Sudan University of Science and Technology

College of Graduate Studies

Assessment of Degenerative Lumbar spine Diseases using Magnetic Resonance Imaging

تقييم أمراض الفقرات القطنية الانحلالية باستخدام التصوير بالرنين المغناطيسي

A Thesis Submitted for Partial Fulfillment for the Requirements of M.Sc. Degree in Diagnostic Radiologic Technology

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الآية

بسم الله الرحمن الرحيم

قال تعالى:

(وَاصْبِرْ لِحُكْمِ رَبِّكَ فَإِنَّكَ بِأَعْيُنِنَا وَسَبِّحْ بِحَمْدِ رَبِّكَ حِينَ تَقُوم)

صدق الله العظيم

سورة الطور (الأيه 48)

Dedication

To my parents

To my family

To colleagues for their love and support

Acknowledgement

I thank God for enabling me to complete this research.

I great thank to **Dr. Duha Abdu Mohamed Abdu** my teacher and my supervisor.

A big thanks to all employees of MRI centers for the dedicated help in collecting the patient's data to complete this research.

Abstract

This is a retrospective statistical study to assess the degenerative lumbar spine diseases by magnetic resonance imaging which conducted at Alribat University Hospital and Almoalem Medical City during period from May 2022 to July 2022. Open and close magnetic resonance imaging machine were used and routine lumbar spine was performed. A total of 50% of participants (25% males and 25% females) with age range 30-80 years old who referred to magnetic resonance imaging department were enrolled in the study.

The magnetic resonance imaging findings were interpreted independently and correlated with gender, age and site of the disease.

The result of study revealed that the most common disease is Disc herniation (46%) in 71-80 years and Spondylolithesis (36%) and Spinal stenosis (18%) are most common among 61-70 years. Males are more frequently affected by Disc herniation and Spinal stenosis than females, but the Spondylolithesis are common in females than Males. The Degenerative lumbar spine diseases are more frequently at L4-L5 level.

MRI is the procedure of choice in evaluation of Degenerative lumbar spine diseases, but isn't only factor to determine Degenerative lumbar spine diseases etiology. For that proper history and clinical examination are very necessary to determine which type of images are needed, and also allow the technologist to focus the effort on the disc levels affected.

المستخلص

هذه دراسة إحصائية بأثر رجعي لتقييم أمراض العمود الفقري القطني التنكسيه عن طريق التصوير بالرنين المغناطيسي و التي اجريت في مستشفى الرباط الجامعي ومدينة المعلم الطبية خلال الفترة من مايو 2022 إلى يوليو 2022. تم استخدام جهاز التصوير بالرنين المغناطيسي المفتوح والمغلق وتم إجراء العمود الفقري القطني الروتيني. إجمالي 50٪ من المشاركين (25٪ ذكور و 25٪ إناث) تتراوح أعمارهم بين 30-80 عامًا تم تحويلهم إلى قسم التصوير بالرنين المغناطيسي في الدراسه.

تم تفسير نتائج التصوير بالرنين المغناطيسي بشكل مستقل وربطت مع الجنس والعمر وموقع المرض.

أظهرت نتيجة الدراسة أن أكثر الأمراض شيوعًا هو فتق القرص (46٪) في عمر 71-80 عامًا وأن انزلاق الفقار (36%) وتضيق العمود الفقري (18%) أكثر شيوعًا بين 61-70 عامًا. يتأثر الذكور بشكل متكرر بفتق القرص وتضيق العمود الفقري أكثر من الإناث ولكن الانقسام الفقاري شائع في الإناث أكثر من الذكور. تتكرر أمراض العمود الفقري التنكسيه القطنيه في المستوى L4-L5.

التصوير بالرنين المغناطيسي هو الإجراء المفضل في تقييم أمراض العمود الفقري التنكسيه القطنيه ولكنه ليس عاملاً فقط لتحديد مسببات أمراض العمود الفقري التنكسيه. لهذا التاريخ الصحيح والفحص السريري ضروريان للغايه لتحديد نوع الصور المطلوبه ، وكذلك السماح للتقني بتركيز الجهد على مستويات القرص المتأثره.

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List of abbreviations

CSF	Cerebrospinal Fluid
DLSD	Degenerative Lumbar Spine Disease
FOV	Field of View
FSE	Fast Spin Echo
GRE	Gradient Echo
HNP	Herniation of the Nucleus Pulposus
L1	First Lumbar Vertebra
L2	Second Lumbar Vertebra
L3	Third Lumbar Vertebra
L4	Fourth lumbar vertebra
L5	Fifth Lumbar Vertebra
MRI	Magnetic Resonance Imaging
RF	Radiofrequency
SE	Spin Echo
SPSS	Statistical Package for Social Sciences
STIR	Short Time Inversion Recovery
T1	Longitudinal Relaxation Time
T2	Transverse Relaxation Time
TE	Time to Echo
TR	Time to Repeat

Chapter one

Introduction

Chapter one
Introduction

1.1 Introduction

The lumbar vertebrae are located at the bottom section of the vertebral column, inferior to the rib cage and superior to the pelvic and sacrum. There are five lumbar vertebrae (denoted as L1-L5) found in adult humans, and they are situated beneath the thoracic vertebrae, since these vertebrae are most largely responsible for bearing the weight of the upper body (and permitting movement), they are logically also the largest segments of the vertebral column. (Alice, 2021)

Distinguishing features of the lumbar vertebrae include a thick and stout vertebral body, a blunt, quadrilateral spinous process for the attachment of strong lumbar muscles, and articular processes that are oriented differently than those found on the other vertebrae. (Alice, 2021)

The vertebral body is large, wider laterally compared to longitudinally and thicker in the front than in the back. It is also flattened or slightly concave superiorly and inferiorly, concave behind and deeply restricted at the front and laterally. (Alice, 2021)

Magnetic resonance imaging (MRI) of the spine uses radio waves, a magnetic field and a computer. It creates clear, detailed pictures of the spine and surrounding tissues. MRI does not use radiation and may require an injection of gadolinium contrast material. (Rsna, 2022)

1.2 Research problem

The absence of diagnosis of the degenerative diseases by MRI scan and unidentified causes of the disease will lead treatment to be late.

1.3 Research objectives

1.3.1 General objective

To assess the degenerative lumbar spine diseases using MRI.

1.3.2 Specific objectives

- To determine the common causes of the degenerative lumbar spine diseases.
- To correlate the cause of disease and patients gender
- To correlate the cause of disease and patients age
- To correlate the cause of disease and site level of the disease

1.4 Research over view

This research consists five chapters:

Chapter one introduction, problem, and objectives of the study.

Chapter two theoretical background and previous studies.

Chapter three materials and methods.

Chapter four the results.

Chapter five discussion, conclusion and recommendations

References

Appendices

Chapter Two

Theoretical Background and Previous Studies

Chapter two

Theoretical Background and Previous Studies

2.1 Theoretical Background

2.1.1 Anatomy

The five lumbar vertebrae are distinguished from vertebrae in other regions by their large size. Also, they lack facets for articulation with ribs. The transverse processes are generally thin and long, with the exception of those on vertebra LV, which are massive and somewhat cone shaped for the attachment of iliolumbar ligaments to connect the transverse processes to the pelvic bones. The vertebral body of a typical lumbar vertebra is cylindrical and the vertebral foramen is triangular in shape and larger than in the thoracic vertebrae. (Richard et al, 2020)

2.1.1.1 Bones

Transverse processes are long and slender

Articular processes have nearly vertical facets

Spinous processes are short and broad

Accessory processes can be found on the posterior aspect of the base of each transverse process.

Mammillary processes can be found on the posterior surface of each articular process. (Vicky, 2020) (Figure 2.1.1)

2.1.1.2 lumbar vertebral joints

There are two types of joint in the lumbar spine:

Cartilaginous joint – between vertebral bodies, adjacent vertebral bodies are joined by intervertebral disc.

Synovial joint – between vertebral arches, formed by the articulation of superior and inferior articular process from adjacent vertebrae. (Vicky, 2020)

2.1.1.3 lumbar vertebral ligaments

The joints of the lumbar vertebrae are supported by several ligaments. They can be divided into two groups; those present throughout the vertebral column and those unique to the lumbar spine. (Figure 2.1.2)

Present throughout vertebral column:

Anterior and posterior longitudinal ligaments: Long ligaments that run the length of the vertebral column, covering the vertebral bodies and intervertebral discs.

Ligamentum flavum: Connects the laminae of adjacent vertebrae.

Interspinous ligament: Connects the spinous processes of adjacent vertebrae.

Supraspinous ligament: Connects the tips of adjacent spinous processes.

Unique to Lumbar Spine the lumbosacral joint (between L5 and S1 vertebrae) is strengthened by the iliolumbar ligaments. These are fan-like ligaments radiating from the transverse processes of the L5 vertebra to the ilia of the pelvis. (Vicky, 2020)

2.1.1.4 Lumbar intervertebral disc

There are 5 lumbar disc (or intervertebral fibrocartilage) lies between adjacent vertebrae in the vertebral column. Consist of an outer fibrous ring, the anulus fibrosus disc intervertebralis, which surrounds an inner gel-like center, the nucleus pulposus. The anulus fibrosus consists of several layers (laminae) of fibrocartilage made up of both type I and type II collagen. (Wikipedia, 2022) (Figure 2.1.3)

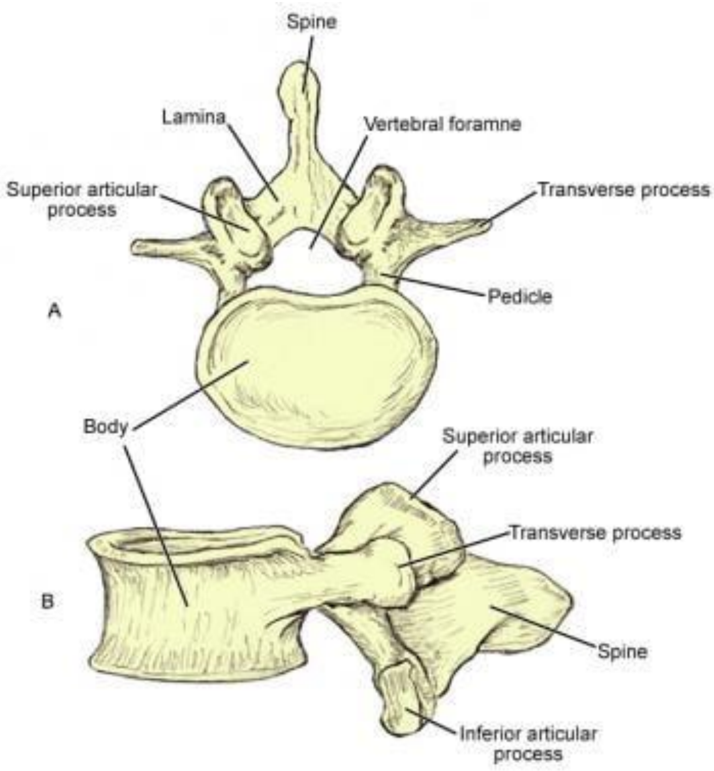

Figure 2.1.1: Show Anatomy of lumbar vertebra (Stephen, 2017)

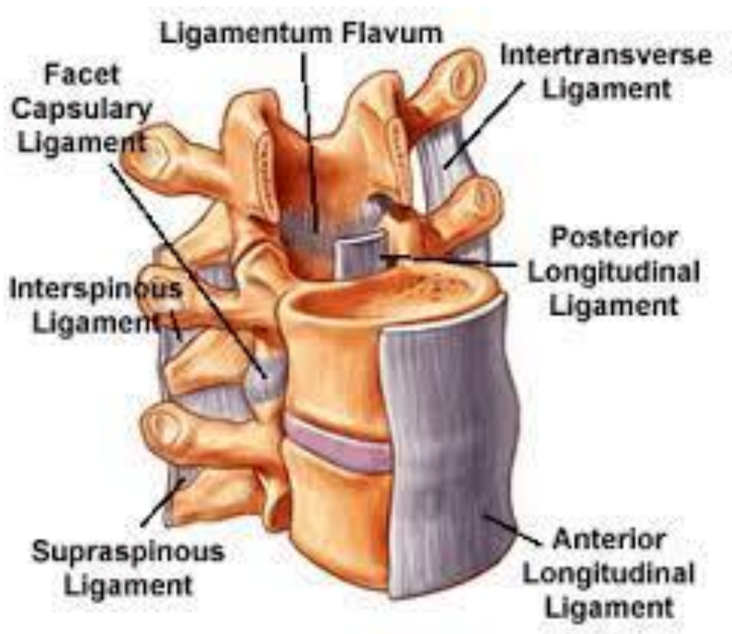

Figure 2.1.2: Show lumbar vertebral ligaments (Frey and Schmidt, 2016)

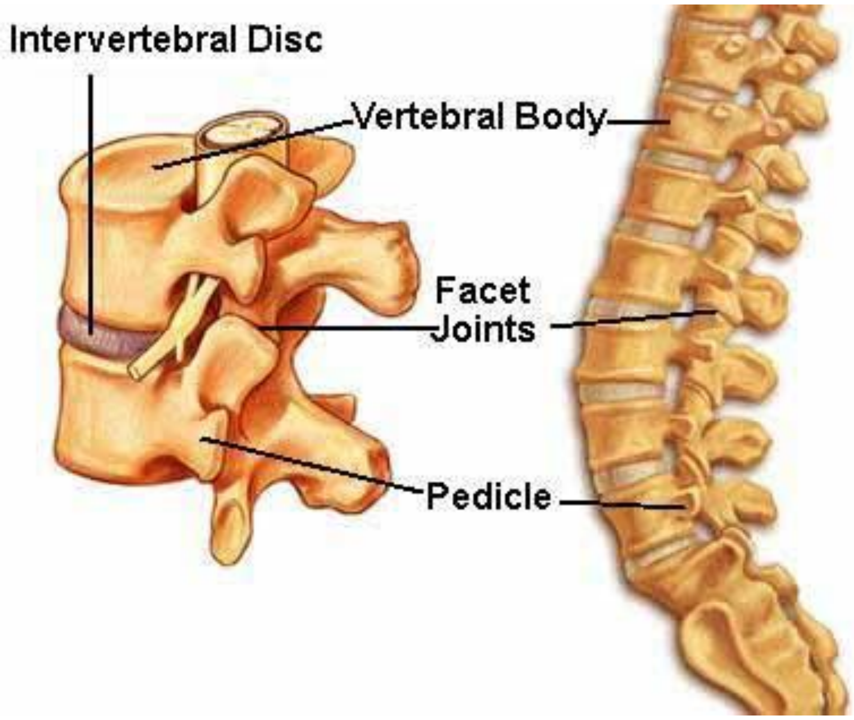

Figure 2.1.3: Show lumbar intervertebral disc (Frey and Schmidt, 2016)

2.1.1.5 Spinal cord

The spinal cord is a cylindrical structure that runs through the center of the spine, from the brainstem to low back. It's a delicate structure that contains nerve bundles and cells. Your spinal cord is one of the main parts of your nervous system. (Cleveland, 2022)

2.1.1.6 Lumbar spine musculature

Lumbar vertebrae provide attachment points for numerous muscles: erector spinae, interspinales, intertransversarii, latissimus dorsi, rotatores, and serratus posterior inferior. (Joshua et al, 2021)

2.1.1.7 Lumbar spine vasculature

2.1.1.7.1 Arterial

The lumbar arteries are the four pairs of branches of the abdominal aorta found on the posterior abdominal wall. These arteries arise in series with the posterior intercostal arteries and complete the abdominal portion of the vascular supply of the posterior trunk wall. Each lumbar artery divides into the medial, middle and lateral branch adjacent to the corresponding intervertebral foramen. (Jana, 2022)

2.1.1.7.2 Venus

The lumbar veins are four pairs of blood vessels that drain the lumbar segments of the spinal cord, posterolateral abdominal wall and lumbar structures of the back. They usually empty into the inferior vena cava, but they can also drain into the ascending lumbar, azygos, renal or other lumbar veins. Ipsilateral lumbar veins are interconnected by ascending lumbar veins, one on each side of the body. On their way towards the inferior vena cava, the lumbar veins receive many tributaries from the posterolateral abdominal wall. This establishes an alternate pathway for the drainage of the pelvis, spinal cord and lower limbs in case of an inferior vena cava obstruction. (Adrian, 2022)

2.1.1.8 Cross-sectional anatomy of lumbar spine

On normal T1 weighted image fat is bright. Fatty tissues include subcutaneous fat and bone marrow of the vertebral bodies. Cerebrospinal fluid (CSF) contains no fat – so it appears black on T1-weighted images.

On normal T2 weighted image fat and water are bright. CSF has a bright and the bone marrow becomes lower signal intensity (dark). (Graham, 2017) (Figure 2.1.4, 5, and 6)

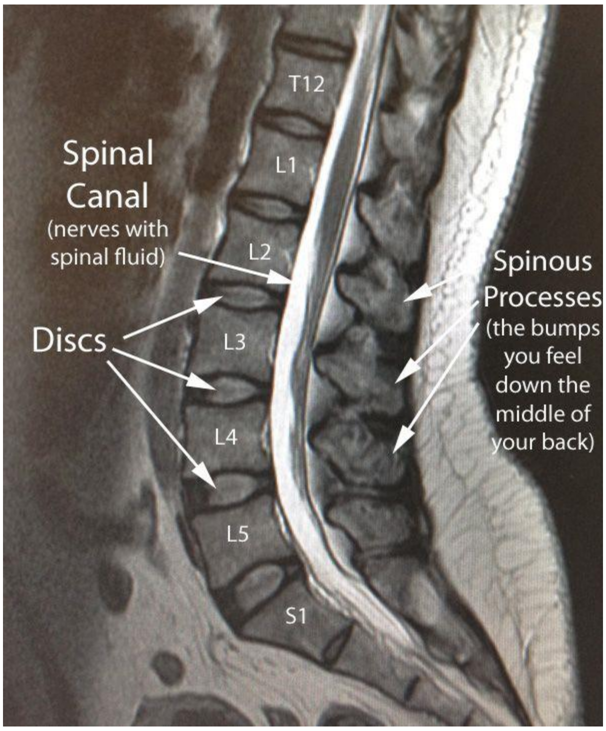

Figure 2.1.4: Show normal image of sagittal T2-weighted MRI scan of lumber spine (Sibel, 2018)

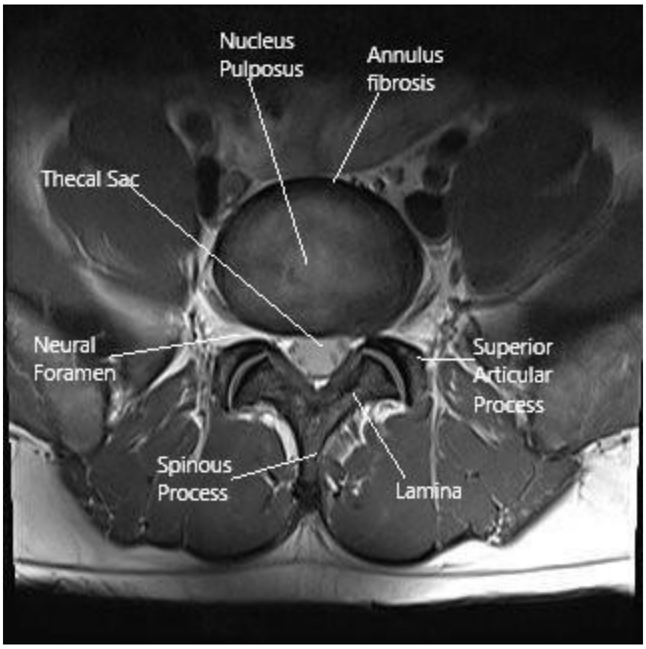

Figure 2.1.5: Show normal image of axial T2-weighted MRI scan of lumbar spine (Adam, 2022)

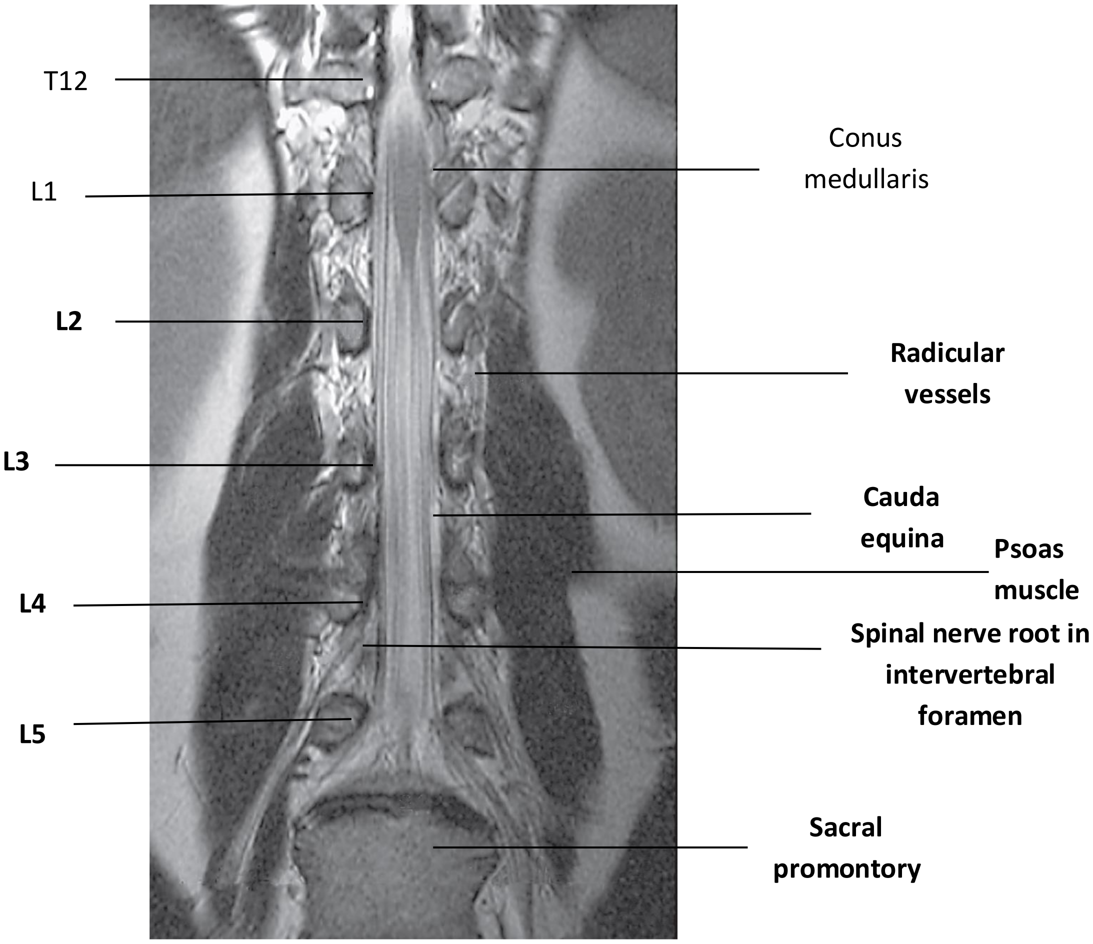

Figure 2.1.6: Show normal image of coronal T2-weighted MRI of spinal cord, conus medullaris and cauda equina (Lorrie and Connie, 2018)

2.1.2 Physiology

The functions of lumbar spine are assists in supporting the upper body. The lumbar vertebrae (L1-L5) are much larger when compared to other regions of the vertebral column, which allow them to absorb axial forces delivered from the head, neck, and trunk. The lumbar vertebrae form a canal that serves to protect the spinal cord and spinal nerves. This arrangement allows for the communication of information from the central nervous system to the lower extremities and vice versa. (Brett, 2021)

The lumbar spine allows for diverse types of truncal motion, including flexion, extension, rotation, and side bending. From a lateral view, the lumbar spine has a concave curvature, referred to as the lumbar lordosis. This curvature is variable in degree and transfers the upper body mass over the pelvis to allow for efficient bipedal motion. (Brett, 2021)

The pedicles resist motion and transmit forces from the posterior elements to the vertebral body. From the junction of the two laminae, the spinous process extends posteriorly. At the junction between the pedicles and laminae, four articular processes and two transverse processes reside. (Brett, 2021)

The transverse processes extend laterally, serving as attachment points for ligaments and musculature. The superior and inferior articular processes create the zygapophyseal joints (aka facet joints). These joints lie in the sagittal plane and participate in flexion and extension of the lumbar spine. (Brett, 2021)

The pars interarticularis is the location of the lamina between the superior and inferior articular processes and is prone to the development of stress fractures (spondylolysis) in the growing spine. (Brett, 2021)

The function of the lumbar disc is shock absorption. Two longitudinal ligaments lie anterior and posterior to the vertebral body. The anterior longitudinal ligament resists lumbar extension, translation, and rotation. The posterior longitudinal ligament resists lumbar flexion. (Brett, 2021)

2.1.3 Pathology

2.1.3.1 Degenerative lumbar spine disease

Degenerative lumbar disease is when your spinal discs wear down. Spinal discs are rubbery cushions between your vertebrae (bones in your spinal column). They act as shock absorbers and help you move, bend and twist comfortably. For most people the spinal discs degenerate over time and are a normal part of aging. (Cleveland, 2021)

2.1.3.1.1 Herniated disc

A herniated disc (also called bulged, slipped or ruptured) is a fragment of the disc nucleus that is pushed out of the annulus, into the spinal canal through a tear or rupture in the annulus. Discs that become herniated usually are in an early stage of degeneration. There are four stages of HNP: disc protrusion, prolapsed disc, disc extrusion and sequestered disc. The spinal canal has limited space, which is inadequate for the spinal nerve and the displaced herniated disc fragment. Due to this displacement, the disc presses on spinal nerves, often producing pain, which may be severe. A single excessive strain or injury may cause a herniated disc. However, disc material degenerates naturally as one ages, and the ligaments that hold it in place begin to weaken. As this degeneration progresses, a relatively minor strain or twisting movement can cause a disc to rupture. The signs and Symptoms of patients with lumbosacral herniated disc will present with low back pain, radiating to the buttocks, legs, and feet, usually unilaterally. Sensory and motor loss, muscle weakness, and atrophy of the leg muscles may be experienced if a lumbar spinal nerve root is compressed. (Brunilda, 2020)

2.1.3.1.2 Spondylolisthesis

Spondylolisthesis is a condition of the spine. It happens when one of your vertebrae moves more than it should and slips out of place. It usually happens at the base of the spine. When the slipped vertebra puts pressure on a nerve, it can cause pain in your lower back or legs. The signs and Symptoms patients may present with low back pain and/or stiffness and loss of function. Tight hamstrings may force the patient to walk with the knees bent and a short stride, causing unusual gait. (Brunilda, 2020)

2.1.3.1.3 Spinal stenosis

Lumbar spinal stenosis the spinal canal narrows and compresses the nerves and blood vessels at the level of the lumbar vertebrae. Spinal stenosis may be congenital (rarely) or acquired (degenerative), can occur as either central stenosis (the narrowing of the entire canal) or foraminal stenosis (the narrowing of the foramen through which the nerve root exits the spinal canal). Severe narrowing of the lateral portion of the canal is called lateral recess stenosis if the lumbar spine is affected, the patient may present with a limping type of gait (neurogenic or spinal claudication), low back pain, or paresthesia of the lower extremities. (Wikipedia, 2022)

2.1.3.2 Infection of lumbar spine

2.1.3.2.1 Vertebral Osteomyelitis

Vertebral osteomyelitis is a bone infection usually caused by bacteria. In the spine, it is often found in the vertebrae, although the infection can spread into the epidural and intervertebral disc spaces. Osteomyelitis is rare and most common in young children and the elderly, but it can occur at any age.

The signs and Symptoms patient presents with fever, malaise, pain, and swelling over the affected area. (Rick, 2019)

2.1.3.3 Tumors of lumbar spine

2.1.3.3.1 Metastatic disease of the lumbar spine

A spinal tumor is an abnormal growth of tissue found in the spinal column. When a tumor spreads to the spine from cancer elsewhere in the body, it is called a metastatic spinal tumor (secondary tumor). These tumors may also be referred to as spinal metastases. Most metastatic spinal tumors are found in the vertebrae (bones of the spinal column). The signs and symptoms patient with known cancer history presents with back pain and possible loss of sensory and motor function. Suspected spinal cord compression requires emergent neurosurgical evaluation. (David, 2020)

2.1.3.3.2 Ependymoma

Spinal Ependymoma is the most common tumor of the spinal cord, a tumor that arises from ependymal cells. Ependymomas are intramedullary tumors, which mean they arise within the substance of the spinal cord itself. The signs and symptoms patients most commonly present with pain. Some patients may complain of leg weakness and sphincter dysfunction. (Gaillard, 2022)

2.1.3.3.3 Hemangioma

Vertebral Hemangiomas are the most common benign lesion incidentally found. Hemangiomas are slow-growing vascular tumors that generally do not cause symptoms. The signs and symptoms nonspecific. These lesions rarely result in compression or expansion of the vertebral body with subsequent cord compression. (Michael and Jagan, 2018)

2.1.3.3.4 Meningioma

Spinal Meningiomas are benign and arise from the arachnoid cells located near the dorsal nerve root ganglia. They are characteristically hard, slow growing, and usually highly vascular. The signs and symptoms patient presents with pain associated with compression of the spinal cord and adjacent nerve roots. Sensory and motor dysfunctions such as weakness, bowel and bladder dysfunction, and paresthesias may be present. (Michael and Jagan, 2018)

2.1.4 Methods of lumbar spine imaging

The lumbar spine is examined with conventional x-ray, computed tomography (CT) and magnetic resonance imaging. We often use magnetic resonance imaging to shows the lumbar vertebra, spinal cord, verve roots, ligament and vessels.

2.1.4.1 Magnetic resonance imaging

2.1.4.1.1 MRI Physics

Human body is made up of water, which means a large number of atoms inside our body are hydrogen atoms, the nucleus of which contains a positively charged proton that spins (or precesses) around an axis like a child’s top. This spinning generates its own tiny magnetic field, giving the proton its own north and south poles. Under normal circumastances, these protons spin on randomly oriented axis. When magnetic field is turned on, the axes align with the more powerful external magnetic field with some aligning parallel (low energy state) to the field and some aligning anti-parallel (high energy state) to magnetic field, cancelling each other. The larger the external magnetic field, the greater the difference in energy levels and the larger the excess number aligned with the field. (Figure 2.1.7)

A radiofrequency (RF) coil is used to send pulses is applied for a few milliseconds, excess protons aligning parallel to the magnetic field flips their configuration to high energy state (antiparallel). When the RF pulse stops:

Absorbed RF energy is released by protons

T1 relaxation (recovery): recovery of longitudinal orientation; T1 time refers to interval where 63% of longitudinal magnetization is recovered

T2 relaxation (dephasing): loss of transverse magnetization; T2 time refers to time where only 37% of original transverse magnetization is present

In doing so, a signal is emitted which gets turned into an electric current, which the scanner digitizes. The lower the water content in an area, the fewer hydrogen protons there will be emitting signals back to the RF coils. (Usmle, 2020)

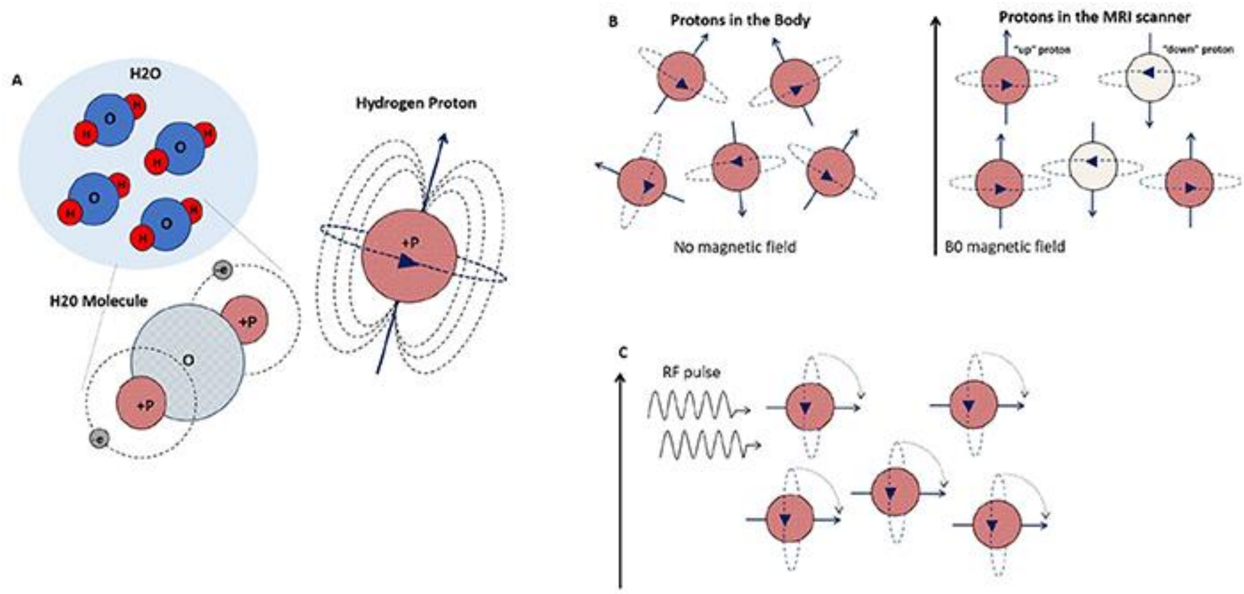

Figure 2.1.7: Hydrogen protons and how they behave in a magnetic field

(Kathryn, 2019)

2.1.4.1.2 MRI Technique

2.1.4.1.2.1 Patient position

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. (Catherine, 2014)

2.1.4.1.2.2 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.

Sagittal SE/FSE T2 (figure 2.1.8)

Sagittal SE/FSE T1.

Axial FSE T2. (Catherine, 2014) (figure 2.1.9)

2.1.4.1.2.3 Additional sequence

Axial/oblique SE/FSE T1/T2 or coherent GRE T2*. With contrast for determining disc prolapse versus scar tissue in failed back syndrome, and for some tumor's.

Coronal SE/FSE T1. For cord tethering or alternative view of conus when sagittal are inconclusive.

Axial/oblique FSE T2. For arachnoiditis.

A STIR sequence can be utilized to visualize bone marrow abnormalities better. (Catherine, 2014)

2.1.4.1.2.4 Contrast usage

Contrast is used to distinguish disc prolapse from scar tissue postoperatively in failed back syndrome. These images are acquired with or without chemical/spectral presaturation. STIR should not be used with contrast enhancement, as the contrast reduces the T1 value of damaged tissues so that it is similar to that of fat, and is therefore nullified by the inverting pulse. Scar tissue enhances immediately after the injection, but disc material does not. However, about 20–30 min after the injection, disc material also enhances and therefore scanning should not be delayed after the administration of contrast. In addition, the epidural veins and granulation tissue at the periphery of a disc and fibrosis may enhance. Contrast is also invaluable to visualize suspicious lesions in the conus. (Catherine, 2014)

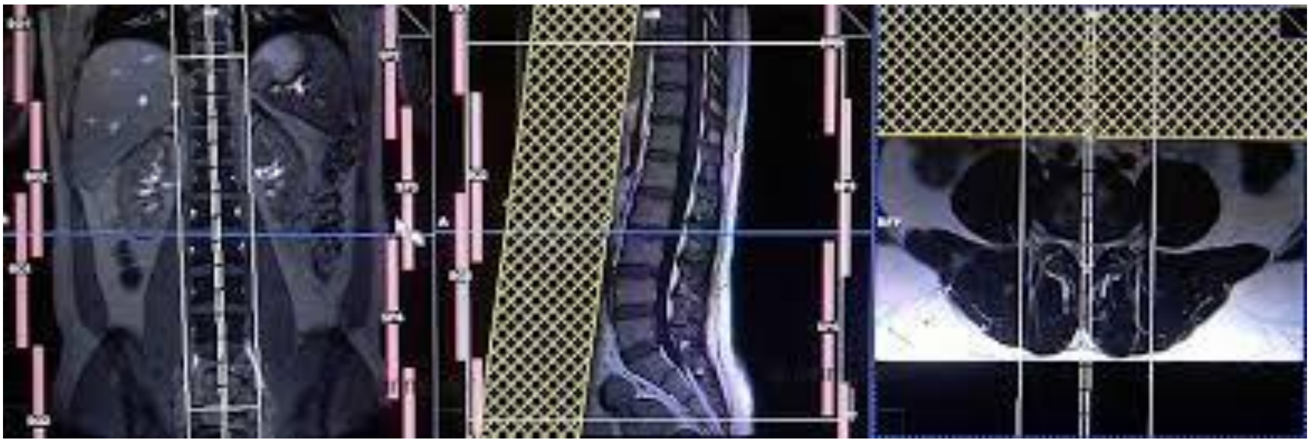

Figure 2.1.8: Planning and protocol sagittal MRI scan of lumbar spine

(R. George 2017)

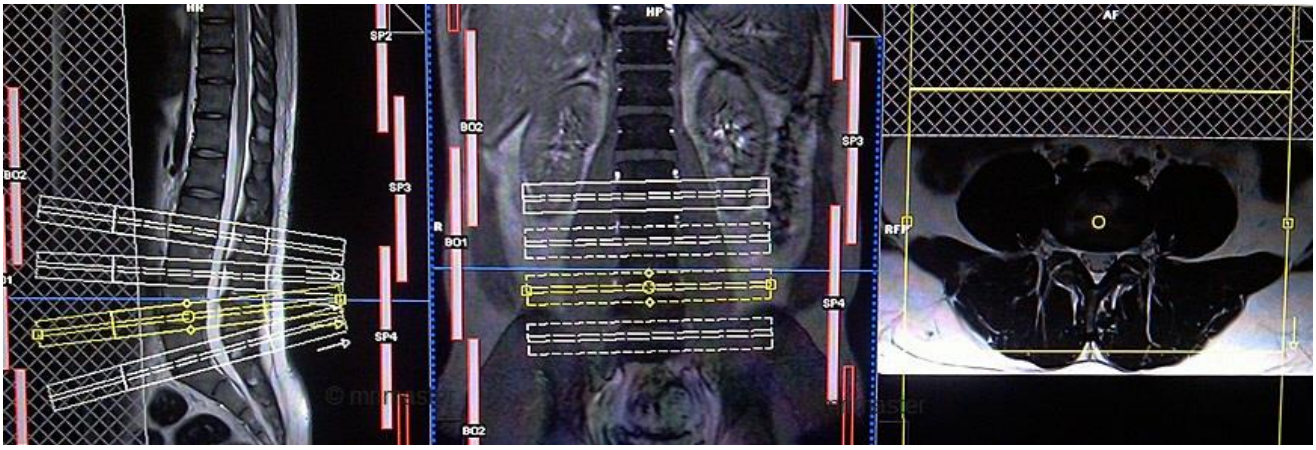

Figure 2.1.9: Planning and protocol axial MRI scan for lumbar spine

(R. George 2017)

2.2 Previous studies

Reddy -2020- had studied Magnetic Resonance Evaluation of Lumbar Disc Degenerative Disease of Low Back Pain- to analysis of lumbar disc degeneration patterns in patients with lower back pain, and evaluation of the extent of involvement- A total of 1000 whole spine and lumbosacral spines were subjected to MRI examination, including spin echo with T1, T2, and STIR sequences- The commonest level of disc degeneration was L4-L5 (41.2%) and the commonest type was disc protrusion (69.4%). Disc height reduction was common at L5-S1 level (32.2%). Multidisc involvement is the commonest presentation (38.2%) followed by contiguous double level (34.7%) with disc bulges frequently reported at L3-L4 (27.2%) and L5-S1 (26.9%) levels. Majority of discs (56.1%) demonstrated Modic changes at prolapsed levels. Spondylolisthesis was commonly reported at L4-L5 level (87.5%) and was mostly associated with lumbar canal stenosis (38.4%). Posterior osteophytes were frequent at L3-L4 (31.1%) and L5-S1 (31.1%) levels. D12-L1 was least affected (4.1%) in lumbar disc degenerative disease.

Klaus et al -2020- had studied Degenerative findings in lumbar spine MRI- to determine the inter-rater reliability of three independent raters evaluating degenerative pathologies seen with lumbar spine MRI- Fifty-nine people, 35 patients with low back pain (LBP) or LBP and leg pain and 24 people without LBP or leg pain- Inter-rater reliability for all raters combined, ranged from (Gwet's AC_1 or AC_2): 0.64–0.99 and according to probabilistic benchmarking to the Landis and Koch scale equivalent to moderate to almost perfect reliability. Overall reliability level for individual pathologies was almost perfect reliability for spondylolisthesis, spinal stenosis, scoliosis and annular fissure, substantial for nerve root compromise and disc degeneration, and moderate for facet joint degeneration and disc contour.

Sitfatima -2016- had studied assessment of degenerative lumbar spine disease using MRI- to assess the degenerative lumbar spine diseases using MRI. This statistical study during period from September to December 2016. Open and close MRI machine were used and routine lumbar spine was performed. A total of 69 patients (30 male, 39 female) with age range (23-80) who referred to MRI department. The result of study revealed that the mean and standard deviation of age and weight was 55.62+ 12.064(years) and 81.29 +15.414(kg) respectively. The MRI findings were interpreted independently and correlated with clinical history and examination, findings from patients' records Results. The incidence of patient with osteophytes and degenerative disc disease with neural compression had the highest percentage (31.9%). Disc degeneration on MRI was most frequent at L4-L5 level (56.5%). The incidence of degenerative lumbar spine diseases (DLSD) in male is greater than female.

Pokhraj -2015- had studied MRI evaluation of lumbar disc degenerative disease- to evaluate the characterization, extent, and changes associated with the degenerative lumbar disc disease by Magnetic Resonance Imaging, A total 109 patients of the lumbar disc degeneration with age group between 17 to 80 y were diagnosed & studied on 1.5 Tesla Magnetic Resonance Imaging machine- Males were more commonly affected in degenerative spinal disease and most of the patients show loss of lumbar lordosis. Decreased disc height was common at L5-S1 level more than one disc involvement was seen per person. L4 - L5 disc was the most commonly involved. L1- L2 disc involvement and spondylolisthesis are less common.

Chapter three

Materials and Methods

Chapter three

Materials and Methods

3.1 Materials

3.1.1 Patients

The study population was composed of group of different patients, they are a 50 of Sudanese patients included 25 males and 25 females their age (30- 80 years), who underwent MRI between May 2022 to July 2022.

3.1.2 Inclusion criteria

(DLSD, infection and tumor), and appendices (A&B)

3.1.3 Exclusion criteria

(Congenital, traumatic and normal patients).

3.1.4 Machine

MRI devices at AlMOALEM medical city name is TOSHIBA AVANTO ELAN, magnetic power is superconductor 1.5 T, Site of device is AlMOALEM medical city, Coil is posterior spinal coil, serial number: GIA1575036 and ALRIBAT university hospital is NEUSOFT Medical System, magnetic power is .5T. (Appendix B.1)

3.2 Methods

3.2.1 Patient position

The patient lies supine on couch with their knees elevated over a foam pad, the coil is selected on the lumbar spine.

3.2.2 Lumbar spine protocols

T1 and T2 weighted images were obtained in the sagittal plane and T2 in the axial plane, and the contrast add if need for T1 axial and T1 sagittal imaging, a field of view of 34cm and slice thickness of 5mm were used, for axial imaging a FOV of 27cm, and slice thickness of 6mm were used. The following MR sequences were performed in sagittal plan T1 weighted TR 620, TE 127 and in axial planT2 weighted TR 3600, TE 119.

3.2.3 Data collection

Data collected by special data collection sheet.

3.2.4 Data analysis

The data was analyzed using SPSS.

3.2.5 Data management

The data presented by tables and figures.

3.2.6 Ethical considerations

No information or patient details were disclosed or used for reasons other than the study.

Chapter four

Result

Chapter four

Results

Table 4.1: Shows frequency distribution and percent for gender

Gender	Frequency	Percent	Valid Percent	Cumulative Percent
Male	25	50.0	50.0	50.0
Female	25	50.0	50.0	100.0
Total	**50**	**100.0**	**100.0**	

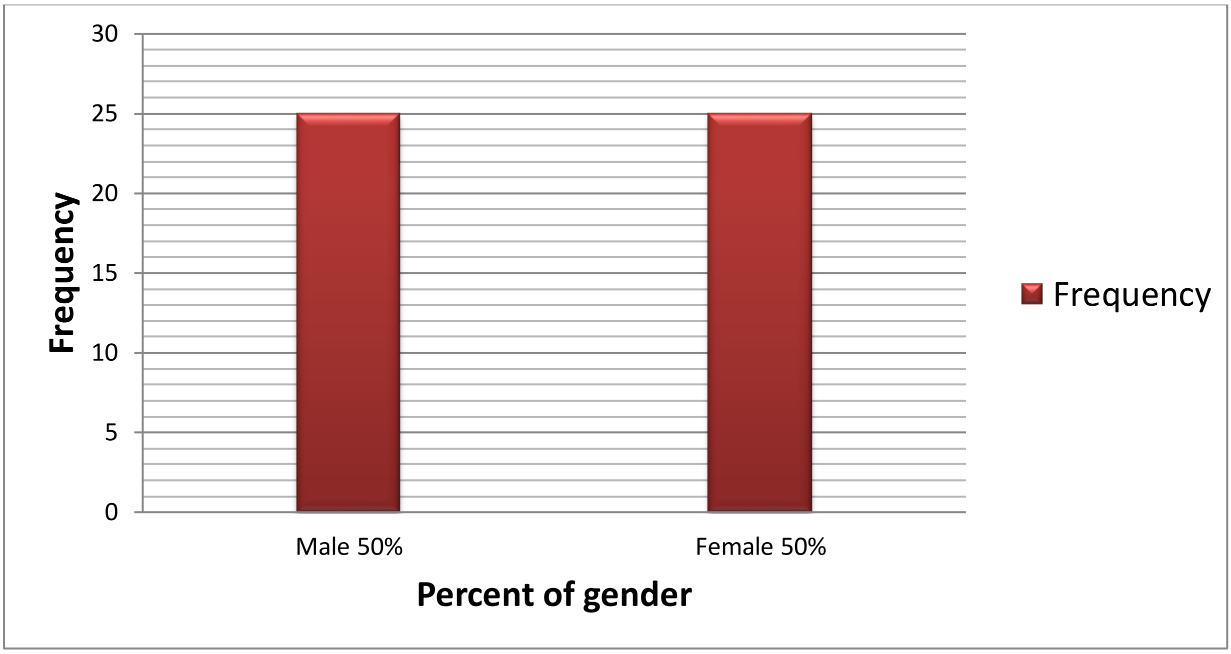

Figure 4-1: Shows the relation between frequency distribution and percent of gender

Table 4.2: Shows frequency distribution and percent for age

Age	Frequency	Percent	Valid Percent	Cumulative Percent
30-40 years	2	4	4	4
41-50 years	8	16	16	20
51-60 years	10	20	20	40
61-70 years	14	28	28	68
71-80 years	16	32	32	100
Total	**50**	**100.0**	**100.0**	

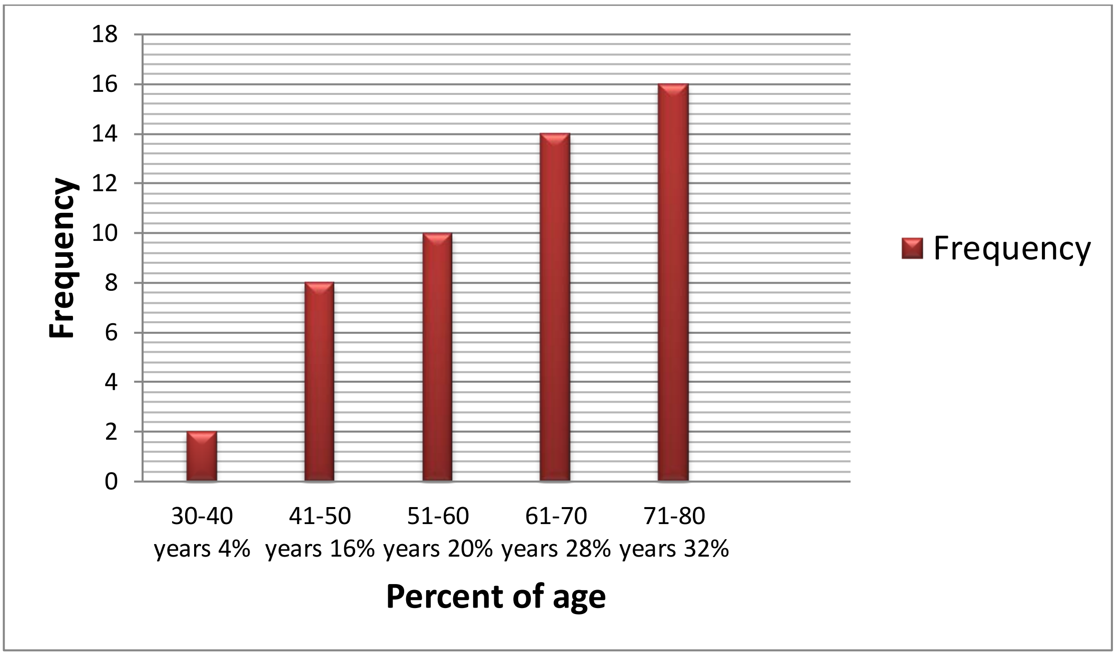

Figure 4.2: Shows the relation between frequency distribution and percent of age

Table 4.3: Shows frequency distribution and percent for causes of disease

Disease	Frequency	Percent	Valid Percent	Cumulative Percent
Disc Herniation	23	46.0	46.0	46.0
Spondylolithesis	18	36.0	36.0	82.0
Spinal stenosis	9	18.0	18.0	100.0
Total	**50**	**100.0**	**100.0**	

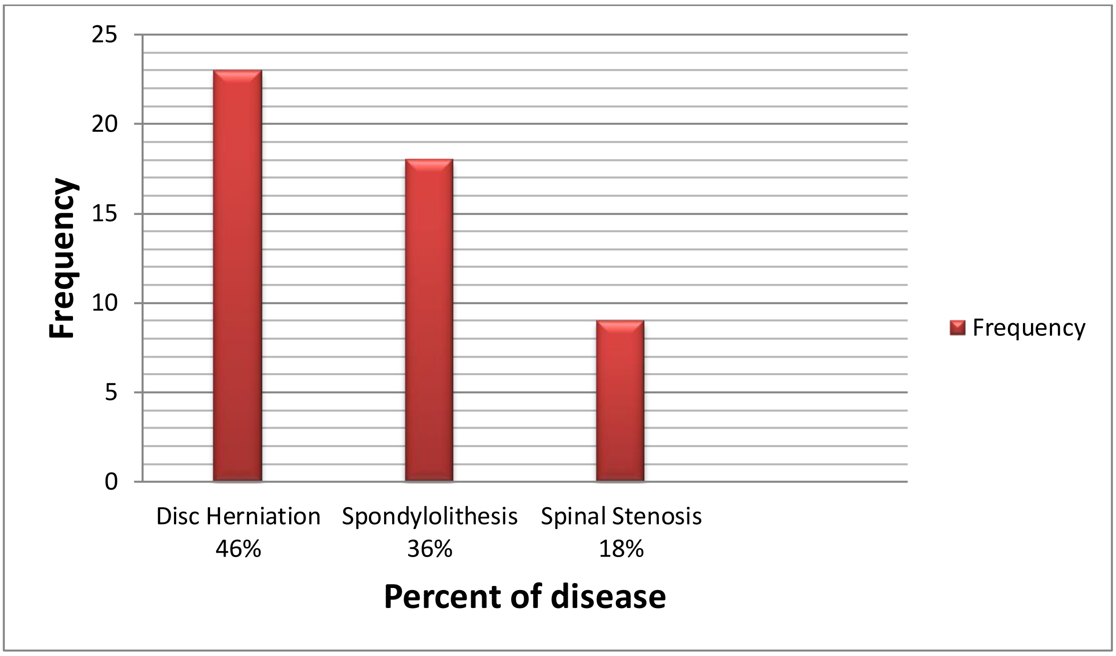

Figure 4.3: Shows the relation between frequency distribution and percent of causes of disease

Table 4-4: Shows frequency distribution and percent for site in DLSD

Site	Frequency	Percent	Valid Percent	Cumulative Percent
L1 - L2	2	4.0	4.0	4.0
L2 - L3	5	10.0	10.0	14.0
L3 - L4	11	22.0	22.0	36.0
L4 - L5	26	52.0	52.0	88.0
L3 -L4/ L4 - L5	2	4.0	4.0	92.0
L2-L3 / L4 -L5	3	6.0	6.0	98.0
L1-L2 / L2 - L3	1	2.0	2.0	100.0
Total	**50**	**100.0**	**100.0**	

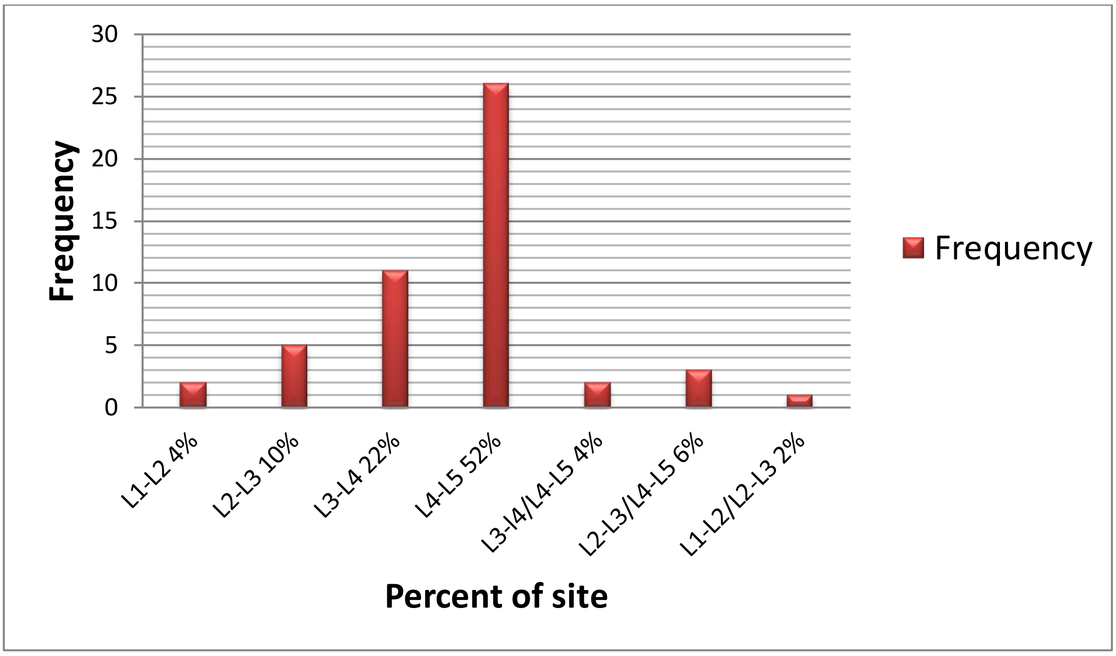

Figure 4.4: Shows the relation between frequency distribution and percent of site

Table 4.5: Shows frequency distribution and percent for gender * MRI disease crosstabulation

Gender		MRI Disease: Disc Herniation	MRI Disease: Spondylolithesis	MRI Disease: Spinal stenosis	Total
Male	Frequency	12	8	5	25
	Percent	48.0%	32.0%	20.0%	100.0%
Female	Frequency	11	10	4	25
	Percent	44.0%	40.0%	16.0%	100.0%
Total	**Frequency**	**23**	**18**	**9**	**50**
	Percent	**46.0%**	**36.0%**	**18.0%**	**100.0%**

P.value = .048

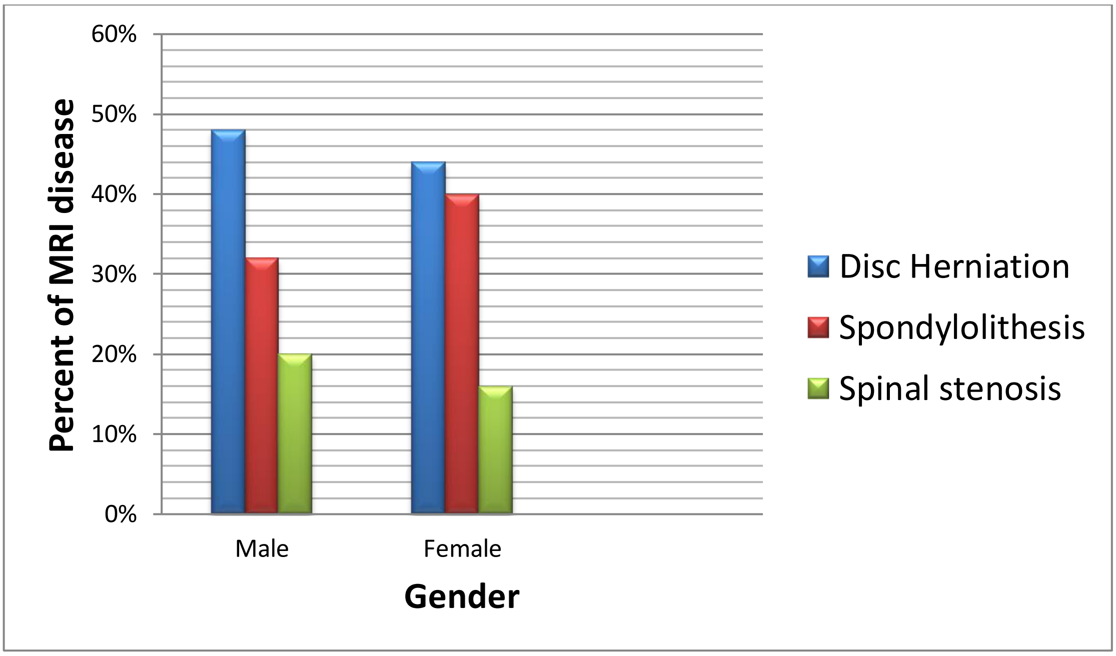

Figure 4.5: Shows the relation between percent of gender * MRI disease

Table 4.6: Shows frequency distribution and percent for age * MRI disease

Age		MRI Disease			Total
		Disc Herniation	Spondylolithesis	Spinal stenosis	
30-40 years	Frequency	0	1	1	2
	Percent	0.0 %	50%	50%	100.0%
41-50 years	Frequency	1	4	3	8
	percent	12.5%	50%	37.5%	100.0%
51-60 years	Frequency	8	2	0	10
	Percent	80%	20%	0.0%	100.0%
61-70 years	Frequency	4	6	4	14
	Percent	28.6%	42.9%	28.6%	100.0%
71-80 years	Frequency	10	5	1	16
	Percent	62.5%	31.3%	6.3%	100.0%
Total	**Frequency**	**23**	**18**	**9**	**50**
	Percent	**46%**	**36 %**	**18%**	**100.0%**

P.value = .041

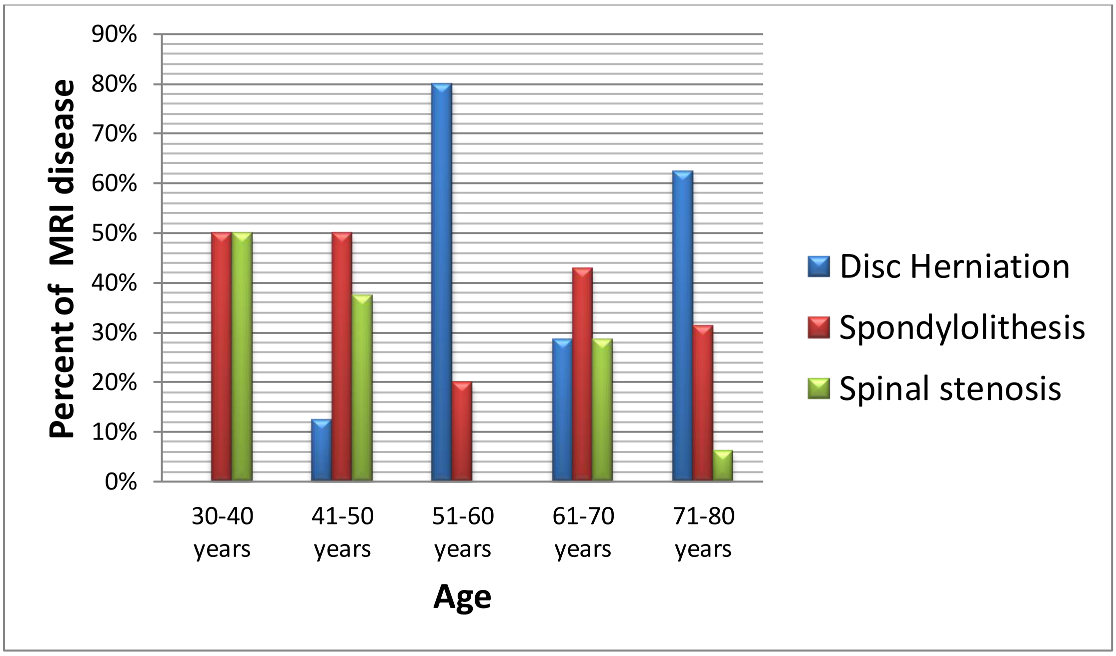

Figure 4.6: Shows the relation between percent of age * MRI disease

Table 4.7: Shows frequency distribution and percent for site * MRI disease

Site		MRI Disease			Total
		Disc Herniation	Spondylolithesis	Spinal stenosis	
L1 - L2	Frequency	1	1	0	2
	Percent	50.0%	50.0%	0.0%	100.0%
L2 - L3	Frequency	2	2	1	5
	Percent	40.0%	40.0%	20.0%	100.0%
L3 - L4	Frequency	3	5	3	11
	Percent	27.3%	45.5%	27.3%	100.0%
L4 - L5	Frequency	14	7	5	26
	Percent	53.8%	26.9%	19.2%	100.0%
L3 -L4/ L4 - L5	Frequency	1	1	0	2
	Percent	50.0%	50.0%	0.0%	100.0%
L2 L3 / L4 -L5	Frequency	2	1	0	3
	Percent	66.7%	33.3%	0.0%	100.0%
L1 -L2 / L2 - L3	Frequency	0	1	0	1
	Percent	0.0%	100.0%	0.0%	100.0%
Total	**Frequency**	**23**	**18**	**9**	**50**
	Percent	**46.0%**	**36.0%**	**18.0%**	**100.0%**

P.value = .039

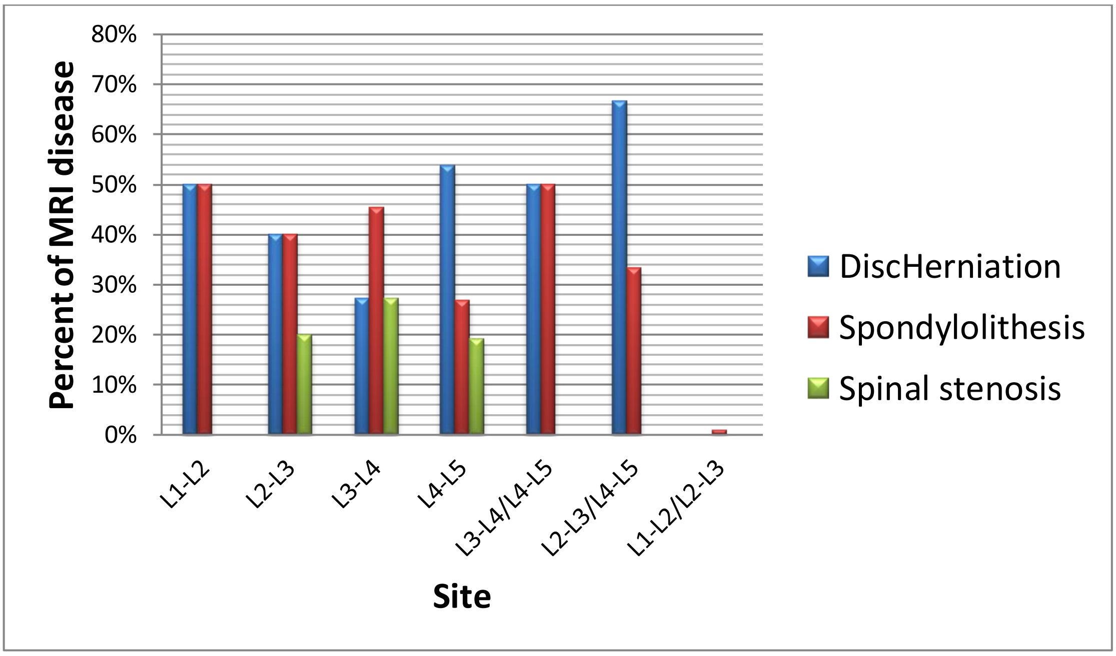

Figure 4.7: Shows the relation between percent of site * MRI disease

Chapter five

Discussion, Conclusion and Recommendations

Chapter five

Discussion and Conclusion and Recommendations

5.1 Discussion

This was study to assess the degenerative lumbar spine disease by using MRI, involved 50 patients (25 males, 25 females) carried out at period between May 2022 and July 2022 in Almoalem medical city and Alribat university hospital.

The table and figure (4.1) showed 50% of participants were males and 50% females.

The table and figure (4.2) showed 32% of participants were 71-80 years old, since (28%) of them were 61-70 years, (20%) of them were 51-60 years, while (16%) of them were 41-50 years, whereas only (4%) were 30-40 years old. Therefore, most of the participants were more than 50 years old.

The table and figure (4.3) showed the most frequent disease was Disc herniation (46%), (36%) of them was spondylolithesis, and only (18%) of them was Spinal stenosis. this result was similar to the study (Reddy-2022) and (Sitfatima-2016).

From table and figure (4.4) we find that have degenerative disease at L4-L5 level, followed by (22%) at L3-L4 level, (10%) at L2-L3 level, since (6%) at L2-L3/L4-L5, while (4%) at L1-L2 and L3-L4/L4-L5 levels, whereas (2%) at L1-L2/L2-L3 levels. This result was similar to the study (Pokhraj et al-2015) and (Sitfatima-2016).

From table and figure (4.5) the most frequent pathology was Disc herniation (48%) in male and (44%) in female, since (40%) of them were Spondylolithesis in female and (32%) in male, and (20%) of them were Spinal stenosis in male and (16%) in female. This result was similar to previous study (Sitfatima-2016).

From table and figure (4.6) the most frequent of pathology (80%) of participants were Disc herniation in 51-60 years old, since (62.5%) of them in 71-80 years, while (28.6%) of them in 61-70 years and (12.5%) of them in 41-50 years. (50%) of them were spondylolithesis in 30-40 years and 41-50 years, since (42.9%) of them in 61-70 years, while (31.3%) of them in 71-80 years, and

(20%) of them in 51-60 years. (50%) of them were Spinal stenosis in 30-40 years, since (37.5%) of them in 41-50 years, (28.6%) of them in 61-70 years, and (6.3%) of them in 71-80 years.

From table and figure (4.7) the most frequent Spondylolithesis (100%) at L1-L2/L2-L3 levels, (50%) of them in at L1-L2 and L3-L4/L4-L5, since (45.5%) of them in at L3-L4, while (40%) of them at L2-L3, whereas (33.3%) of them at L2-L3/L4-L5 and (26.9%) of them at L4-L5 level. (66%) of them were Disc herniation at L2-L3/L4-L5 levels, (53.8%) of them at L4-L5 level, since (50%) of them at L1-L2, while (40%) of them at L2-L3 level and (27.3%) of them at L3-L4 level. (27%) of them were Spinal stenosis at L3-L4, since (20%) of them at L2-L3 level and (19.2%) of them at L4-L5 level.

5.2 Conclusion

The research concluded that most common disease among DLSD is Disc Herniation.

Regarding gender, the Male more frequently affected by Dis herniation and Spinal stenosis than female and female more frequently affected to the Spondylolithesis than Male.

Regarding age, the Disc herniation the most common among 71-80 years, since the Spondylolithesis and Spinal stenosis are most common among 61-70 years.

Regarding site of Degenerative lumbar spine diseases the most level was L4-L5 level.

5.3 Recommendations

- Future studies should be done with large sample size to improve statistical information and more accurate results.
- Researcher suggests correlate the clinical history of the patient with MRI findings to help in diagnosis of the disease.
- Collect samples by MRI device have a magnet power at least 1.5T and above.

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Appendices

Appendix (A)

Data collection sheet

NO	Gender	Age	Patient history	Site	MRI Findings

Appendix (B)

Images of MRI machine

Appendix B.1: Show Magnetic Resonance device Neusoft .5T

Appendix (C)

MRI Images

Image C.1: Sagittal T1 weighted image MRI scan of lumbar spine for male 53 years old, show multilevel Herniated disc with posterior protrusion at L2-L3 and L4-L5

Image C.2: Sagittal T2 weighted image MRI scan of lumbar spine for male 53 years old, show multilevel Herniated disc with posterior protrusion at L2-L3 and L4-L5

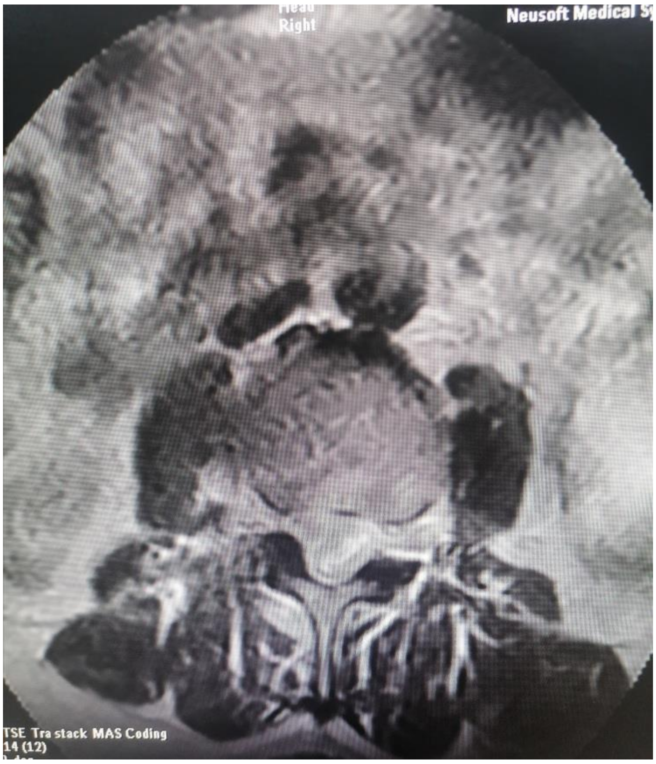

Image C.3: Axial T2 weighted image MRI scan of lumbar spine for Male 53 year's old, show Herniated disc at L4-L5

Image C.4: Sagittal T2 weighted image MRI scan of lumbar spine for female 38 year's old, show Spondylolithesis at L4-L5

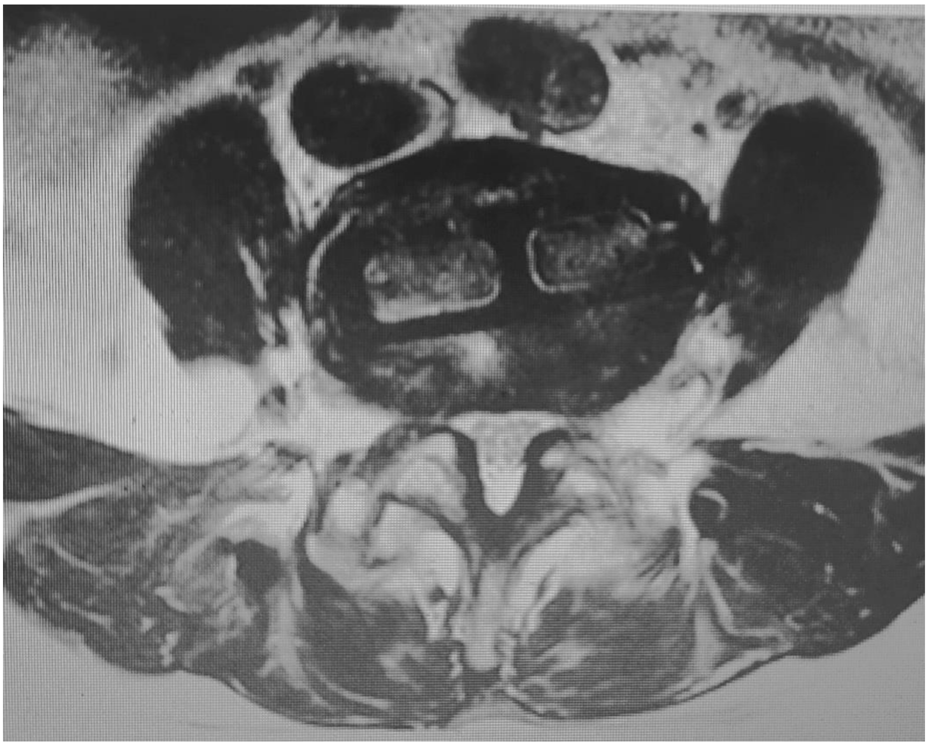

Image C.5: Axial T2 weighted image MRI scan of lumbar spine for female 38 year's old, show Spondylolithesis at L4-L5