

## Patterns of Requests and Findings in Magnetic Resonance Imaging (MRI) of the Lumbosacral Spine at University of Maiduguri Teaching Hospital, Northeastern Nigeria.

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**Abstract : Objective:** The purpose of this study is to determine the patterns of requests and findings of MRI of the lumbo-sacral spine in our locality and to compare with work published by other researchers as it is clear that there is a paucity of data from this locality

**Materials and methods:** This study was carried out in the University of Maiduguri Teaching Hospital from May 2007 to May 2013. A Siemens Magnetom concerto MR Syngo version 2004A with a 0.2Tesla magnetic field strength. Reports were reviewed by two residents and reported by a consultant radiologist. Data from 357 patients who had MRI of the lumbo-sacral region between May 2007 and May 2013 were retrospectively retrieved from the MRI record book of department of Radiology.

**Results:** A total of 357 patients consisting of males (65.8%) and females (34.2%) had lumbosacral MRI done over the period of study. The male: female ratio was 1.9:1. Low back pain was the highest requests (36.5%). Disc prolapse was the most frequent finding in 45.24% of cases. 4.31% patients had normal studies. The most affected age group was 40-49years representing 26.61% and L4/L5 inter-vertebral disk was found to be the most affected level, followed by L5/S1

**Conclusion:** We observed that low back pain was the commonest request and disk prolapse the most frequent finding. This data is the first documentation of the requests and findings of MRI in our locality and will serve as a future reference for further research work.

**Keywords:** Requests, Findings, MRI, Lumbosacral spine

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### I. Introduction

Magnetic Resonance Imaging (MRI) is a diagnostic imaging modality which uses radio waves and magnetic field to image the human body by aligning the magnetic nuclei (protons) of the body in a strong, uniform magnetic field<sup>1,2</sup>. Since its discovery in the 1970s, MRI has gradually replaced Computed tomography (CT) and CT Myelography in the secondary assessment of the spine due to its high contrast resolution and a multiplanar capability<sup>3,4</sup>

Working adults are generally predisposed to degenerative diseases of the back, resulting more often than not in low back pain (LBP). The process that leads to this starts early in the life of an individual, but the causes are numerous with aging being the chief culprits. Bone, ligament and disc diseases are also major causes of this condition<sup>5</sup> Progressive degeneration as a result of aging and cellular changes cannot be avoided in the Intervertebral disk (IVD). These changes are subject to different interpretations, but it is generally agreed that they are important causes of LBP. Studies have shown that most visits to the doctor in the United States by working adults are for complaints on LBP, with obvious economic consequences that run into tens of billions of dollars, to the detriment of the sufferers and the state<sup>6,7</sup>

Mechanical disorders are another very common cause of LBP; with many patients in this category having no recognizable cause for their pain, other than strain and or injury to the muscle or ligament. A smaller number of patients present with symptoms related to systemic illnesses that could be inflammatory, neoplastic or infective in origin<sup>8</sup>

The aim of this study is to determine and document the pattern of requests and findings of lumbosacral (L/S) MRI, the relationship of these findings to age and gender and the most affected level. Our hospital is the only teaching hospital in north eastern Nigeria and a referral center for this sub region and neighboring countries of Chad, Cameroun and Niger republic. In future, our finding might be compared with those seen in other parts of Nigeria to determine if there is any correlation with regards to ethnicity, age and sex. Although similar research have been carried out in other parts of Nigeria,<sup>9,10</sup> to the best of our knowledge there is no existing data in our locality.

## II. Materials and Methods

The MRI requests and findings of three hundred and fifty seven patients with age range 4 to 90 years who had lumbosacral MRI between May 2007 and May 2013 were reviewed. The procedures were carried out in the MRI unit of Radiology department at University of Maiduguri Teaching Hospital (UMTH), NE Nigeria using an open bore MRI scanner (SEIMENS Magnetom Concerto MR Syngo Version 2004A, field strength of 0.2 Tesla) and body spine array volume coil. The images were acquired in T1 weighted sagittal (T1WS), T2 weighted sagittal (T2WS), T1 weighted axial (T1WA), T2 weighted axial (T2WA) using turbo-spin echo (T1WS: TR/TE 450-550/15-22ms; T2WS:4000-5000/100-125ms), slice thickness 4mm, no slice gap, Field of view- sagittal 300mm, Axial 250mm, image matrix 192 X 256 or 256 X 256, averages 2 for T2W and 4 for T1W. Images were also acquired in STIR and FLAIR and Gadolinium based contrast agent (Magnevist) was used where appropriate. Data was obtained from the UMTH MRI record book. A data capture sheet designed to include patients number, date of examination, age, sex, indications and MRI findings was used.

All MRI images were interpreted by three Radiologists (a registrar, senior registrar and a consultant radiologist)

Data were analyzed using SPSS version 13. The results were presented in tables, figures and graphs where appropriate. Limitations encountered were incomplete patient information from the request forms.

## III. Results.

Three hundred and fifty seven (357) patients who presented for lumbar spine MRI were reviewed, out of which 235 (65.8%) were males and 122 (34.2%) were females with a ratio of 1.9:1 as shown in Figure 1.

Figure 2 showed that requests for LBP had the highest occurrence of 36.5% (n=156) followed by ?disc prolapse of 25.77% (n=110) and the ones with the least occurrence include: spinal stenosis, bone tumor, metastasis 0.24% each.

Table 1 shows the distribution of findings with the commonest being disc prolapse 45.2% (n=252), followed by degenerative disk disease (DDD) 36.98% (n=206) and the least findings are nerve compression, haemangioma, ependymoma, soft tissue swelling, sickle cell disease changes, cord transection and myeloma all being 0.18% (n=1). 24 (4.31%) patients were reported as normal.

The most affected age group in this study is 40-49years representing 26.61% (n=95) and the least affected age groups were 0-9 and 90-100 represent 0.28% (n=1) each as shown in Table 2.

Disc prolapse affected mostly patients in the 40-49 years group (12.6%, n = 70) and DDD affected mostly patients in the 50-59 years group (7.5%) (Table 3). This study showed males to be more affected than females for each of the individual findings except for spondylitis and soft tissue swelling (Table 4)

L4/L5 IVD level was the most affected part of the spine (34.87%) when all findings were considered followed by L5/S1 IVD (23.28%) as shown in figure. 3

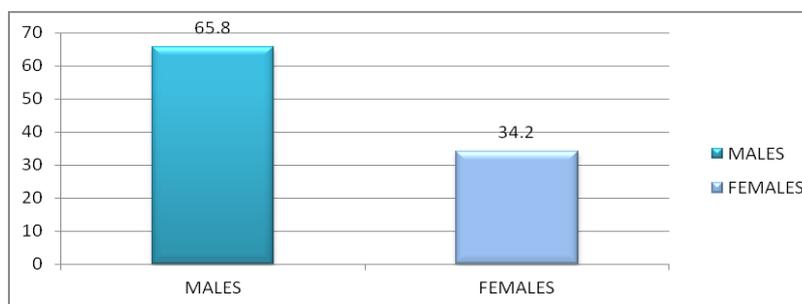


Figure 1: Gender distribution

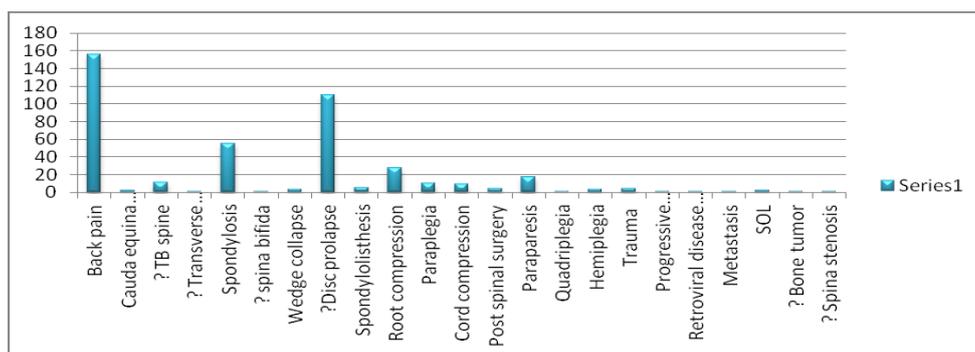


Figure 2: frequency distribution of lumbar MRI requests

**Table 1: Frequency distribution of lumbar MRI findings**

FINDINGS	FREQUENCY	PERCENTAGE
Normal study	24	4.31
Spondylolisthesis	15	2.69
Degenerative disc disease	206	36.98
Disc prolapse	252	45.24
Pott's disease	25	4.49
Spondylitis	3	0.54
Cord compression	8	1.44
Metastasis	6	1.08
Nerve compression	1	0.18
Wedge collapse	11	1.97
Haemangioma	1	0.18
Ependymoma	1	0.18
Soft tissue swelling	1	0.18
Sickle cell disease changes	1	0.18
Cord transection	1	0.18
Myeloma	1	0.18
<b>TOTAL</b>	<b>557</b>	<b>100%</b>

**Table 2: Age distribution**

AGE GROUP	FREQUENCY	PERCENTAGE (%)
0-9	1	0.28
10-19	6	1.68
20-29	21	5.88
30-39	51	14.29
40-49	95	26.61
50-59	90	25.21
60-69	53	14.85
70-79	31	8.68
80-89	8	2.24
90-100	1	0.28
<b>TOTAL</b>	<b>357</b>	<b>100(%)</b>

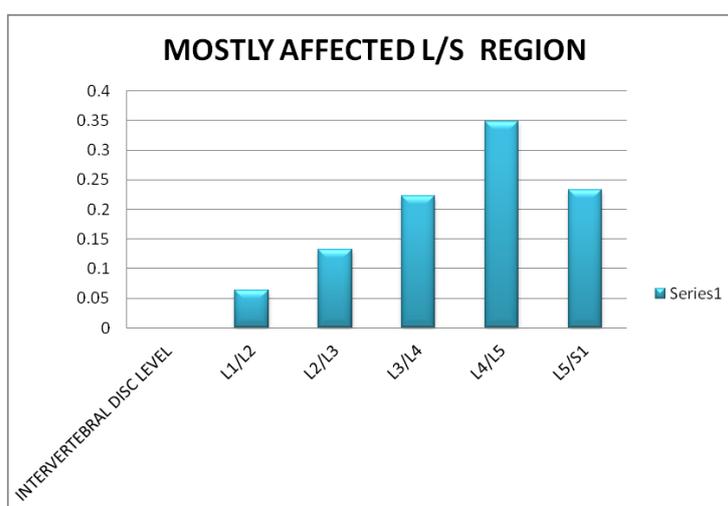
**Table 3: Patterns of findings in relation with age**

FINDINGS	AGE GROUP										TOTAL
	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-100	
Normal	-	2	8	10	-	4	-	-	-	-	24
Spondylolisthesis	-	-	-	3	2	3	4	2	1	-	15
Degenerative disc disease	-	1	1	13	37	42	40	14	6	1	155
Disc prolapse	-	1	9	34	70	66	44	21	6	1	252
Pott's disease	-	-	2	1	4	7	4	6	1	-	25
Spondylitis	-	-	-	-	1	2	-	-	-	-	3
Degenerative disc disease	-	-	-	3	12	14	9	10	3	-	51
Cord compression	-	1	-	2	1	2	1	1	-	-	8
Metastatic bone disease	-	-	1	-	1	1	1	2	-	-	6
Nerve compression	-	-	-	-	1	-	-	-	-	-	1
Wedge collapse	1	-	2	1	2	2	1	2	-	-	11
Haemangioma	-	-	-	-	-	1	-	-	-	-	1
Ependymoma	-	1	-	-	-	-	-	-	-	-	1
Soft tissue swelling	-	-	-	-	-	1	-	-	-	-	1
SCD changes	1	-	-	-	-	-	-	-	-	-	1
Cord transection	-	-	-	1	-	-	-	-	-	-	1
Myeloma	-	-	-	-	1	-	-	-	-	-	1
<b>TOTAL</b>	<b>2</b>	<b>6</b>	<b>23</b>	<b>68</b>	<b>132</b>	<b>145</b>	<b>104</b>	<b>58</b>	<b>17</b>	<b>2</b>	<b>557</b>

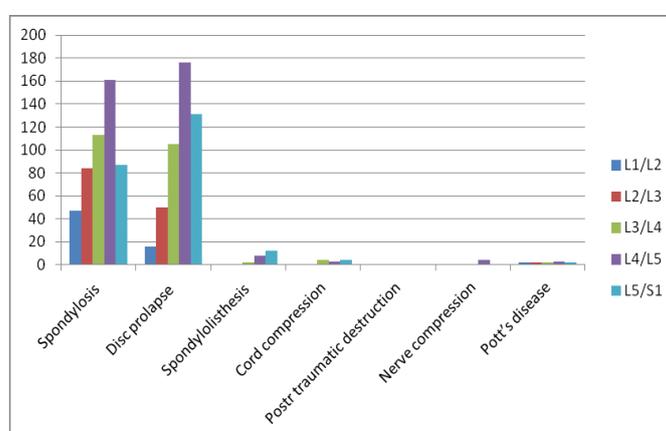
**Table 4: Findings in relation to gender**

FINDINGS	MALE	FEMALE	TOTAL
Normal study	16	8	24
Spondylolisthesis	10	5	15
Spondylolysis	103	52	155
Disc prolapse	171	81	252
Pott's disease	17	8	25
	1	2	3

Spondylitis			
Degenerative disc disease	38	13	51
Cord compression	7	1	8
Metastatic bone disease	3	2	5
Nerve compression	1	-	1
Wedge collapse	8	3	11
Haemangioma	1	-	1
Ependymoma	1	-	1
Soft tissue swelling	-	1	1
Sickle changes	1	-	1
Cord transection	1	-	1
Vertebral lesion	1	-	1
Myeloma	1	-	1
<b>TOTAL</b>	<b>381</b>	<b>176</b>	<b>557</b>



**Fig 3a:** Affected IVD level



**Fig 3b:** frequency of findings and levels

#### IV. Discussion

MRI is an important investigation used to further evaluate the lumbosacral (L/S) spine and it is requested by clinicians from all specialties as its importance lies in its accuracy<sup>11</sup>. It is widely used to visualize the spinal column and its contents with T1W and T2W images giving information about the morphology and integrity of discs and spinal cord<sup>12</sup>. It is recommended after plain radiographic studies which are usually the first line of investigations carried out on the L/S spine for most complaints. Plain radiography gives only some

details on bones and very limited information on the (Intervertebral disc) IVD which is implicated in a significant number of patients as the cause of low back pain (LBP)

MRI remains the imaging modality of choice for investigating the L/S spine with it providing a non-invasive, non ionizing radiation and accurate mode of evaluating the L/S spine despite its limitation of high cost and minimal availability in Africa. Although MRI has been widely in use in the developed countries since its introduction in 1973, its use in Nigeria was not well known till the early 2000s. The MRI equipment in our hospital was installed in 2005<sup>2, 13, 14</sup>.

The gender distribution seen in this study (65.8% males and 34.2% females) is in conformity with Irurhe et al who found 65.5% males and 34.5% females and Uduma et al (2011) which showed 60.4% males and 39.6% females in their studies. Another study by Sreedhar et al (2006) had results for a much smaller population (42 subjects) with 71.19% males and 28.81% female.

Our study found the highest number of patients to be in their 4<sup>th</sup> decade (26.61%). Similar results were found by Younis et al (2011) and Ahmed et al (2009). Irurhe et al (2012) had contrary results which found the 5<sup>th</sup> decade having the highest frequency. The demonstration of low back pain as the highest request in our study is comparable with that reported in other studies<sup>1-3, 9, 6</sup>

LBP is the commonest indication for L/S MRI in both developed and under developed countries and has a tremendous impact and burden on the socio-economic status of any population with about 15-20% of some population having an episode and up to 80% of adults in some population having at least one in their life time. We found our pattern of requests to be in keeping with those of most authors<sup>5, 14, 15</sup> in which 36.5% of our patients presented with a complaint of LBP. ? Disk prolapsed is the second commonest request in this study most probably due to the fact that almost all patients presenting with LBP would have undergone plain radiographic examination before been referred for MRI, thus the focus of the referring physician is now narrowed to the IVD and the spinal cord like osteophytosis and spondylolisthesis. Quadriplegia, retroviral disease (RVD), transverse myelitis, metastases, ? bone tumor, ?spinal stenosis and progressive flexion deformity had the least of 0.24% each. A total of 23 different requests were seen in this study. Metastatic spinal disease can be considered as both a request (where axial imaging is indicated to survey for bony secondaries) and more frequently as a finding. Our results of 0.24% requests for metastases was lower than those seen by Deyo et al (2008) who found an average of 1% . Even with these low values, the use of advanced imaging modalities in these conditions can still be justified as they usually provide the chance for pre-operative diagnosis and staging of many malignant diseases.

Despite the array of causes of low back pain that exist, 90% are as a result of mechanical disorders with only 10% been due to all other causes such as malignancies, infections, inflammations, systemic diseases and trauma<sup>15</sup>. The findings of this study did not defer from those of earlier researchers in this regard.

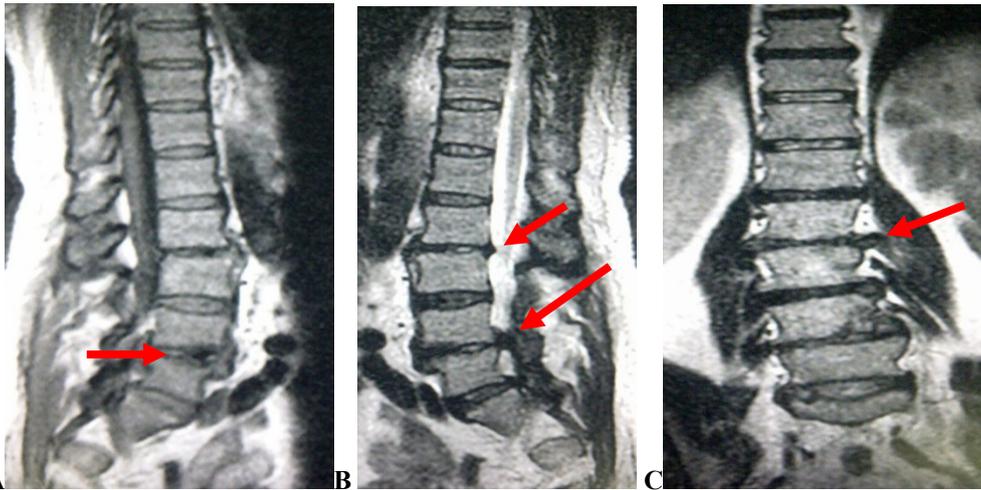
15 individual findings with a combined frequency of 557 from 357 patients imaged were seen. The most common finding was disk prolapse with a frequency of 252 (45.24%), followed by degenerative disk disease with 206(36.98%). Our 3<sup>rd</sup> most common finding is Pott's disease 25 (4.49%), spondylolisthesis 15 (2.69%), wedge collapse is seen in 11 (1.97%) cord compression 8 (1.44%), Metastases 6(1.08%) Spondylitis was diagnosed in 3 (0.54%). haemangioma, ependymoma, soft tissue swelling, SCD changes, nerve compression, cord transection and myeloma all having a frequency of 1 (0.18%). 24(4.31%) patients had normal reports.

In the process of compiling our data, we merged all forms of disk migration (protrusion, extrusion, bulge and herniation) under disk prolapse and the various forms and grades of degenerative disk diseases (DDD) were also merged.

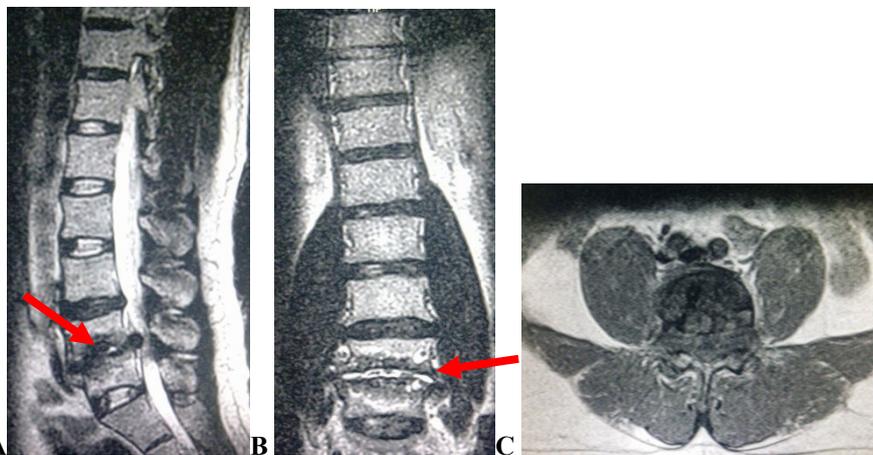
This study demonstrates that disk prolapsed is the commonest cause of LBP in this environment and correlates with studies carried out in Cameroon by Uduma et al (2011), bearing in mind our proximity with this hospital and also the fact that we saw a handful of patients from that country. Other researchers within Nigeria<sup>9</sup> showed finding in keeping with ours. Disk prolapse is a focal displacement of disk material beyond the margins of the adjacent vertebral end plate involving <50% of the disk circumference. Disk prolapsed is best visualized on T2W sagittal and axial MRI images which shows good contrast between the inner nucleus pulposus and the outer annulus fibrosus. It is worthy of note that a substantial number of asymptomatic subject are found to have disk protrusion. This supports arguments by earlier researchers that disk prolapse and LBP may be multifactorial and normal aging may be a chief culprit<sup>7, 16, 17</sup>

The IVD is made up grossly of annulus fibrosus and the nucleous pulposus and the adjoining endplates. Degeneration of the IVD occurs when the nucleous pulposus becomes dehydrated leading to progressive decrease in the height of the IVD. On MRI, disk dehydration manifests as decreased signal intensity on T2W images<sup>17, 18</sup>. These parts of the spine were hitherto unavailable for assessment prior to the invention of MRI. Dysfunction, instability and restabilization are the three phases of degeneration of the lumbar spine and DDD is involved in the first of these phases<sup>12</sup>. It would be fair to say that all patients who had features of DDD from our study were symptomatic but impossible to tell if this finding was a cause of their backache or simply a

coincidence considering a significant number of normal subjects showed all grades of DDD at all levels of the spine<sup>18, 19</sup> MRI is the recommended investigation for spinal infections, metastases and cord compression with a sensitivity of 80 – 100%<sup>15</sup> the majority of patients with Pott's disease had a know diagnosis of pulmonary tuberculosis and were on treatment with their MRI reports mostly in keeping with this disease.



**Figure 5:** (A) T1W sagittal image shows degenerative change with some signal changes of the IVD at that level (arrow). (B) T2W sagittal image shows disc protrusion at that level (arrow indicate multiple levels if prolapse) and (C) T2W coronal image shows lateral disc protrusion and loss of signal.



**Figure 6:** (A), (B) and (C) Mid sagittal T2W, coronal T1W and axial images at L4/S1 IVD level shows complete destruction at that level, marked signal changes and reduction in height of the opposing vertebrae (arrow)

## V. Conclusion

In conclusion, our study showed that low back pain is the most common request in this adult study population. Disk prolapse followed by degenerative disk disease (DDD) were the commonest findings (figures 5 and 6) and the L4/L5 intervertebral level was the most affected. Our study emphasizes that MRI remains the gold standard for imaging the spine despite the presence of false positives in asymptomatic subjects. This study serves as the first documentation of MRI findings in the lumbosacral spine in our region. In future, we hope more work will be done to compare these findings with those in CT and to MRI findings from other regions of the spine.

## Acknowledgement

The authors gratefully thank all the Consultants, Residents and Radiographers in Radiology department, UMTH for their assistance.

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