . (Kapural et al, 2011)

2.3.11.2 Spondylatic degenerative change:

2.3.11.2.1Spondylosis:

Is incomplete development and formation of the connecting part of the vertebra, the pars interarticularis. Multilevel spondylosis means that these changes affect multiple vertebrae in the spine. There are several medical terms that sound similar to and are often confused with spondylosis including the following: Spondylitis is inflammation of one or more vertebrae, such as in ankylosing spondylitis, an inflammatory form of arthritis of the spine. This is a very different process than spondylosis because spondylosis is degenerative while spondylitis is inflammatory. (Ravindra, 2018)

2.3.11.2.2 Spondylolisthesis:

Is forward or backward displacement of the body of one vertebrae in relation to an adjacent vertebra. For example, anterior spondylolisthesis of L4 on L5 means that the fourth lumbar vertebra has slipped forward on the fifth lumbar vertebra. As a result, the spine is not normally aligned. If the displaced vertebrae shift with movement of the spine, this is referred to as dynamic spondylolisthesis. Dynamic shifting of the vertebrae is visualized with X-rays of the spine performed with patients flexing (bending forward) and then extending (bending backward) their back. (Ravindra, 2018)

Sagittal plane MRI is best for displaying the abnormal anatomy of spondylolisthesis T2 weighted images for the canal and T1 weighted images for the pars interarticularis and neural foramina . The MRI sagittal view clearly shows the degree of sublaxation and relationship of intervertebral disc to adjacent vertebral bodies and spinal canal. (Kapural et al, 2011)

2.3.11.2.3 Spondylosisdeformans:

Is growth of bone spurs (osteophytes) or bony bridges around a degenerating intervertebral disc in the spine. (Ravindra, 2018)

Figure (2.10): Sagittal T2W image shows spondylolisthesis of L5 vertebra. Sagittal T2W image shows spondylolisthesis of L5 vertebra. (Ravindra, 2018)

2.3.11.2.4 Spinal Instability:

The basic concept behind spinal instability is that there is an excess of motion between two spinal segments that results in pain or compromised neurologic function. The controversy in diagnosis arises, because in the majority of cases, the motion is not demonstrated, but only inferred solely by the presence of pain. We know that pain can be the result of excess motion. Since there is pain, we infer motion. The problem is that pain is often due to other factors and so that inferring that the pain is due to undetectable motion is a stretch. Surgery that is based on such an inference has a poorer success rate than surgery done in cases of demonstrable instability. In my opinion, this circular logic and the subsequent surgical treatments that follow is the main reason that spine surgery has developed such a poor reputation. (Ravindra, 2018)

2.3.11.2.5 Diagnosis of degenerative lumbar spine disease:

Patients with lumbar disc disease often present with amyriad of symptoms including pain, radicular symptoms, and weakness. LBP may be exacerbated by position and movement. Flexion often worsens the symptoms, while extension will relieve them. An increase in pain with extension may indicate facet arthropathy hen examining patients with presumed lumbar DDD, it is important to exclude other potential known etiologies for their pain. Abdominal pathology including aorticaneurysms, pancreatic disease, and renal calculi must be excluded. Furthermore, it is imperative that patients be questioned regarding other symptoms such as fevers, chills, fatigue, and weight loss, which may be indicative of other pathology. (Ravindra, 2018)

Upright plain radiographs in two planes are the initial imaging study of choice. They aid in ruling out pathologiescauses of back pain and, often supplemented by other imaging modalities, are evaluated for signs of degeneration. Findings in degenerative discs include disc space narrowing,endplate sclerosis, “vacuum” phenomenon within the disc,and osteophytes. Flexion and extension views may be helpfulif instability is suspected. (Ravindra, 2018)

2.4 Magnetic Resonance Imaging (MRI):

Magnetic Resonance Imaging (MRI) has emerged as a noninvasive multi-planar imaging modality with a superior soft tissue contrast resolution which can better define degenerative changes in the lumbar spine.

2.4.1 Equipment:

- Posterior spinal coil/multi-coil array spinal coil.
- Foam pads to elevate the knees.
- Earplugs/headphones. (Westbrook, 2014)

2.4.2 Patient positioning:

The patient lies supine on the examination couch with their knees elevated over a foam pad, for comfort and to flatten the lumbar curve so that the spine lies nearer to the coil. The coil should extend from the xiphisternum to the bottom of the sacrum for adequate coverage of the lumbar region. The patient is positioned so that the longitudinal alignment light lies in the midline, and the horizontal alignment light passes just below the lower costal margin, which corresponds to the third lumbar vertebra. Depending on the particular coil configuration, the patient may be placed either head first or feet first. If the patient is anxious or claustrophobic, when/if possible, the feet-first position may be better tolerated. (Westbrook, 2014)

2.4.3 Suggested protocol:

Sagittal/coronal SE/FSE T1 or coherent GRE T2: Acts as a localizer if three-plane localization is unavailable. The coronal or sagittal planes may be used. Coronal localizer: Medium slices/gaps are prescribed relative to the vertical alignment light, from the posterior aspect of the spinous processes to the anterior border of the vertebral bodies. The area from the conus to the sacrum is included in the image. (Westbrook, 2014)

P 20mm to A 30mm

Sagittal localizer: Medium slices/gaps are prescribed on either side of the longitudinal alignment light, from the left to the right lateral borders of the vertebral bodies. The area from the conus to the sacrum is included in the image. (Westbrook, 2014)

Figure (2.11): Sagittal FSE T1-weighted midline slice through the lumbar spine showing normal appearances (Westbrook, 2014)

Sagittal SE/FSE T1 (Figure 9.13): Thin slices/gaps are prescribed on either side of the longitudinal alignment light, from the left to the right lateral borders of the vertebral bodies (unless the paravertebral region is required). The area from the conus to the sacrum is included in the image. (Westbrook, 2014)

L 22mm to R 22mm

Sagittal SE/FSE T2 or coherent GRE T2: Slice prescription as for sagittal T1. Axial/oblique SE/FSE T1/T2 or coherent GRE T2: Thin slices/gaps are angled so that they are parallel to each disc space and extend from the lamina below to the lamina above the disc. The lower three lumbar discs are commonly examined. (Westbrook, 2014)

Figure (2.12): Sagittal FSE T2.weighted midline slice through the lumbar spine showing normal appearances. (Westbrook, 2014)

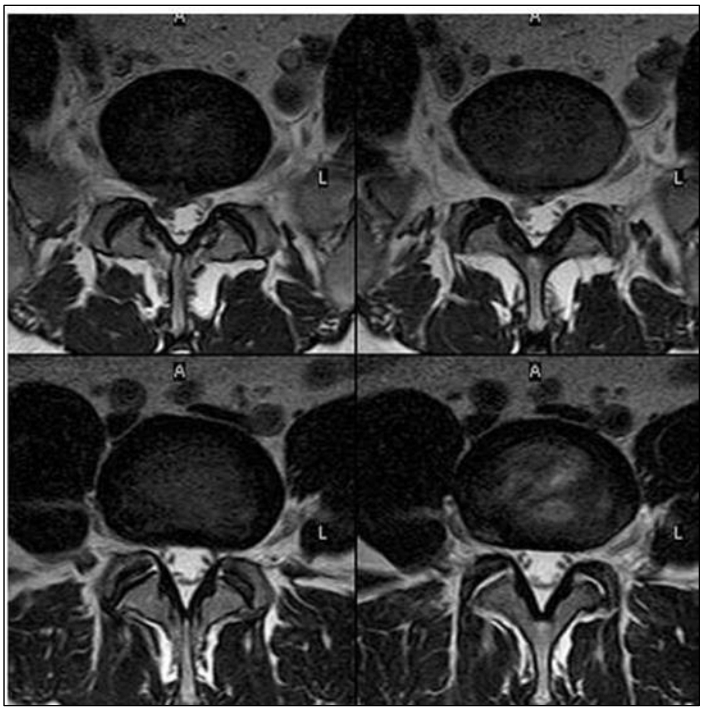

Figure (2.13): Axial/oblique FSE T2.weighted image of the lumbar spine (Westbrook, 2014)

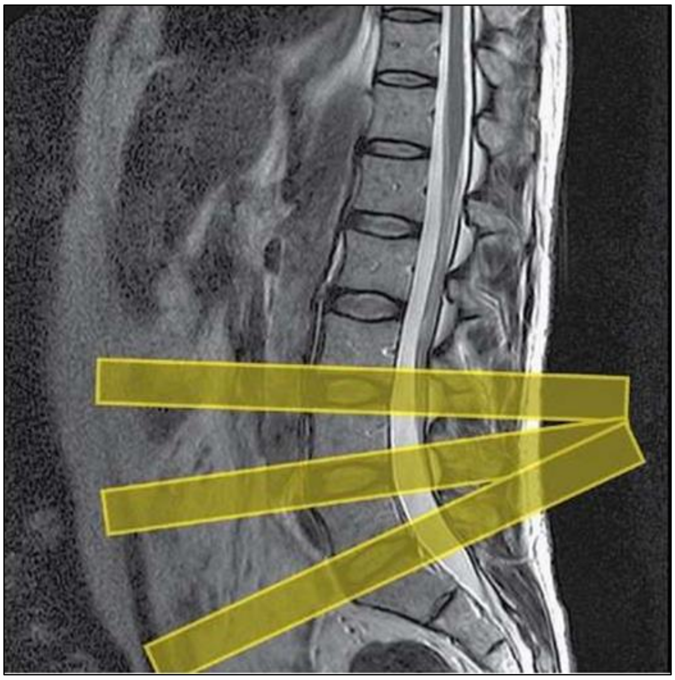

Figure (2.17): Sagittal FSE T2.weighted midline slice showing slice prescription boundaries and orientation for axial/oblique imaging of lumbar discs. (Westbrook, 2014)

2.4.4 Additional sequences:

Axial/oblique or sagittal SE/FSE T1: With contrast for determining disc prolapse versus scar tissue in failed back syndrome, and for some tumours. Without contrast in spinal dysraphism. Tissue suppression is beneficial to differentiate between fat and enhancing pathology. (Westbrook, 2014)

Coronal SE/FSE T1: For cord tethering or alternative view of conus when sagittals are inconclusive. (Westbrook, 2014)

Axial/oblique FSE T2: For arachnoiditis. As for axial/obliques, except prescribe one slice through, and parallel to, each disc space and vertebral body from the sacrum to the conus. (Westbrook, 2014)

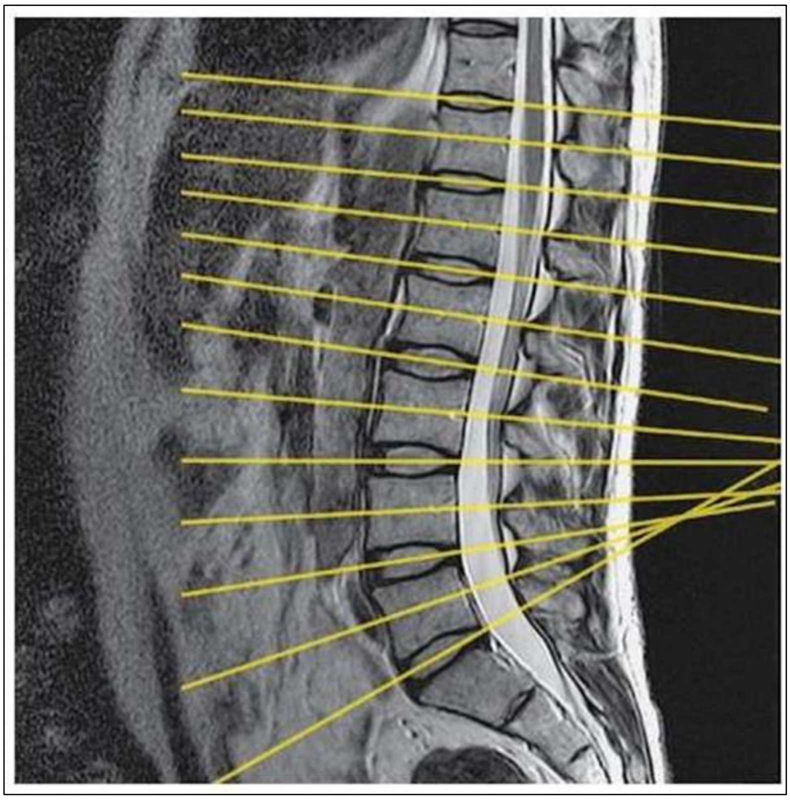

Figure (2.15): Sagittal FSE T2.weighted image of the lumbar spine showing axial/oblique slice prescription for arachnoiditis. (Westbrook, 2014)

STIR: While FSE sequences provide excellent T2.weighted images of the spine, the signal intensity from the normal fat in the marrow of the vertebral bodies is generally high, even with longer TE times. For that reason, marrow pathology, such as tumours or fractures, may not be adequately visualized on T2.weighted FSE sequences. A STIR sequence can be utilized to visualize bone marrow abnormalities better. (Westbrook, 2014)

The T1-weighted FSE shows an acute fracture of the L1 vertebral body. The T2.weighted FSE also shows the fracture, but the majority of the bone marrow signal in the L1 vertebral body appears similar to the other vertebral bodies. The STIR clearly shows the increased signal within the L1 vertebral body consistent with an acute fracture. (Westbrook, 2014)

2.5 Previous studies:

- Study by (Babiker, 2012): The objective of the study was to assess the severe lower back pain disorders using MRI which was conducted at University Diagnostic Centre (UDC) in National Cancer Institute (NCI) during the period from 2010 to 2011. Open MRI machine 0.5 tesla was used and routine lumbar spine MRI protocol was performed. Random sample of 50 patients male and female with different age and weight suffering from severe lower back pain. The study was found that disc bulge was the most common causes 46% ,disc bulge & disc herniation 6% ,disc bulge enervative 10% ,disc bulge ,degenerative & stenosis 2%, disc bulge ,degenerative & spondylolisthesis 2%, disc bulge ,degenerative &other 8%, disc bulge, disc herniation, degenerative , other 4%, disc bulge & spondylolisthesis 2% ,disc bulge & other 2% ,disc herniation 6%,normal 8%and others 4% . The incidence of LBP is equal between the men and female. Most patients affected by diseases their age range between 40-69 yrs. The L4/L5 was the most level of spine affected by diseases. MRI has become promising modality for diagnosis the causes of low back pain. (Babiker, 2012)

- Study by (Abdlamaged, 2016): Degenerative spine conditions involve the gradual loss of normal structure and function of the spine over time. They are usually caused by aging, but may also be the result of tumors, infections or arthritis. The aim of this study was to evaluate age related changes in lumbar vertebrae degeneration. The entire populations of this study were 50 patients' males and females with different ages range. They referred to MRI center for MRI examination of lumbar spine. The result of the study showed that degenerative disc disease is more common in women than in men. Furthermore, Disc degeneration with diffuse disc changes are more commonly found at L4 - L5 and L5 – S1 level and L1 – L2 is least common. This Cranio-caudal directionpattern is also followed by disc herniation. In addition, the Lumbar disc degeneration is the most common cause of low back pain. MRI is the standard imaging modality for detecting disc pathology due to its advantage of lack of radiation, multiplanes imaging capability, excellent spinal soft-tissue contrast and precise localization of intervertebral discs changes.(Abdlamaged, 2016)

- Study by (Osman, 2017): This is descriptive study was conducted during period from 2016-2017 at Modern Medical Center and Ribat Hospital University by using two magnetic resonance imaging (MRI) , close MRI machine 1.5 tesla ,and open MRI machine 0.3 tesla. This study carried a sample of 100 patients (56 males and 44 females) was used and routine lumber spine MRI protocol was performed. The purpose of this study , the study lower back pain by using MRI and correlated to age , gender, weight, height . The main result of this study were that the men and standard deviation for age, weight , height , and time duration .Was ± 47.7100SD 16.00397(years), ±74.8600SD 15.21(kg), 167.210 SD15.422(cm), ± .1100 SD .31447 (years) . The study found that disc bulge was the most common causes 21%, Spondylolisthesis 12%, Spondylatic arthritis11% , Disc degeneration18% , Disc prolapsed14%, Disc protusion 13%, Others11% . The study showed that no correlation between the subject's age weight, just height and time pain.(Osman, 2017)

- Study by (Semaan et al, 2015): To determine the prevalence and nondetection rate of incidental extraspinal findings (IESFs) in adult patients undergoing MRI of the lumbar spine performed for low back pain by using a structured approach. A total of 859 IESFs were found in 671 of 3024 lumbar spine patients undergoing MRI (22%). A total of 623 out of them (73%) were categorized E2 (clinically unimportant finding), 192 (22%) were categorized E3 (likely unimportant finding), and 44 (5%) were categorized E4 (potentially important finding). A total of 347 of 859 findings were not mentioned in the archived reports for a nondetection rate of 40%. The nondetection rate for E4 category findings was 38.6% (17/44). Conclusion. IESFs on lumbar spine MRI are common with a significant nondetection rate of 40% using a nonstructured approach. Specifically, there was a significant nondetection rate of 38.6% for potentially important (E4). (Semaan et al, 2015)

- Study by (Ahmed, 2015): Lumbar spine injuries continue to be an enormous public health problem even with modern medicine in the 21 century. Most patient mild stage, the remaining injuries are divided equally between moderate and severe categories. This study is statistical study, but through it the researcher reflected the social and economic impact of lumbar spine injuries. The main purpose of this study is to estimate variety and severity of lumbar spine injuries. This received in some CT diagnostic centers and police hospital in Khartoum state. 30 case were selected randomly, those with clinical diagnosis of lumbar spine injuries and their CT report were collected to evaluate them. The study carried out in four diagnostic centers and in police hospital in Khartoum state in period extends from January to April 2015. The result of study explain that male have high incidence of lumbar spine injuries.(Ahmed, 2015)

Chapter three

Materials and Methods

Chapter three

Materials and Methods

3.1 Materials:

3.1.1 Study Type:

Descriptive Cross sectional study.

3.1.2 Study Area:

The study was carried out at Khartoum state, the data were collected from (Abdon Seed Ahmed Medical Complex, Alzaytona Hospital).

3.1.3 Study Duration:

The study conducted from July 2021 to March 2022.

3.1.4 Sample size:

104 patients were enrolled in this study 48 female and 56 were male and their age range between 11 to 80 years.

3.1.5 Inculcation criteria:

Non-traumatic Sudanese patients who underwent to MRI lumbar spine scan were included.

3.1.6 Instrumentation:

MRI machines Toshiba, Siemens, and Philipswith strength range from 0.2 to 1.5 tesla.

3.2 Methods:

3.2.1 Technique used:

The patient lies supine on the examination couch with their knees elevated over a foam pad, for comfort and to flatten the lumbar curve so that the spine lies nearer to the coil. The coil should extend from the xiphisternum to the bottom of the sacrum for adequate coverage of the lumbar region. The patient is positioned so that the longitudinal alignment light lies in the midline and the horizontal alignment light passes just below thelower costal margin, which corresponds to the third lumbar vertebra. MRI of lumbar spine was performed with multiplane image. Sagittal/coronal SE/FSE T1 or coherent GRE T2*(Acts as a localizer if three-plane localization is unavailable) , Sagittal SE/FSE T1 (Thin slices/gap are prescribed on either side of the longitudinal alignment light , from the left to the right lateral borders of the vertebral bodies), Sagittal SE/FSE T2 or coherent GRE T2* , Axial/oblique and SE/FSE T1/T2 or coherent GRE . Additional protocol Sagittal SE/FSE T1 With contrast for determining disc prolapse versus scar tissue in failed back syndrome, and for some tumours.

3.2.2 Data collection:

The data were collected by data collection sheets specifically designed for this study that contains all study variables.

3.2.3 Data analysis:

The data were analyzed using static package for social science (SPSS).

3.2.4 Data storage:

The data were storage in personal hard disk, personal computer and personal phone.

3.2.5 Data presentation:

The data were present in Tables and graphs.

3.2.6 Ethical consideration:

I had approval from Sudan University of science and technology by research committee in college of Graduated Studies, Khartoum state ministry of health research department, and from hospitals. The data were collected from the patients who already came to spine MRI with signed permission or oral agreement from them. No personal data were published; also the data kept in personal computer with personal password due to privacy and confidentiality.

Chapter four

Results

Chapter four

Results

Table (4.1): Frequency distribution of age group:

Age group	Frequency	Percent
(11-25)	12	11.5%
(26-40)	24	23.1%
(41-55)	32	30.8%
(56-70)	29	27.9%
more than 70	7	6.7%
Total	104	100%

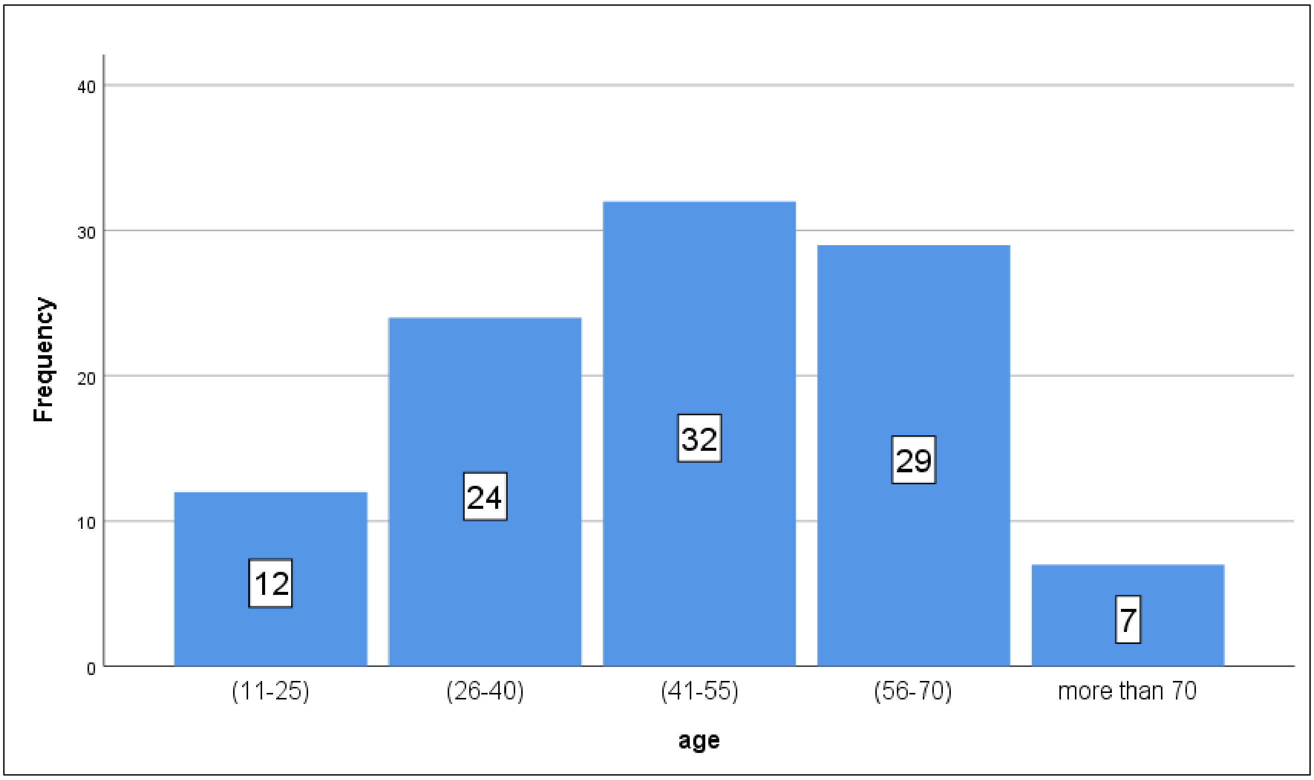

Figure (4.1): Frequency distribution of age group

Table (4.2): Frequency distribution of gender:

Gender	Frequency	Percent
Male	56	53.8%
Female	48	46.2%
Total	104	100%

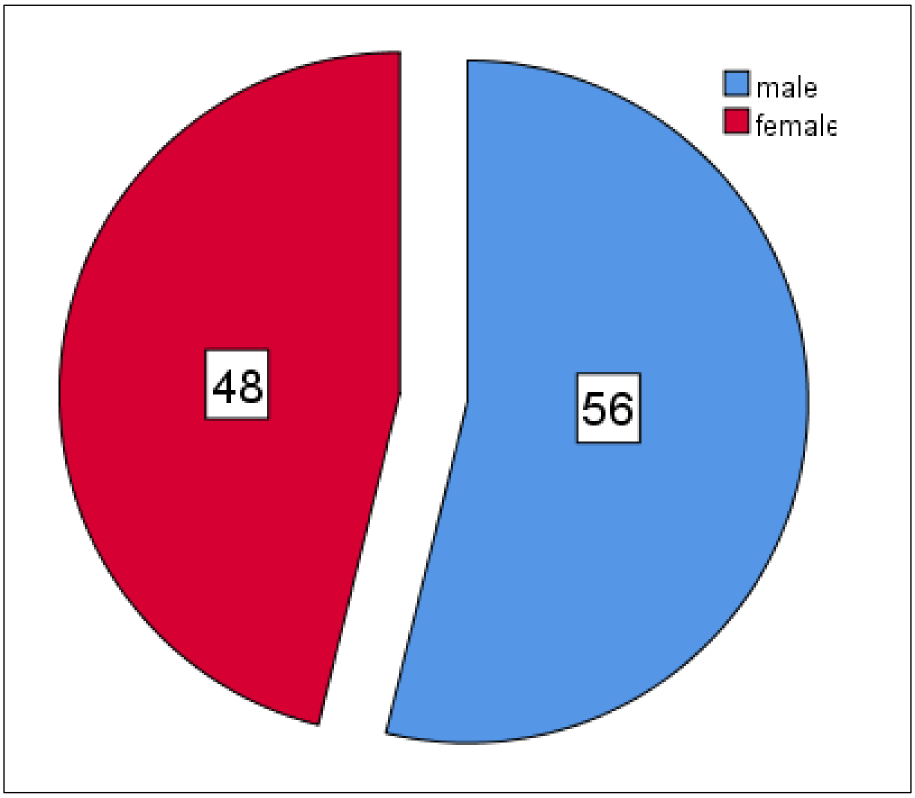

Figure (4.2): Frequency distribution of gender

Table (4.3): Frequency distribution of BMI:

BMI	Frequency	Percent
Underweight	1	1%
Healthy	35	33.6%
Overweight	34	32.7%
Obese	34	32.7%
Total	104	100%

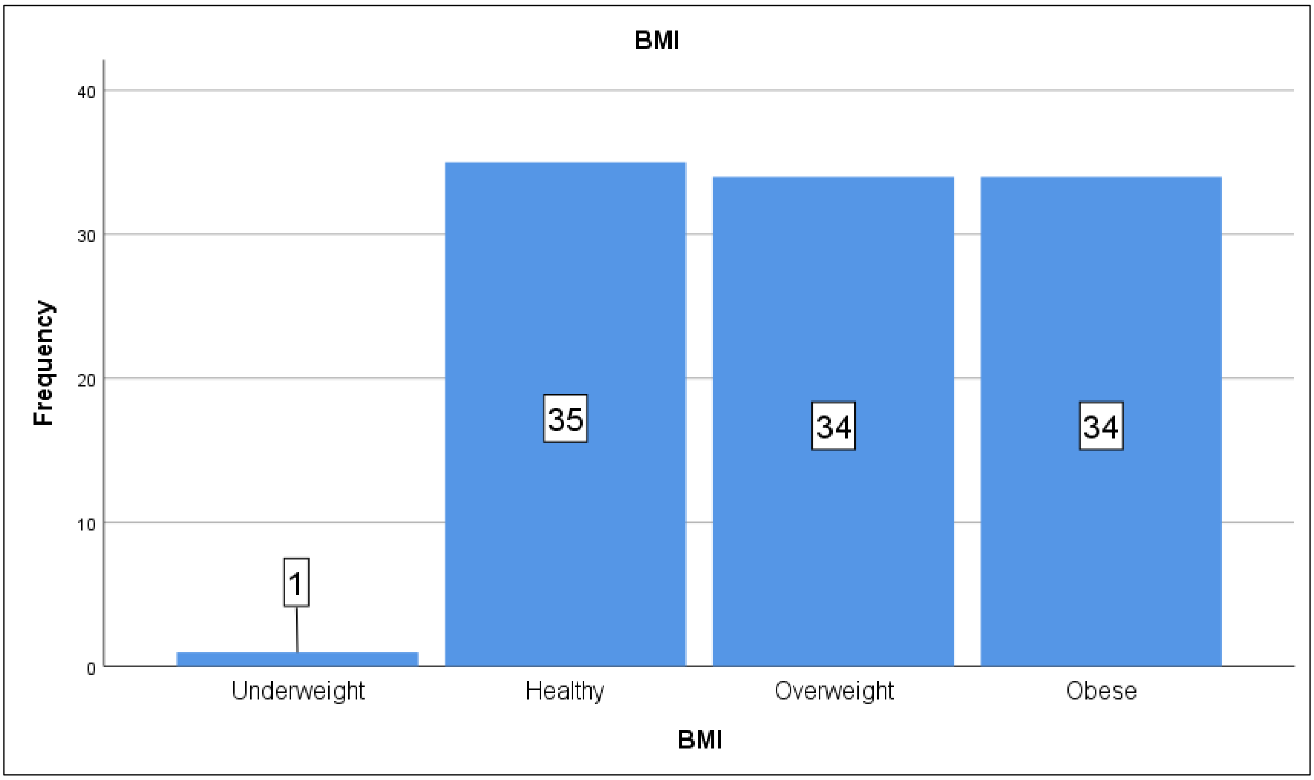

Figure (4.3): Frequency distribution of BMI

Table (4.4): Frequency distribution of occupation:

Occupation	Frequency	Percent
employee	8	7.7%
police	27	26%
freelance	27	26%
housewife	24	23%
student	11	10.6%
teacher	2	1.9%
farmer	2	1.9%
lawyer	2	1.9%
driver	1	1%
Total	104	100%

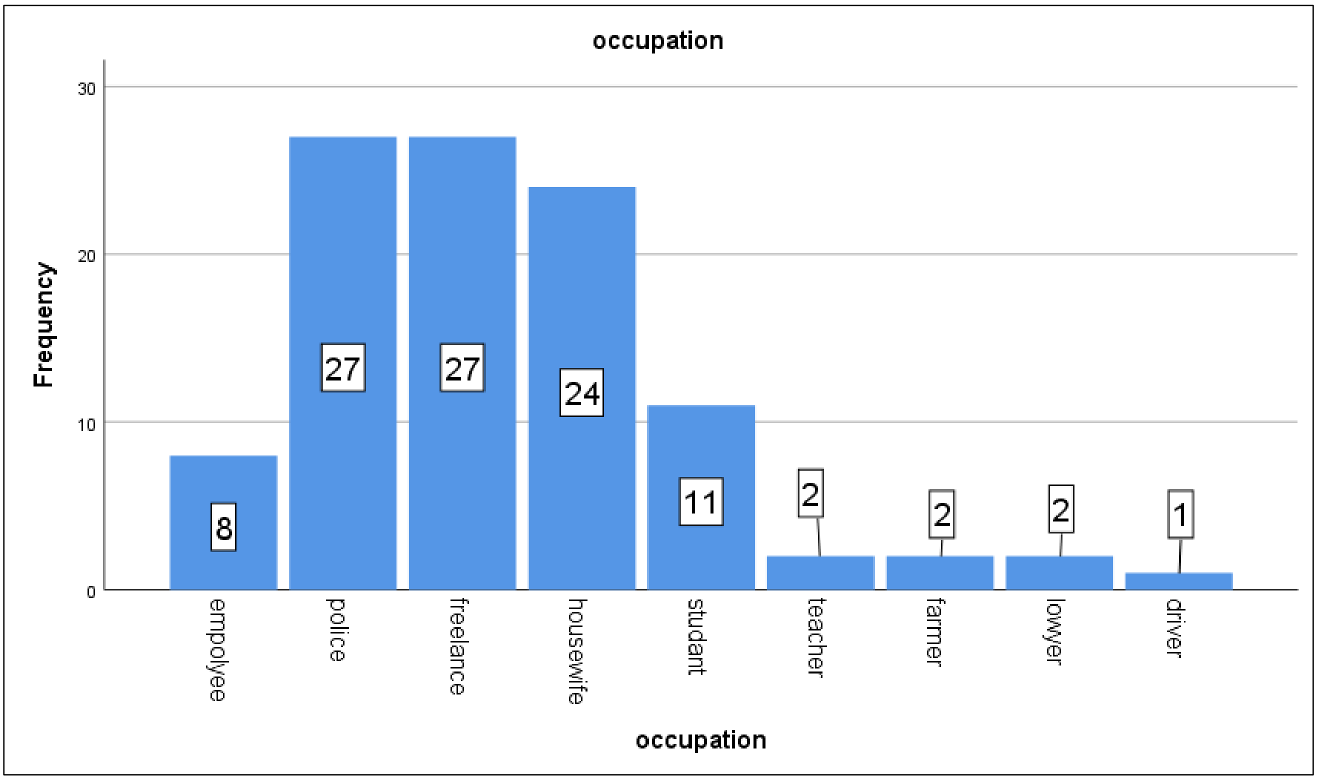

Figure (4.4): Frequency distribution of occupation

Table (4.5): Frequency distribution of MRI findings:

MRI findings	Frequency	Percent
disc bulge	65	67.6%
loss of lordosis	47	48.9%
loss of height	4	4.2%
disc herniation	17	17.7%
fracture [fx]	6	6.2%
dehydration	4	4.2%
excessive lumbar lordosis	2	2.1%
muscle spasm	1	1.04%
pott's disease	4	4.2%
soft tissue lesion	1	1.04%

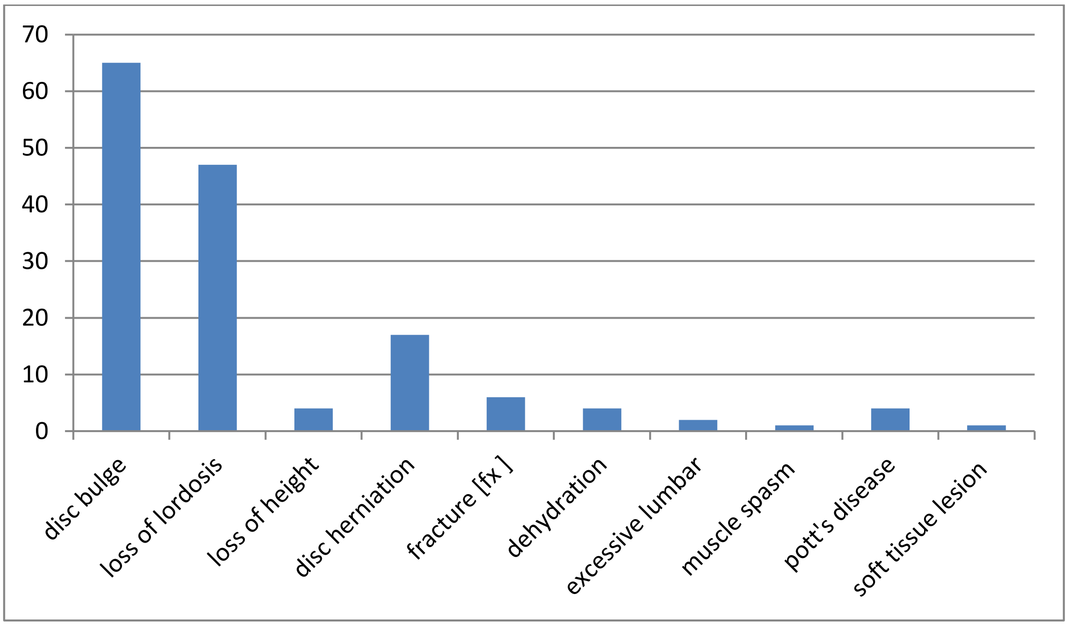

Figure (4.5): Frequency distribution of MRI findings

Table (4.6): Correlation between MRI findings and age groups:

		Age group					Total
		(11-25)	(26-40)	(41-55)	(56-70)	> 70	
MRI	disc bulge	7	16	23	16	3	65
	loss of lordosis	5	11	13	13	4	46
	loss of height	0	0	3	3	1	7
	disc herniation	2	5	5	2	1	15
	fracture [fx]	1	0	1	3	1	6
	dehydration	0	0	1	1	0	2
	excessive lumbar lordosis	0	0	1	1	0	2
	muscle spasm	0	0	0	1	0	1
	pott's disease	0	0	1	2	0	3
	soft tissue lesion	0	0	0	1	0	1
p-value = 0.62							

Table (4.7): Correlation between MRI findings and gender:

		Gender		Total
		Male	Female	
MRI	disc bulge	33	32	65
	loss of lordosis	33	13	46
	loss of height	4	3	7
	disc herniation	6	9	15
	fracture [fx]	4	2	6
	dehydration	3	1	4
	Excessive lumbar lordosis	1	1	2
	muscle spasm	1	0	1
	pott's disease	2	1	3
	soft tissue lesion	1	0	1
p-value = 0.11				

Table (4.8): Correlation between MRI findings and BMI:

		BMI				Total
		Underweight	**Healthy**	**Overweight**	**Obese**	
MRI	disc bulge	0	22	21	22	65
	loss of lordosis	1	17	17	11	46
	loss of height	0	2	3	2	7
	disc herniation	0	3	6	6	15
	fracture [fx]	1	1	2	2	6
	dehydration	0	2	1	1	4
	excessive lumbar lordosis	0	0	1	1	2
	muscle spasm	0	0	1	0	1
	pott's disease	0	1	1	1	3
	soft tissue lesion	0	1	0	0	1
p-value = 0.00						

Table (4.9): Correlation between MRI findings and occupation:

		Occupation									Total
		employee	police	freelance	housewife	student	teacher	farmer	lawyer	driver	
MRI	disc bulge	6	18	17	15	6	1	1	1	0	65
	loss of lordosis	1	15	17	6	5	1	0	0	1	46
	loss of height	0	2	2	2	0	1	0	0	0	7
	disc herniation	2	4	3	4	1	0	0	1	0	15
	fracture [fx]	0	0	3	2	1	0	0	0	0	6
	dehydration	0	0	1	1	1	0	0	1	0	4
	excessive lumbar lordosis	0	0	1	1	0	0	0	0	0	2
	muscle spasm	0	0	0	0	0	1	0	0	0	1
	pott's disease	0	1	0	1	0	0	0	0	0	1
	soft tissue lesion	0	0	0	0	1	0	1	0	0	3
p-value = 0.001											

Table (4.10): Levels affected presented in MRI findings:

Disc	Frequency
L1-L2	0
L2-L3	0
L3 - L4	23
L4 - L5	48
L5 - S1	10

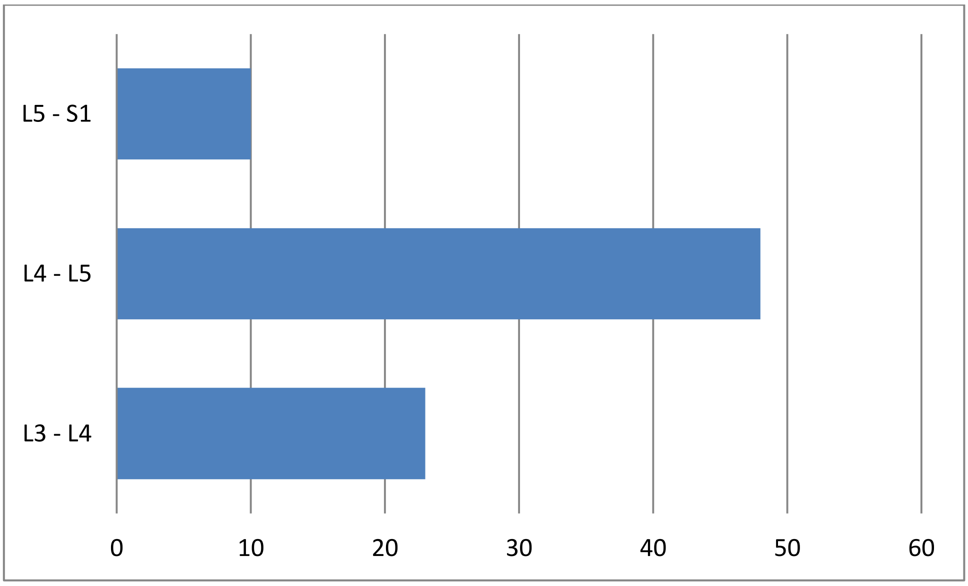

Figure (4.6): Levels affected presented in MRI findings

Table (4.11): Cross tabulation between levels affected and MRI findings:

Findings	**Level**				
	L1-L2	**L2-L3**	**L3-L4**	**L4-L5**	**L5-S1**
disc bulge	0	0	18	36	8
disc herniation	0	0	4	10	1
dehydration	0	0	1	2	1

Chapter five

Discussion, Conclusion and Recommendations

Chapter five

Discussion, Conclusion and Recommendations

5.1 Discussion:

This was descriptive Cross sectional study aimed to study of MRI findings in lumbar spine among Sudanese population at Khartoum state, carried out at Khartoum state hospitals and medical centers which have MRI department (Abdon Seed Ahmed Medical Complex, Alzaytona Hospital), conducted in period from July 2021 to March 2022, 104 patients who came to MRI department with spinal pain, requested for lumbar spine MRI aged between (11-80) years.

The results showed the most affected age group were (41-55) years (30.8%) followed by (56-70) years then (26-40) years, as shown in table; figure (4.1). The genders distributed as 56 (53.8%) were males and 48(46.2%) were females, as shown in table; figure (4.2).

Regarding to BMI ranges most of the patients were healthy 35 (33.6%), overweight and obese were 34 (32.7%) for each class then underweight was only one patient, as shown in table; figure (4.3).

Regarding patient's occupation most of them were police and freelance 27(26%) then housewife 24 (23%), students were 11 (10.6%), employee were 8(7.7%), teacher, farmer and lawyer were 2(1.9%) for each group at last one patient was driver, as shown in (4.4).

Concerning the MRI findings disc bulge was 65(67.6%), loss of lordosis was 47(48.9%), loss of height was 4(4.2%), disc herniation was 17(17.7%), fracture [fx] was 6(6.2%), dehydration was 4(4.2%), excessive lumbar lordosis was 2(2.1%), muscle spasm was 1(1.04%), pott's disease was 4(4.2%) and soft tissue lesion was 1(1.04%), as shown in table (4.5).This results were disagree with previous studies.

The results found there was statistically insignificant correlation between MRI findings and age groups (p-value= 0.62), as shown in table (4.6). We agree with (Osman, 2017) who found that no correlation between age and pain.

The results found there was statistically insignificant correlation between MRI findings and gender (p-value= 0.11) as shown in table (4.7).

There was statistically significant correlation between MRI findings and BMI (p-value= 0.00) as shown in table (4.8). Also the results found there was statistically significant correlation between MRI findings and occupation (p-value= 0.00). Table (4.9).

Also the results found (L4-L5) was most affected disc in 48 patients, followed by disc (L3-L4) in 23 patients and at last disc (L5-S1) in 10 patients; The other levels (L1-L2), (L2-L3) not appeared in this study as shown in table (4.10), figure (4.6). This result agrees with (Babiker, 2012) who found the L4/L5 was the most level of spine affected by diseases.

Finally the results found from cross tabulation between levels affected and MRI findings mostly patients had disc bulge at level L4-L5. as shown in table (4.11).

5.2 Conclusion:

The study concluded to:

- Lower back pain has become common among the adults and older people. Obviously, they have relation with age, weight, height and lower back pain duration.
- The analysis of abnormal MRI findings in this study showed that disc bulge, loss of lordosis, loss of height, disc herniation, fracture [fx], dehydration, excessive lumbar lordosis, muscle spasm, pott's disease and soft tissue lesion are the main findings.
- Disc bulge is common finding of lumbar spine MRI (67.6%) of the study cases.
- The common level of lumbar spine affected by disease is L4/L5.
- MRI have big role in diagnosis of lumbar spine pathologies and has ability to differentiate between them.

5.3 Recommendations:

- This study will be starting point for new researches because the study found that healthy people are the most group that came to MRI department with lumber spine pain.
- For that proper history and clinical examination are very necessary to determine which type of imaging is need and it will also allow the technologist to focus the effort of the examination at proper disc level.
- Further studies should be done using a large sample of patient's for further assessment.
- Further studies should be use dynamic MRI machine to give more accurate results.

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Appendices

Appendix [A]

Data collection sheet

No	Age	Gender	Height	Weight	BMI	Occupation	MRI findings
1.							
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Appendix [B]

MRI Images

Image 1: Shows 26 years female sagittal T2 MRI (pre and after contrast) with pott's disease.

Image 2: Shows 21 years male sagittal T2 MRI with disc plug L4-L5

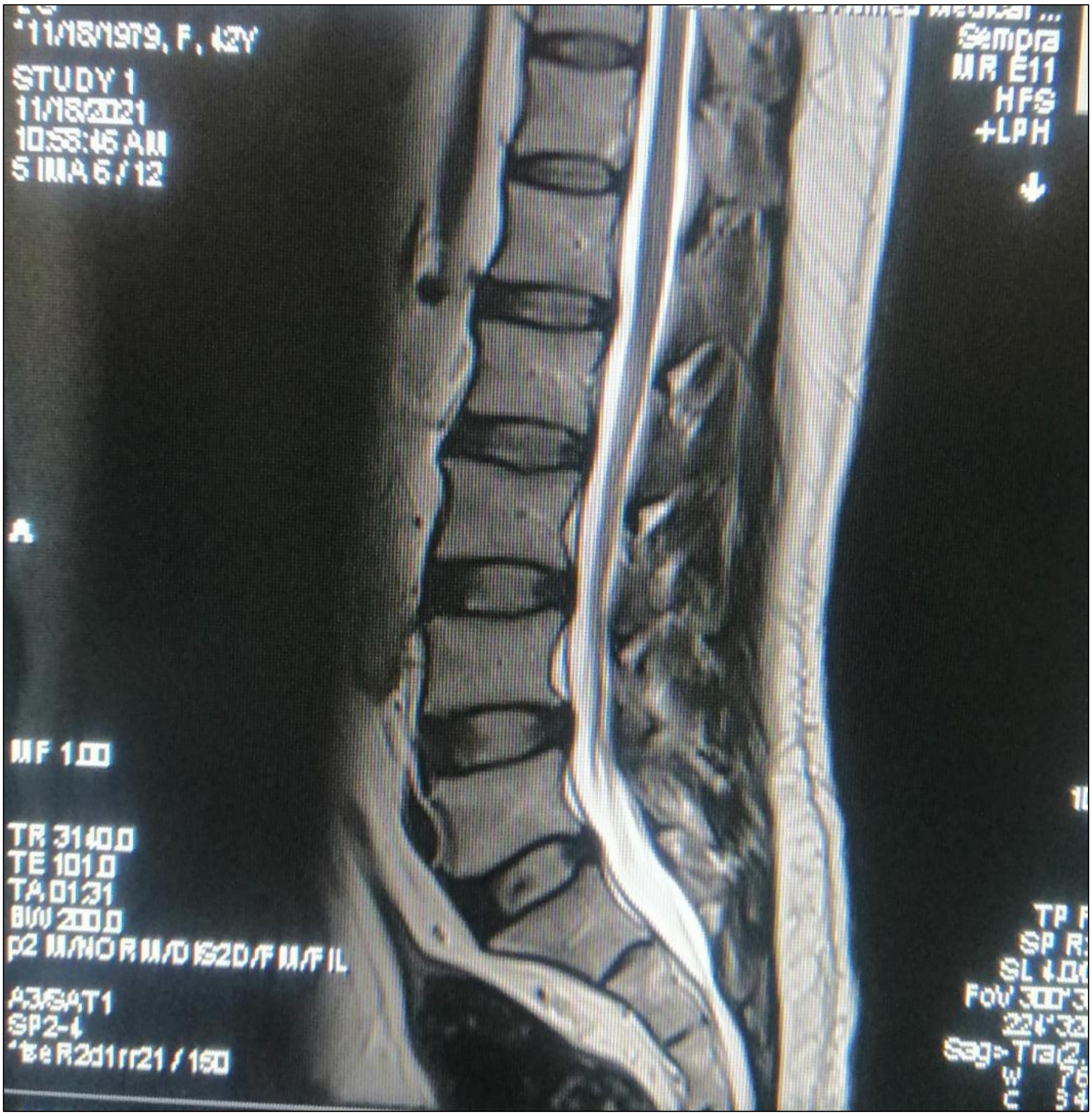

Image 3: Shows 42 years female sagittal T2 MRI with disc plug and loss of lordosis.

Image 4: Shows 63 years male sagittal T2 MRI with loss of lordosis.

Image 5: Shows Siemens Sempra MRI Machine