Sudan University of Science and Technology

Collage of Graduate Studies

A Study of MRI Findings in the Cervical Spine in Sudanese Patients

دراسة نتائج التصوير بالرنين المغناطيسي في العمود الفقري العنقي في المرضى السودانيين

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

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الآيـــــة

بِسْمِ اللَّهِ الرَّحْمَٰنِ الرَّحِيمِ

" قالوا سبحانك لا علم لنا الا ما علمتنا انك انت العليم الحكيم"

سورة البقرة– الآية (32)

Dedication

To my first teachers in the life, to my parents

To my brother and sisters, to my family

To my friends and everyone who stand beside me.

This research is dedicated to you with love.

Acknowledgement

First thanks to Allah, then thanks to my guider and supervisor Dr.Rahma Abdalla Awad for her patient, guiding and wise advices. Thanks to staff and friends in Aliaa, Alribat, and Antalia hospitals for their helping and patients all the period of my research.

Abstract

The Magnetic Resonance Imaging (MRI) is the gold standard in Sufficiently depicting the cervical spine disorders, but There is a wide variability in the reported prevalence of different MRI findings and only limited knowledge is available to inform the clinician about what should be expected of MRI findings at different populations .so this thesis studies the MRI findings in the cervical spine in Sudanese patients.

This study was retrospective cross sectional descriptive study. The objective of this study was to found out the common MRI finding for cervical spine in Sudanese patients and its relations with age and gender and determine the most affected level. Data were collected from 53patients from both genders their ages between 20 to 80 years old came to radiological departments of Aliaa Specialist Hospital, Alribat University Hospital, and Antalya Centre for cervical MRI scan in a period from July 2020 to September 2020. The data were collected from medical reports using data collecting sheet. The data analysed by SPSS (version 19).The study found that the most common MRI findings were disc bulge(52.6%), disc degenerative changes (22.7%), and spondylosis (11.3%), while the most common affected disc level were C4/C5 (29.9%), C5/C6 (26.8%) and C3/C4 (24.7%).The study showed that the cervical disorder is common in female and in subject over forty but also The study revealed that the MRI findings had no significant different nor with age neither with gender. The study recommended to evaluate younger age groups which suffering from neck pain.

الخلاصة

التصوير بالرنين المغناطيسى هو المعيار الذهبي في تصوير اضطرابات العمود الفقري العنقي بشكل كافٍ ، ولكن هناك تباينًا واسعًا في الانتشار المبلغ عنه لنتائج التصوير بالرنين المغناطيسي المختلفة ، ولا تتوفر سوى معرفة محدودة لإبلاغ الطبيب بما يجب توقعه من التصوير بالرنين المغناطيسي النتائج في مجموعات سكانية مختلفة. لذلك تدرس هذه الرسالة نتائج التصوير بالرنين المغناطيسي في العمود الفقري العنقي في المرضى السودانيين.

هذه الدراسة هي دراسة رجعية وصفية. الهدف من هذه الدراسة كان ايجاد اكثر نتائج الرنين المغنطيسي شيوعا في المرضى السودانيين و علاقتها بالعمر و الجنس و تحديد اكثر مستوى قرص تأثرا. البيانات التي تم جمعها من 53 مريضا من كلا الجنسين اعمارهم تتراوح بين 20 و 80 سنة جاءوا إلى أقسام الأشعة في مستشفى علياء التخصصي ، ومستشفى الرباط الجامعي ، ومركز أنطاليا لفحص الفقرات العنقية بالرنين المغناطيسي في الفترة بين يوليو 2020 الى سبتمبر 2020. تم جمع البيانات من التقارير الطبية بواسطة ورقة جمع البيانات. تم تحليل البيانات بواسطة برنامج SPSS النسخة 19وجدت الدراسة ان أكثر نتائج التصوير بالرنين المغناطيسي هي انتفاخ القرص (52.6٪) ، والتغيرات التنكسية للقرص (22.7٪) ، وداء الفقار (11.3٪) ، بينما كان مستوى القرص الأكثر إصابة هو بين الفقرات العنقية 4 و5 (29.9%), بين الفقرات العنقية 5 و 6 (26.8%), و بين الفقرات العنقية 3 و4 (24.7%)

الدراسة وجدت أيضًا أن نتائج التصوير بالرنين المغناطيسي ليس لها علاقة معنوية لا مع تقدم العمرو لا مع الجنس. اوصت الدراسة بتقييم الفئات العمرية الاصغر سنا الذين يعانون من الم العنق.

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List of abbreviation

Abbreviation	Meaning
MRI	Magnetic Resonance Images
DD	Degenerative Disease
T	Tesla
RF	Radiofrequency
NMR	Nuclear Magnetic Resonance
TSE	Turbo Spin Echo
STIR	Short Time Inversion Recovery
WI	Weighted Image

Chapter One
Introduction

Chapter One

Introduction

1.1 Introduction:

The position and functions of the cervical spine and its intervertebral discs in the human body make it prone to degenerative changes and other functional disorders and Magnetic Resonance Imaging (MRI) is the gold standard in adequately depicting these changes.

The cervical spine has the most spinal mobility with as much as 600 movements per hour in a normal individual, thus its high susceptibility to degenerative changes (Hashemi et al., 2002; Bland., 1989).

Cervical spondylosis is a degenerative process of the spine with a gradual onset which alone or in combination with other factors may result in narrowing of the central spinal and root canals. It is a very common cause of spinal cord dysfunctions with progressing age and some researchers have documented that by the 7th decade, it would have reached a prevalence of 95% in many subjects and may manifest with long periods of disability which worsens progressively, (Malcolm., 2002;Maccormick et al., 2003).

Degenerative disc disease and its squeal are main causes of neck pain, thus suspicion of it is a strong indication for an MRI investigation, which will aid in the diagnosis of severe disease as well as identify reversible and thus treatable causes, although this modality has also been shown to demonstrate degenerative changes in both symptomatic and asymptomatic patients (Matsumoto et al., 1998).

A prospective study done by Siivola shows MRI changes of cervical spine in asymptomatic and symptomatic young adults. Data of 826 patients who had MRI of cervical spine over 7 years period. The study found that disc herniation was the only MRI finding that was significantly associated with neck pain. These findings indicate that pathophysiological changes of cervical spine verified on MRI seem to explain only part of the occurrence of neck and shoulder pain in young adults. (Siivola et al., 2002).

1.2 Problem Statement:

Disorders of the cervical spine are a common source of pain. The high percentage of neck pain in Sudanese population initiates the need for assessing the suspected causes of this pain.There is a wide variability in the reported prevalence of different MRI findings such as for example disc degeneration and only 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 neck pain in different populations

1.3 Objectives:

1.3.1 General objective:

Evaluation of cervical spine changes and disorders in symptomatic patients.

1.3.2 Specific objectives:

-Identify the most common pathological finding.

-Determine the most affected disc level.

-Correlate the MRI pathological finding with age.

-Find outthe relationbetween the MRI finding and gender

1.4 Over view:

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, recommendations and limitations. At the end references were cited, and appendices were added.

Chapter Two
Literature review

Chapter Two

Literature review

2.1 Theoretical backgrounds:

2.1.1 Anatomy and physiology

The cervical portion of the spine is an important one anatomically and clinically. It is within this region that the nerves to the arms arise via the brachial plexus, and where the cervical plexus forms providing innervation to the diaphragm among other structures. The cervical spine also allows passage of important vasculature to reach the brainand provides attachment sites for muscles that move the head, neck, and shoulder girdle. (Edward C. Benzel.2012).

2.1.1.1 Cervical spine vertebrae

The cervical spine consists of seven vertebrae, which articulate with each other to form a strong pillar for the support of the head. The C1, C2, and C7 vertebrae presented with exceptional or atypical features (atypical vertebrae), while C3 through C6 vertebrae presented with similar characteristics (typical). (Edward C. Benzel.2012).

2.1.1.1.1 Typical cervical vertebrae:

A typical vertebra consists of two essential parts, a ventral segment or vertebral body and a dorsal part, the vertebral or neural arch; these enclose a foramen, the vertebral foramen. the vertebral arch consists of pair of pedicles and pair of laminae and supports seven processes, which include four articular, two transverse, and one spinous. A typical cervical vertebra is characterized by the corpus vertebrae, pedicles, laminae, and spinous articular, and transverse processes. (Edward C. Benzel.2012).

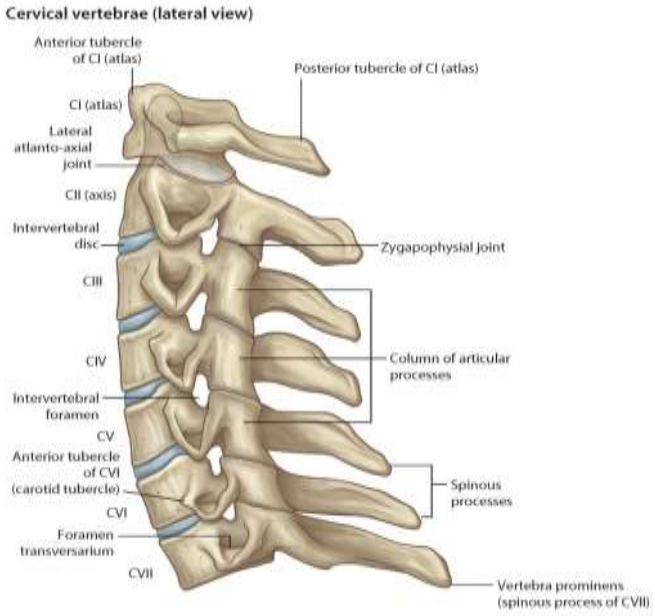


Figure 2.1 shows lateral view of cervical spine (ddxof.com,2020).

2.1.1.1.2 Atypical cervical vertebrae:

The first two cervical vertebrae are specialized vertebrae adapted to allow movement of the head and to accommodate articulation with the cranium, or skull. (Edward C. Benzel.2012).

2.1.1.1.2.1 First cervical vertebra(atlas):

The first cervical vertebra C1 ,or atlas is a ring shaped structure that articulats superiorly with the occipital condyles and inferiorly with the second cervical vertebra, the axis, via the atlantoazial joints. Its peculiarities include the absence of vertebral body, and spinous process, it is ring-like, and it consists of ventral and dorsal arch and two lateral masses. Its the widest cervical vertebra, with its ventral arch approximately half as long as its dorsal arch. (Edward C. Benzel.2012).

2.1.1.1.2.2 The second cervical vertebra(axis):

Is also known as the epitrophysis because it forms the pivot upon which the first vertebra carrying the head, rotates. It is characterized by a dens or odontoid process that projects upward from the body of C2 to articulate with the dorsal aspect of the ventral arch of C1. Lateral to the dens, the body has facets that articulate with the lower surface of the lateral masses of C1, which are large, slightly convex, and face upward and outward. These are not true superior articular processes because the articular surface arises directly from body and

pedicle lateral to the dens. The spinous process is large and bifid and is often one of the largest in the cervical spine..(Edward C. Benzel.2012).

2.1.1.1.2.3 The seventh cervical vertebra:

The most distinctive characteristic of the seventh cervical vertebra is the existence of a long and prominent spinous process, this process is thick, nearly horizontal in direction, not bifurcated, but terminating in a tubercle to which the lower end of the ligamentumnuchae is attached. The transverse processes are of considerable size, their dorsal roots are large and prominent, while the ventral roots are small and faintly marked. The foramen transversarium may be as large as that in the other cervical vertebrae but is generally smaller on one or both sides..(Edward C. Benzel.2012).

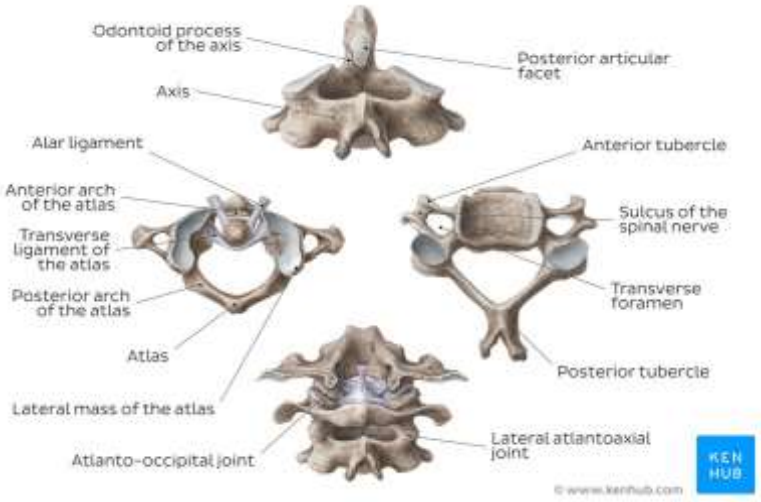
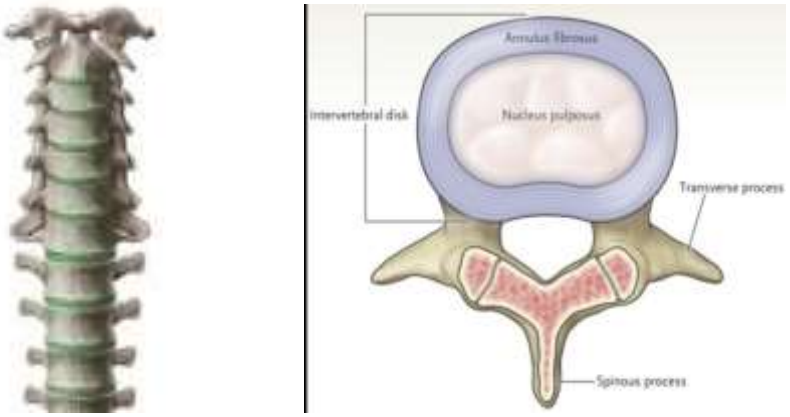


Figure 2.2 shows the cervical spine and bones. (kenhub.com,2020).

2.1.1.2 Intervertebral discs:

Below the second and subsequent cervical vertebrae are intervertebral discs between adjacent vertebrae. These discs contribute to more than one quarter of the length of the cervical column and are a factor in allowing considerable movement of the neck. (Alison Middleitch, Jean Oliver.2005).



a b

Figure 2.3 shows Intervertebral disc (a.ventral view, b cross sectional view).

2.1.1.3 Cervical spine ligaments

The cervical spine ligaments are a combination of ligaments that continue from lower regions of the vertebral column (that change names as they reach C2) and ligaments that are unique to the cervical spine. (Alison Middleitch, Jean Oliver.2005).

2.1.1.3.1 Craniovertebral ligaments:

Stability of the craniovertebral region is dependent upon the integrity of the ligaments of the upper cervical spine. From anterior to posterior the ligaments of the region are:

2.1.1.3.1.1 The anterior atlanto-occipital membrane:

This connects the foramen magnum above to the arch of the atlas below, and is continuous with the anterior longitudinal ligament. It overlies the capsules of the atlanto-occipital joints laterally. (Alison Middleitch, Jean Oliver.2005).

2.1.1.3.1.2 The apical ligament:

This is short and finer than the alar ligaments and attaches the tip of the dens to the anterior margin of the foramen magnum. (Alison Middleitch, Jean Oliver.2005).

2.1.1.3.1.3The two alar ligaments:

These are symmetrically placed, arising from the posterior part of the tip of the dens. (Alison Middleitch, Jean Oliver.2005).

2.1.1.3.1.4 The transverse ligament of the atlas:

This is a thick band which holds the odontoid in place and passes between the tubercles on the medial side of the lateral masses of the atlas. The whole ligament is in the shape of a cross and is termed the cruciform ligament of atlas. (Alison Middleitch, Jean Oliver.2005).

2.1.1.3.1.5 Tectorial membrane:

Connecting the posterior surface of the body of the axis to the basiocciput, the membrane tectoria is a prolongation of the posterior longitudinal ligament.(Alison Middleitch, Jean Oliver.2005).

2.1.1.3.2 Ligaments of lower cervical spine:

2.1.1.3.2.1 Anterior longitudinal ligament:

Is a strong band which lies anterior body. It is attached to the basilar part of the occipital bone, from which is extends to the tubercle of the atlas and then attaches the front of the vertebral bodies. (Alison Middleitch, Jean Oliver.2005).

2.1.1.3.2.2 Posterior longitudinal ligament:

Is posterior to the vertebral body, lies inside the vertebral canal, and is attached to the body of the axis and then to the margins of the vertebral bodies and intervertebral discs. This ligament is broad and uniform in width in the cervical spine. It is stretched during neck flexion and relaxed in extension. (Alison Middleitch, Jean Oliver.2005).

2.1.1.3.2.3 The ligamentaflava:

Ligament flava are predominantly yellow elastic tissue and connect the laminae of the adjacent vertebrae. These ligaments, which are broad and long in the neck, allow flexion to occur, but prevent hyperflexion by braking the movement

so that the end of range is not reached abruptly. (Alison Middleitch, Jean Oliver.2005).

2.1.1.3.2.4 The interspinous ligament:

Are rudimentary in the cervical spine and connected adjoining spinous processes. (Alison Middleitch, Jean Oliver.2005).

2.1.1.3.2.4 The intertransverse ligament:

The intertransverse ligament connect adjacent transverse processes. They are irregular in the cervical spine and are reinforced by the intertransverse muscles. (Alison Middleitch, Jean Oliver.2005).

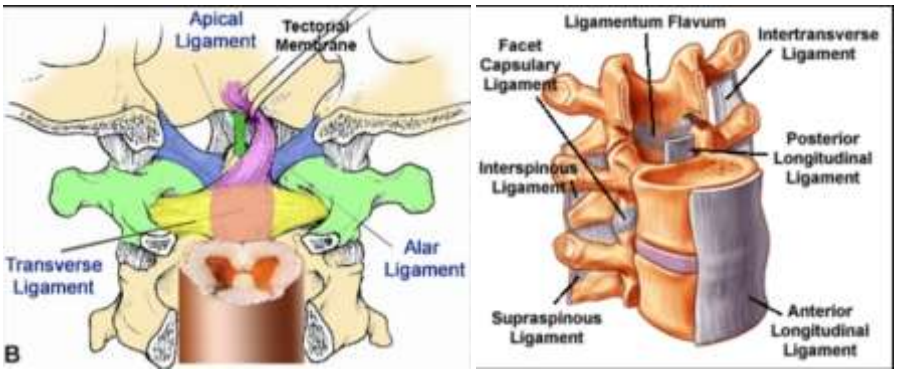


Figure 2.4 shows ligaments of cervical spine.(Orthobullets,2020).

2.1.1.4 Nerves arising from the cervical spine

The first cervical nerve root exits between the occiput and C1. While nerves C2 to C7 exit above the correspondingly numbered vertebrae, the C8 nerve root exits through the intervertebral foramen formed between the seventh cervical vertebra and the first thoracic vertebra.

The cervical plexus originates primarily from the anterior rami of C1 to C4 nerve roots. The cervical plexus is arranged in a serious of loops from which peripheral branches arise. (Edward C. Benzel.2012).

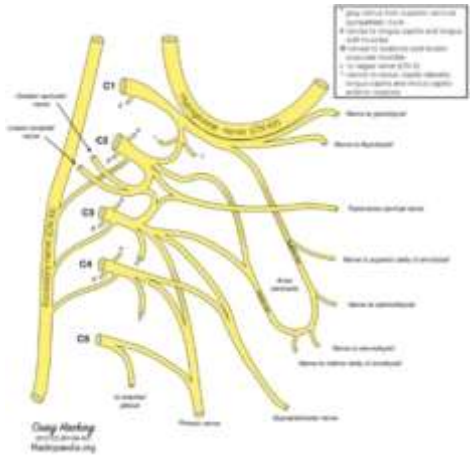


Figure 2.5 shows cervical plexus (Radiopaedia.org,2020).

2.1.1.5 Muscles of cervical spine:

There are many muscles in the cervical region, not all of them attach to the cervical spine, but many of them do. The following are muscles that either originate or insert (at least partially), or both, onto the vertebrae in the cervical spine. If a muscle attaches to the skull it will move the head, if it does not, the muscle will only move the neck. (Edward C. Benzel.2012).

2.1.1.5.1 The longuscolli:

Located on the ventral aspect of the cervical spine and consists of three portions: the superior oblique portion originates from the anterior tubercleof the transverse processes of the third through the fifth cervical vertebrae and inserts on the tubercle of the ventral arch of the atlas, the inferior oblique portion arises from the ventral surface of the vertebral bodies T1 to T3 and inserts on the anterior tubercles of the transverse processes C5 to C6, and the ventral portion arises from the ventral bodies of C7 to T3 and inserts on the ventral bodies of C2 to C4. The muscle acts to flex the neck and allows some rotation of the cervical spine. (Edward C. Benzel.2012).

2.1.1.5.2 The longuscapitis:

Originates from tendinous slips from the anterior tubercles of the transverse processes of the third through the sixth cervical vertebrae, rising to insert on the basilar portion of the occipital bone. It is a flexor of the upper cervical spine and head. (Edward C. Benzel.2012).

2.1.1.5.3 The rectus capitis anterior:

Located just deep to the superior aspect of the longuscapitis, originates from the ventral surface of the lateral mass and the root of the transverse process of C1. It inserts on the foramen magnum ventrally and on the basilar portion of the occipital bone. This muscle flexes the head and stabilize the atlantooccipital joint. (Edward C. Benzel.2012).

2.1.1.5.4 The rectus capitislateralis:

Originates from the superior surface of the transverse process of C1 and inserts on the inferior surface of the jugular process of the occipital bone. The muscle causes ipsilateral lateral bending of the head and stabilizes the atlantooccipital joint. (Edward C. Benzel.2012).

2.1.1.5.5 The scalenus anterior:

Lies deep to sternocleidomastoid arising from the anterior tubercle of the transverse process of C3 to C6 and inserts on the scalene tubercle on the inner ridge of the upper aspect of the first rib . (Edward C. Benzel.2012).

2.1.1.5.6 The scalenusmedius:

Originates from the posterior tubercle of the transverse process of C2 through C7 and inserts on the upper first rib behind the subclavian groove. (Edward C. Benzel.2012).

2.1.1.5.7 The scalenus posterior muscle:

Arises from the posterior tubercle of the transverse process at C4 through C6 and inserts on the outer surface of the second rib just deep to the attachment of the scalene anterior. These muscles as a group act to flex and rotate the neck while rising the rib on which they insert. (Edward C. Benzel.2012).

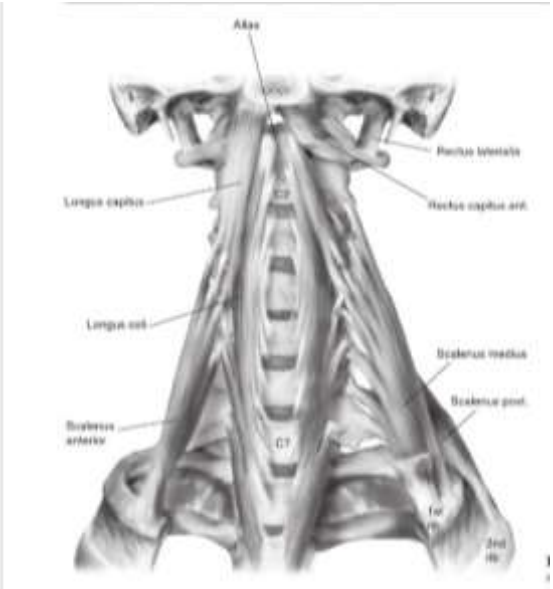


Figure 2.6 shows muscles of cervical spine. (Edward C. Benzel.2012).

2.1.1.1Pathology:

2.1.1.1.1 Cervical spondylosis:

Cervical spondylosis is a general term for age-related wear and tear affecting the spinal disks in your neck. As the disks dehydrate and shrink, signs of osteoarthritis develop, including bony projections along the edges of bones (bone spurs).

Cervical spondylosis is very common and worsens with age. More than 85 percent of people older than age 60 are affected by cervical spondylosis. (www.mayoclinic.org).

2.1.1.1.1.1 Symptoms:

For most people, cervical spondylosis causes no symptoms. When symptoms do occur, they typically include pain and stiffness in the neck.

Sometimes, cervical spondylosis results in a narrowing of the space needed by the spinal cord and the nerve roots that pass through the spine to the rest of your body. If the spinal cord or nerve roots become pinched, you might experience: Tingling, numbness and weakness in your arms, hands, legs or feet, Lack of

coordination and difficulty walking, and Loss of bladder or bowel control. (www.mayoclinic.org).

2.1.1.1.1.2 Causes:

As you age, the bones and cartilage that make up your backbone and neck gradually develop wear and tear. These changes can include Dehydrated disks, Herniated disks, Bone spurs, and Stiff ligaments. (www.mayoclinic.org).

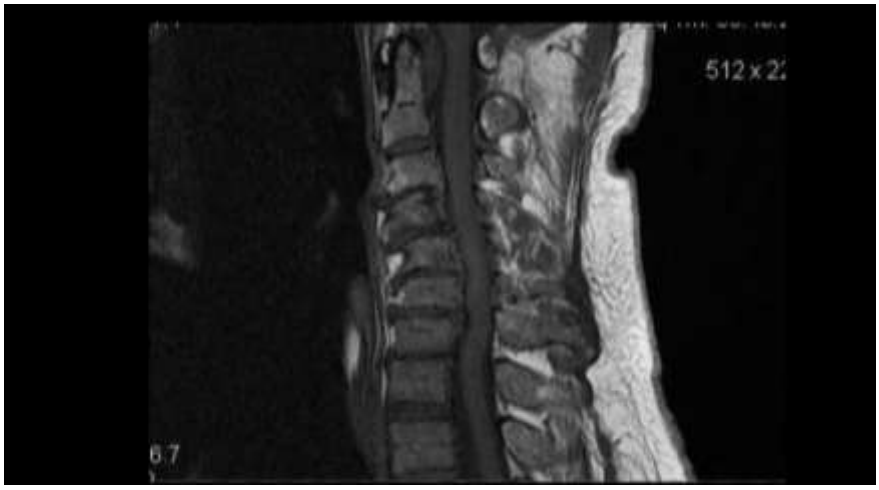


Figure 2.7 shows spondylosis in MRI (STIR).

2.1.1.1.2 Cervical disc degenerative disease:

Degeneration of the discs particularly in the moving sections of the spine (cervical and lumbar levels) is a natural process of aging. This dehydration or desiccation of the disc material reduces the flexibility and typically the height of the disc. In most patients the mere presence of degenerative discs is not a problem leading to pain, neurological compression, or other symptoms. However, in a certain number of patients, the disc degeneration leads to spinal "instability," the condition in which the spine is unable to bear the patient's weight or perform its normal functions without disabling pain.

2.1.1.1.2.1 Symptoms:

Cervical disc degenerative disorder can be characterized by neck pain. This neck pain can be most prevalent when the patient is upright or moving the head and can be reduced by lying down or reclining. Often the disc will be associated with osteophytes or bone spurs. They can further reduce movement and lead to nerve compression. The cervical nerve roots innervate the back of the head and

neck as well as the arms and hands. If they are affected, the patient could have burning, tingling, numbness, and pain in these areas. Sometimes headaches result from cervical degenerative disc problems.

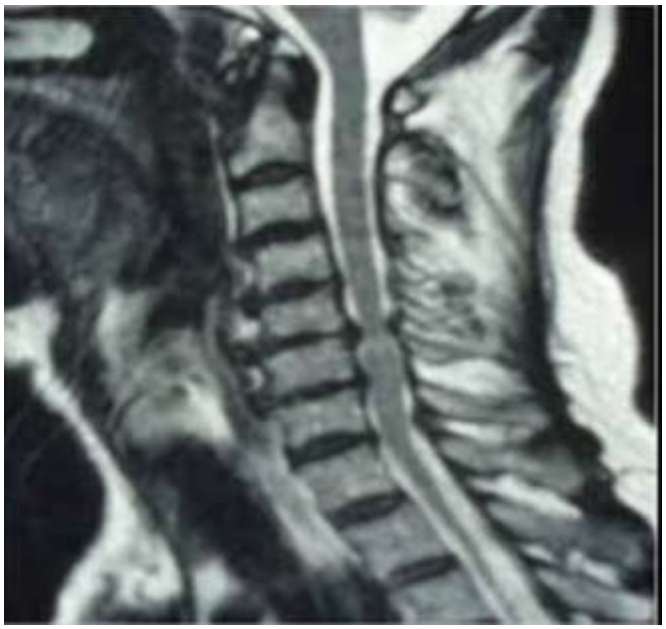


Figure 2.8 shows degenerative disease with spinal canal stenosis.(MRI T2 WI).

2.1.1.1.3 Disc bulge:

A bulging disc in the neck occurs when a spinal disc weakens and encroaches on the spinal cord. In some cases, this can cause pain in the neck, shoulders, arms, and back. Acute injury to the area can cause a bulging disc in the neck.

Long-term trauma, such as poor posture or being overweight, can also cause a bulging disc in the neck. These structures in the spine tend to weaken over time, so aging can increase the risk of a bulging disc in the neck. (Aaron Kandola, 2019).

2.1.1.1.3 .1 Causes:

A weak spinal disc can cause a bulge in the neck. It is possible for spinal discs to dislodge. This is most common in the lower spine. However, it can also occur in the upper portion of the spine, and it can cause a bulge into the spinal canal. In more severe cases, it can lead to a herniated disc.Herniated and bulging are

terms that describe the disc. Some people compare a bulging disc to a tire that is going flat, whereas they consider a herniated disc similar to a tire blowout.

A herniated disc occurs when damage to the outer layer causes the inner substance to leak out of the disc. The causes of bulging or herniated discs include sudden or long-term trauma.

Having poor posture and lifting weights with improper form are examples of what can cause long-term trauma. Other possible causes include being overweight, being older, being sedentary, and having intervertebral disc disease.

Spinal discs weaken over time and become more vulnerable to injury. This means that aging increases the risk of a bulging or herniated disc. It depends on what begins to degenerate first.If the nucleus pulposus, or the inner soft tissue, starts to degenerates first, a disc may have no problem.However, if the annulus fibrosis, which is the outer supporting layer, starts to degenerate first, the inner nucleus pulposus may escape into the vertebral canal and press on a nerve root or the spinal cord. (Aaron Kandola, 2019).

2.1.1.1.2.3 Symptoms:

It is possible for a bulging disc to occur without any symptoms. In other cases, however, the disc presses on a nerve in the neck. This can cause pain in the neck, shoulders, and back, pain when moving, numbness or tingling in the shoulders, arms, or fingers, and a reduced range of motion.

The severity of the symptoms will depend on how much pressure there is on the nerve. The symptoms often worsen during activity and improve when resting. (Aaron Kandola, 2019).

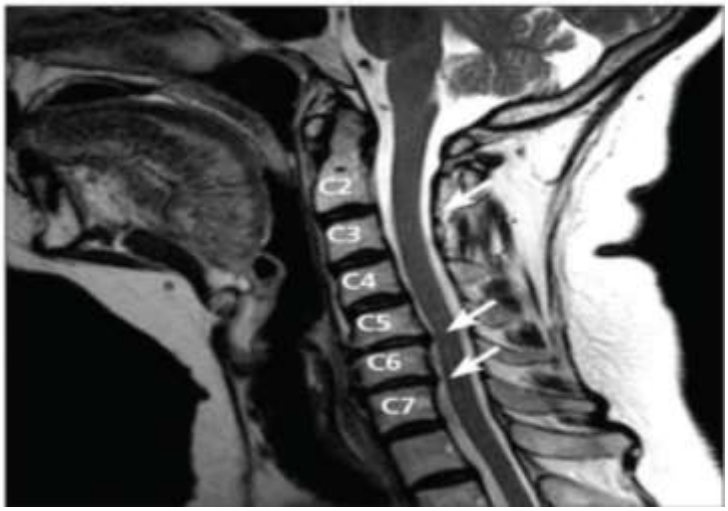


Figure 2.9 shows disc bulge in MRI (T2 WI).

2.1.3 Magnetic resonance imaging for the cervical spine:

MRI is a medical imaging technique used in radiology to form pictures of the anatomy and the physiological processes of the body. MRI scanners use strong magnetic fields, magnetic field gradients, and radio waves to generate images of the organs in the body. MRI does not involve X-rays or the use of ionizing radiation. (Sasaki M, Ehara S, Nakasato T,1990).

2.1.3.1 Common indications:

MRI can detect a variety of conditions of the cervical spine as well as problems in the soft tissues within the spinal column, such as the spinal cord, nerves, and disks. MRI of the cervical spine can be useful in evaluating problems such as pain, numbness, tingling or weakness in the arms, shoulder or neck area, and can help detect certain chronic diseases of the nervous system. It also can help diagnose tumors, bleeding, swelling, infections, or inflammatory conditions in the vertebrae or surrounding tissues. (Sasaki M, Ehara S, Nakasato T,1990).

2.1.3.2 Equipment:

The major components of an MRI scanner are the main magnet, which polarizes the sample, the shim coils for correcting shifts in the homogeneity of the main magnetic field, the gradient system which is used to localize the region to be scanned and the RF system, which excites the sample and detects the resulting NMR signal. The whole system is controlled by one or more computers.MRI requires a magnetic field that is both strong and uniform to a few parts per million across the scan volume. The field strength of the magnet is measured in teslas – and while the majority of systems operate at 1.5 T, commercial

systems are available between 0.2 and 7 T. Most clinical magnets are superconducting magnets, which require liquid helium to keep them very cold. Lower field strengths can be achieved with permanent magnets, which are often used in "open" MRI scanners for claustrophobicpatients. (Sasaki M, Ehara S, Nakasato T,1990).

Figure 2.10 shows MRI machines (by researcher,2020).

2.1.3.3 Patient positioning:

Head first supine, position the head in the head and neck coil and immobilise with cushions, centre the laser beam localizer over the mid neck(2.5 cm below the chin in chin down position). (Sasaki M, Ehara S, Nakasato T,1990).

Figure 2.11 shows patient position and neck coil. (Sasaki M, Ehara S, Nakasato T,1990).

2.1.3.4 Conventional technique (protocol):

A scout three planes (axial, sagittal, and coronal) is done. The conventional protocol includes T2 TSE sagittal, T1 TSE, T2 TSE STIR sagittal, T1 TSE Axial, and T2* Axial. (Sasaki M, Ehara S, Nakasato T,1990).

2.2 Previous studies:

A study done by Ali M Alshami,2015 to show the prevalence of spinal disorders and their relationships with age and gender in patients who came to physical therapy department. The data was 5929 patients who diagnosed of cervical disorders over 3 months period. The study found weak relationships of age and gender with some of the disorders of the cervical spine were found. The neck pain was more common among patients <30 years than in older patients. A national prevalence study from the USA, found that LBP, neck pain were more common in women and among older age groups. Neck pain exhibited a mild peak near middle age. Pain, spondylosis, and disc disorders were the most common disorders that affected the cervical spine (Ali M. Alshami, 2015).

A nother study done by Mustapha and his colleages to show the type and distribution of pathological changes and abnormalities in the cervical spines of patients who presented with symptoms of neck pain and radiculopathy. Data of 170 patients who had an MRI of the cervical spine over a 60 month period were retrieved and reviewed from the MRI database. The study found that Patients aged 45-54 years were the highest imaged though the percentage of abnormal findings increased linearly with age. The most affected disc level was at C4/C5. Cervical spondylosis and degenerative disc disease are common in this locality. Degenerative changes are common in this locality and were shown by this study to increases linearly with age and affect multiple intervertebral disk levels.(Mustapha et al,2014).

MedaRaghavendra,2016 investigate a total of 3,337 patients presented to the pain clinic—including 2,047 women (61%) and 1,290 men (39%). Clearly, women outnumbered men by a ratio of 3:2, various explanations have been proposed, including hormonal differences and the belief that men may be less willing to report pain so detect pathology. (MedaRaghavendra,2016).

The previous study found that abnormalities were commoner in older subjects, 62% of being seen in those over 40 years old. In subjects aged less than 30 years there were virtually no abnormalities. DD was the most common abnormality, seen in 10% of discs; 57% DD was in subjects aged over 40. DD at the C5/6 level was the most common finding. No differences in abnormal findings between males and females were observed. (Lehto et al., 1994).

Chapter three
Materials and methods

Chapter three

Materials and methods

3.1 Materials:

3.1.1 Study design:

This is a retrospective cross sectional descriptive study.

3.1.2 Study period:

The study was conducted from July 2020 to September 2020.

3.1.3 Study area:

The data were collected from three different hospitals: Aliaa Specialist Hospital, Alribat University Hospital, and Antalya Centre, Khartoum, Sudan

3.1.4 Sample size:

53 patients were enrolled in this study. 30 female and 23 were male and their age range between 20 to 80 years. The data collected from 97 disc levels.

3.1.5 Inclusion criteria:

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

3.1.6 Data collection tool:

The data were taken from the medical reports, which were written by qualified specialists. The data was collected using data collecting sheet which was designed to comply with this study. The Collected variables included: age, gender, the affected disc levels, and the MRI findings.

3.2.7 MRI machines:

The MRI studies were performed using open MRI machine (0.35 T) manufactured by Neusoft, and two superconductive machines (1.5 T) manufactured by General electrical (GE) and Toshiba.

3.2 Methods:

3.2.1 Technique used:

All patients underwent cervical MRI scan using comparable protocol; sagittal T1 weighted image, sagittal T2 weighted image, sagittal STIR, axial T1, and axial T2* pulse sequences. All patients used cervical coil. The images were diagnosed by highly experienced radiologists.

3.2.2 Data management and analysis:

The study used a comparative analytical method by SPSS statistical programme based on descriptive statistics, comparative, and relationship tests to demonstrate the most common finding and the most common level of pathology and relation of disorders with age and gender.

3.2.3 Ethical concern:

The data was collected and based on MRI findings from reports considering the patients privacy and department approval.

Chapter Four

Results

Chapter Four

Results

Table 4.1: Distribution of participant according to gender.

Gender	Frequency	Percept
Male	23	43.4
Female	30	56.6
Total	**53**	**100.0**

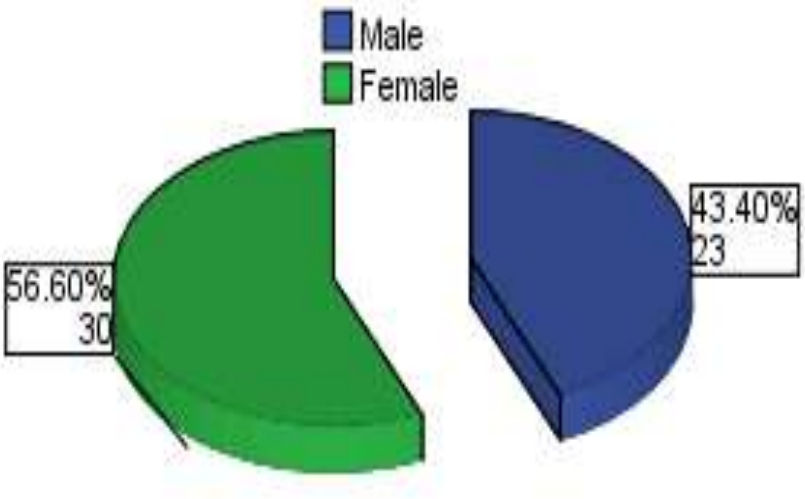


Figure 4.1: Distribution of participant according to gender.

Table 4.2: Distribution of participant according to age.

Age	Frequency	Percent
Less than 30 years	4	7.5
30-40 years	4	7.5
41-50 years	15	28.3
51-60 years	18	34.0
More than 60 years	12	22.6
Total	**53**	**100.0**

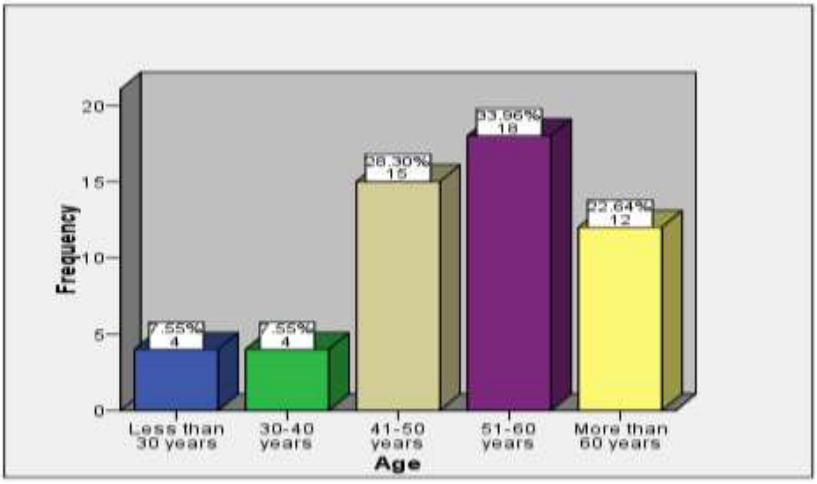


Figure 4.2: Distribution of participant according to age

Table 4.3: Distribution of participant according to MRI findings.

	Frequency	Percent
Disc bulge	52	53.6
Disc protrusion	6	6.2
Degenerative disc disease	22	22.7
Neurofiberoma	1	1.0
Spondylodegenerative disease	2	2.1
Spondylosis	11	11.3
Spondylodiscitis	1	1.0
Normal	2	2.1
Total	**97**	**100.0**

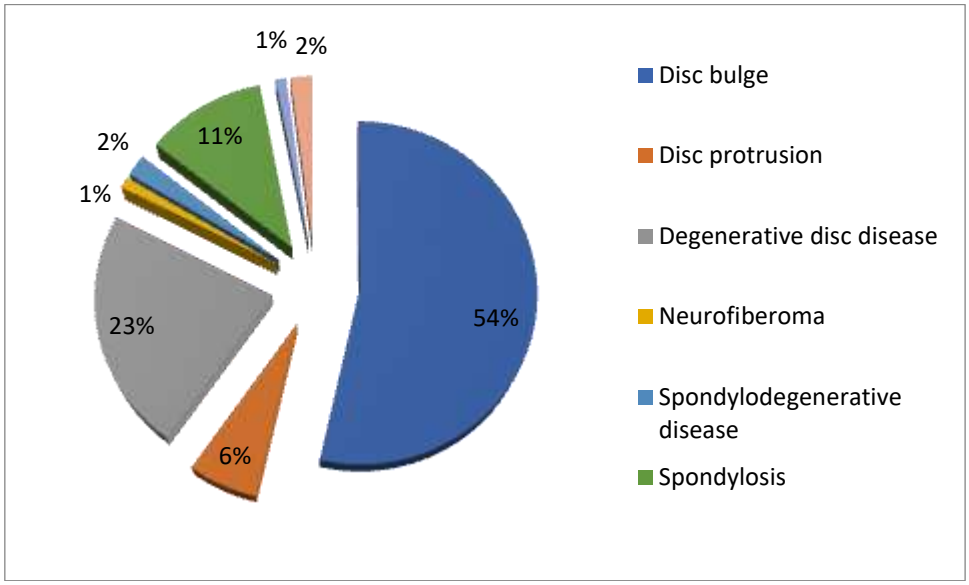


Figure 4.3: Distribution of participant according to MRI findings:

Table 4.4: Distribution of participant according to pathology level

	Frequency	Percent
C2\C3	1	1.0
C3\C4	24	24.7
C4/C5	29	29.9
C5/C6	26	26.8
C6/C7	15	15.5
Normal	2	2.1
Total	**97**	**100.0**

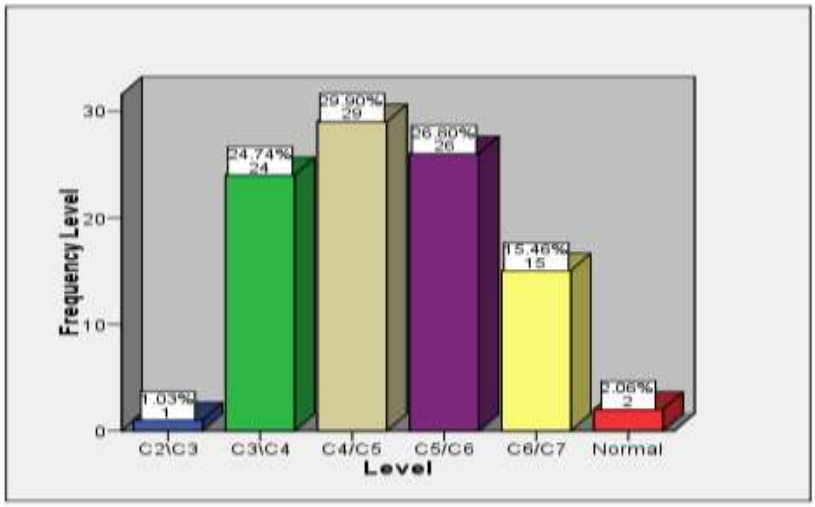


Figure 4.4: distribution of participant according to pathology level:

Table 4.5: Chi-Square test for association between MRI findings and gender

			Gender		
			Male	Female	Total
MRI Finding	Disc bulge	Count	25	27	52
		%	48.1%	60.0%	52.6%
	Disc protrusion	Count	1	5	6
		%	1.9%	11.1%	6.2%
	Degenerative disc disease	Count	16	6	22
		%	30.8%	13.3%	22.7%
	Neurofiberoma	Count	0	1	1
		%	.0%	2.2%	1.0%
	Spondylodegenerative disease	Count	1	1	2
		%	1.9%	2.2%	2.1%
	Spondylosis	Count	7	4	11
		%	13.5%	8.9%	11.3%
	Spondylodiscitis	Count	1	0	1
		%	1.9%	.0%	1.0%
	Normal	Count	1	1	2
		%	1.9%	2.2%	2.1%
Total		Count	52	45	97
		%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	P-value
Likelihood Ratio	12.286	8	0.139

Table 4.6: Chi-Square test for association between MRI findings and age.

		Age					
MRI finding		Less than 30 years	30-40 years	41-50 years	51-60 years	More than 60 years	Total
Disc bulge	N	2	5	19	12	14	52
	%	50.0%	62.5%	73.1%	46.2%	42.4%	52.6%
Disc protrusion	N	0	2	0	2	2	6
	%	.0%	25.0%	.0%	7.7%	6.1%	6.2%
Degenerative disc disease	N	2	0	3	6	11	22
	%	50.0%	.0%	11.5%	23.1%	33.3%	22.7%
Neurofiberoma	N	0	1	0	0	0	1
	%	.0%	12.5%	.0%	.0%	.0%	1.0%
Spondylodegenerative disease	N	0	0	1	0	1	2
	%	.0%	.0%	3.8%	.0%	3.0%	2.1%
Spondylosis	N	0	0	0	6	5	11
	%	.0%	.0%	.0%	23.1%	15.2%	11.3%
Spondylodiscitis	N	0	0	1	0	0	1
	%	.0%	.0%	3.8%	.0%	.0%	1.0%
Normal	N	0	0	2	0	0	2
	%	.0%	.0%	7.7%	.0%	.0%	2.1%
Total	N	4	8	26	26	33	97
	%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests			
	Value	df	P-value
Likelihood Ratio	46.056	32	0.051

Chapter Five

Discussion, Conclusion and Recommendations

Chapter Five

Discussion, Conclusion and Recommendations

5.1 Discussion:

Neck pain and cervical radiculopathy are common reasons for requests of MRI of the cervical spine, however as well as requests for the evaluation of spondylitis, trauma and less frequently neoplastic disease processes of the neck in order to achieve better patient outcome. This thesis studies the common MRIfinding in cervical spine and the most common level of pathology and relation of disorders with age and gender.

A sample of (53), mostly (56.6%) females (table 4.1) and majorly (85%) were more than 40 years old (table 4.2) was underwent to cervical MRI scan. The study showed that the most common MRI findings were disc bulge(52.6%), disc degenerative changes (22.7%), spondylosis (11.3%) (table 4.3).97 disc level were investigated and the most common level of pathologywereC4/C5 (29.9%), C5/C6 (26.8%) and C3/C4 (24.7%) (Table 4.4).

Males were mostly affected with degenerative disc disease, whilst females were mostly affected with disc bulge (60%) as shown in table 4.5.and when correlate pathological finding with age group .the disc bulge was common in middle age while the degenerative disc disease common in elderly as shown in table 4.6.but this is not significantly different.

The study found that the cervical disorder is more prominence in female than male .The literature reviews support this finding. MedaRaghavendra,2016 investigate a total of 3,337 patients presented to the pain clinic—including 2,047 women (61%) and 1,290 men (39%). Clearly, women outnumbered men by a ratio of 3:2, various explanations have been proposed, including hormonal differences and the belief that men may be less willing to report pain so detect pathology.

The study found that the MRI findings does not significantly differ between males and females (P-value = 0.139> 0.05) (table 4.5) which indicates that MRI findings independent on gender, although the study found that most of females developed disc bulge, while male had disc degenerative changes. It was agree with the studies of Ali M. Alshami (2015) and Lehto, I.J. et al., (1994).

The study found that the MRI findings does not significantly differ between different age groups (P-value = 0.051> 0.05) (table 4.5) which indicates that MRI findings independent on age, although the study found that the disc bulge was common in middle age while the degenerative disc disease common in elderly. It was consistent with the study of Lehto and his colleagues, 1994. And the explanation of this finding is that disc degenerative diseases is age related disease while disc bulge is the simple form of vertebral disease may arise in any age .

The study showed that the common affected level C4/C5 and this confirms the result of Mustafa study.

5.2 Conclusion:

The goal of the study were to found out the common MRI finding for cervical spine in Sudanese , its relations with age and gender and determine the most affected disc level .

The study showed that the common MRI findings in Sudanese are the disc bulge and the degenerative disc diseases. The female had more cervical disorder than male. Also the C4\C5 is the most affected disc level in cervical spine. Cervical changes are common over fourty.

The study reveals that the MRI findings had no significant relation nor with age neither with gender.

5.3 Recommendations:

- Today the frequency of neck pain and cervical spine disorders is highly irradiate the diagnostic radiology department so further imaging modalities should be existed to evaluate such disorders and its extension in order to enhance the outcome.
- Future study should include more data.
- Evaluation in younger age groups can be useful.

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Appendices

Image 1: A 30 years male came to MRI department and diagnosed with Disc bulge in C4\C5, C5\C6.

Image 2: A 30 years old male came to MRI department and diagnosed with degenerative changes in C5\C6, C6\C7.

Data collection sheet

Pt No.	Gender	Age	Affected disc level	MRI finding