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The Magnetic Resonance Imaging Scan Findings in Adult Nigerians with Low Back Pain

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Abstract: In the adult population 50-90% suffer from low back pain at least once in their life time, the pain could be excruciating and disabling. This leads to extensive and expensive investigations. At present, magnetic resonance imaging is the gold standard for diagnosing the aetiology of low back pain; its use has been associated with 82.6% accuracy. This study aimed to investigate the pattern of MRI findings in patients with low back pain in a Sub-Saharan Tertiary Hospital. This is a retrospective study of the MRI images and medical record of 270 patients between February 2010 and May 2011. The mean age was 54.5±12.5 years, with one-third (32%) of patients in the age range of 50-59 years, male patients constituted (65.5%) and females (34.5%). The most common abnormality seen on MRI was disc desiccation (66%), others includes disc height reduction (62%), multiple disc herniation (59.7%), posterior protrusion (44.7%), posterior extrusion (24.7%), disc degeneration (37%) and disc bulge (3.5%). The morphological abnormalities involved multiple discs in 65.5% of patients. Conclusion- We observed that disc desiccation is not uncommon in our environment, however; disc bulge was a rare finding. The morphological abnormalities increased with age.

Key words: MRI Pattern · Low Back Pain

INTRODUCTION

Magnetic Resonance Imaging (MRI) Scan was introduced into clinical practice in the 1980's and has since remained the gold standard for diagnosis of low back pain and spinal disorders [1]. Though plain radiograph is readily available, affordable, quick, portable and reliable, there is difficulty in interpreting the films and a high rate of false-positive findings has been reported [2]. In contrast, MRI facility is expensive, not portable and difficult to access, however; it provides high resolution, multiaxial, multiplanar images of tissue with no known biohazard effects. MRI is contraindicated in the presence of ferromagnetic implants, cardiac pacemakers, intracranial clips and may result in claustrophobia.

The most common abnormalities reported on X-rays include loss of disk-space height (61%) and facet degeneration (34%). However, on MRI, the most common abnormalities reported include disk bulges (60%), disk herniation (33%) and central spinal stenosis (20%) [3]. MRI and computed tomographic (CT) scanning have been found to demonstrate abnormalities in "normal" asymptomatic people [2,4,5]. Thus, positive findings in patients with back pain are frequently of questionable clinical significance. MRI scans revealed herniated discs in approximately 25% of asymptomatic persons less than 60 years of age and in 33% of those more than 60 years of age [5].

MRI is also useful in planning surgical management of patients with sciatica attributable to lumbar disc herniation [6], in determining vertebral end-plate changes and facet joint effusions when selecting patients for spinal fusion [6-8]. It is also useful in detecting occult compression of the spinal cord or cauda equina in patients with skeletal metastases and back pain. It has also been used in the follow up management of posterior ligament rupture of the lumbar spine [9]. Hence, MRI is the emerging radiological diagnostic tool in the management of low back pain. This study was designed to determine retrospectively the patterns of MRI findings

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in patients with low back pain and develop a guideline for the management of low back pain with the hope of setting up a multidisciplinary pain clinic.

MATERIALS AND METHODS

This is a retrospective study of the MRI images of 270 patients with low back pain who presented at the Radiodiagnosis Department of Lagos University Teaching Hospital. The sample size calculation was based on a predetermined formula of proportion using a previous study with MRI pattern suggestive of spinal stenosis in 20% of patients with low back pain [10]. The Data collection included patients' demographic data and MRI findings.

Technique of Scanning the Lumbosacral Spine: All patients were positioned supine on the scanner table such that the median sagittal plane was equidistant to the table. A radiofrequency surface coil was placed over the patient to cover the lumbar spine (area between the costophrenic angle and the iliac crest). Laser beam was aligned on patients at the centre point (between L1 and L3). The table was then moved under the magnet until the patient was at the isocentre of the magnet. All dorsolumbar MRI scans were obtained using the Siemens Magnetom Concerto (MR 2004A), an open magnet of 0.2 Tesla strength.

The Studies Consisted of Five Spin-Echo Sequences:

- Coronal, sagittal and axial localizers with a repetition time and echo time (TR/TE) of 25/10 msec; field of view (FOV) of 40cm, matrix 128X256.
- Sagittal view with a TR/TE of 500/19 msec, FOV of 31cm, matrix 358X512.
- Axial view with a TR/TE of 600-1100/25 msec, FOV of 21cm, matrix 288X512.
- Sagittal view with a TR/TE of 5000-6000/103 msec, FOV of 32cm, matrix 338X512.
- Axial view with a TR/TE of 5000-6000/103 msec, FOV of 26-28cm, matrix 338X512.

A slice thickness of 4mm with 1mm gap was used for all sequences.

The sagittal view covered the entire width of the spine from foramen to foramen. Axial views were obtained parallel to the plane of the disc space and also covered as much of the adjacent vertebral body as possible.

Patterns of MRI Images [10-12]: MR images signal intensity of the intervertebral disc was assessed using Milette *et al*. criteria [13].

End-plate changes were assessed with Modic classification.

Normal Standard for Each Patient: The brightest signal intensity observed on T2W1 in the central four-fifths of D11-D12, D12-L1 and L1-L2 disc.

High-Intensity Zone (HIZ): High intensity signal located in the substance of the posterior annulus fibrosus, clearly dissociated from the signal of the nucleus pulposus.

Disc Bulge: Diffuse disc extension beyond the adjacent vertebral body margins.

Disc Protrusion: Displacement of the nucleus pulposus through some of the fibres of annulus fibrosus, while remaining confined by the intact outermost fibres. Disc *Extrusion*- true herniated disc that had extended through all layers of the annulus.

Sequestrated Disc: Fragment that was no longer in continuity with the parent disc material [14, 15].

Foraminal Narrowing: Measured at the foraminal segment of the radicular canal [16].

Normal Measurement: Was taken as ≥4 mm. Ligamentum flavum - measured at the widest diameter on axial images.

Hypertrophy: Considered when it was ≥5mm

Anteroposterior Diameter of the Spinal Canal: Measured from the posterior margin of the intervertebral disc to the spinolaminar junction.

Stenosed Spinal Canal: <11.5 mm [13].

Statistical Analysis: Data was collected by the researchers or research assistance. Categorical data was presented as frequency and numerical data as means ±standard deviation.

RESULTS

The mean age of the study population was 54.5 ±12.5 (31-70) years, 87% (235) were less than 60 years and 13%

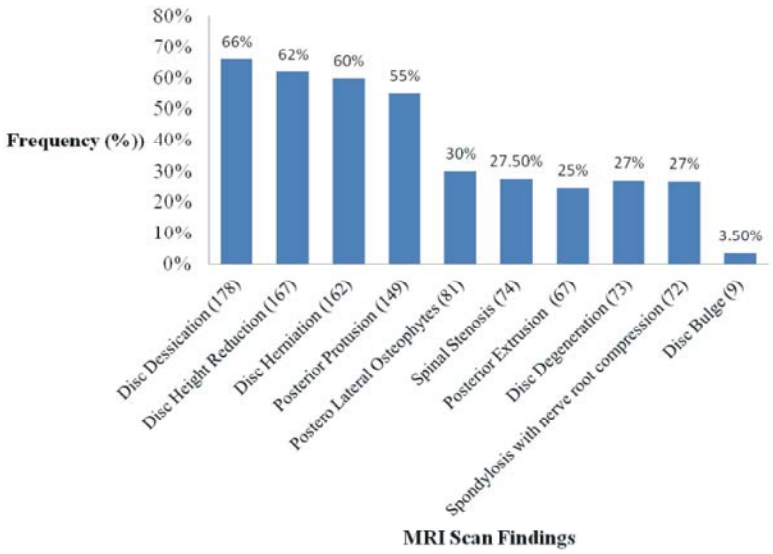

Fig. 1: The finding on MRI in patients with low back pain

(35) older than 60 years. In patients less than 60 years, one third (32%) were in the age group 50-59 years and they had the highest incidence of low back pain. Males constituted (65.5%) and females (34.5%).

Patterns of MRI Findings: The MRI scan of patients with low back pain is shown in Figure 1. The most common finding was disc desiccation in 178 (66%), this was followed by disc height reduction 167(62%) and thereafter disc herniation 162(59.7%), posterior protrusion 149(55%), posterior extrusion 68(25%), postero-lateral osteophytes 81(30%), spinal stenosis 74(27.5%). The least observed abnormality was disc bulge in 9 (3.5%). The disc abnormality was multiple and involved more than one disc in some patients. The prevalence of disc height reduction, disc degeneration, protrusion and extrusion was highest at L4-L5 and L5, while that of disc desiccation and herniation was at L1-L5 and L4-L5. The prevalence of disc desiccation, degeneration and spinal stenosis according to the age of the patients and the location of abnormalities in the intervertebral disc space are presented in Tables 1-3.

This study has demonstrated that disc desiccation was the commonest morphological abnormality on MRI of patients with symptomatic low back pain with an incidence of 66%. Abnormalities were seen on a single disc L4 in 0.5% and multiple discs in 65.5% of the patients, which included all discs (L1-L5) in 32%, L4-L5 (11%), L3-L5 (8.5%), L2-L5 (6.5%), L5 (3.0%), L3-L4 (2%), L2-L4 (1.5%), L1-L3 (0.5%), L2-L3 (0.5%). The prevalence of disc desiccation increased significantly with age ($p = 0.03$);

Table 1: The number of patients with disc desiccation

	Location of disc desiccation					
	L1-L2	L3-L4	L2-L5	L3-L5	L1-L5	At least one level
Age (years)	No of Subjects					No of Subjects
30-39 (n =21)	0	0	1	2	11	7
40-49 (n =43)	1	1	3	3	23	12
50-59 (n =86)	1	2	11	14	37	21
>60 (n = 28)	2	2	3	4	15	2
Total (n = 178)	4	5	18	23	86	42

Table 2: The number of patients with disc degeneration

	Location of disc degeneration				
	L2-L4	L3-L4	L3-L5	L4-L5	At least one level
Age (years)	No of Subjects				No of Subjects
30-39 (n =5)	0	0	1	3	1
40-49 (n =8)	0	1	1	4	2
50-59 (n =38)	1	1	13	21	2
>60 (n = 22)	2	2	5	10	3
Total (n = 73)	3	4	20	38	8

Table 3: The number of patients with spinal stenosis

	Location of disc degeneration			
	Mild	Moderate		At least one level
	L1-L3	L2-L3	L2-L5	Severe
Age (years)	No of Subjects			No of Subjects
30-39 (n =10)	4	2	2	2
40-49 (n =34)	4	8	8	14
50-59 (n =48)	9	9	9	21
>60 (n = 20)	8	4	4	4
Total (n = 112)	25	23	23	41

in patients less than 60 years 150 (63.87%) and in older than 60 years 28 (80%). There was disc height reduction in (62%); abnormalities involved multiple discs in 53.5% and single disc (L5) in 8.5%. Disc height reduction was highest in L4-L5 (27%), this was followed by L3-L4 (8.5%), L3-L5 (8.5%), L1-L5 (2%), L2-L3 (2.5%), L2-L4 (1.5%) and L2-L5 (1.5%).

The prevalence for disc degeneration was 37.5%. it involved a single disc (L5) in 2.5% and multiple discs in 34.5% which included L4-L5 (14%), L3-L5 (7.5%), L3-L4 (1.5%), L2-L4 (1%) and L2-L5 (0.5%). The degeneration of the disc also increased with age, in patients less than 60 years 51 (21.7%) and in patients older than 60 years 22 (62.86%). There was disc herniation in 59.7% involving multiple discs, L1-L5 disc (32%), L2-L4 (8.5%), L4-L5 (2.2%), L3-L5 (7%) and L3-L4 (2%). In patients with posterior protrusion, a single disc L1 was affected in 1% and multiple disc in 54%, this was highest with L4-L5 (21.5%), L3-L5 (8%), L5 (8%), L1-L4 (1.5%), L2-L4 (1.5%), L2-L5 (1.5%) and L3-L4 (7%). Similar posterior extrusion involved a single disc in 3% (L5 (2%) and L4 1%)), multiple disc in 22% which incluL4-L5 (12%), L2-L4 (1%), L3-L4 (2%) and L3-L5 (2%), Disc bulge was the least reported pathology in 3.5%, it involved L5 (2%) and L4-L5 (1.5%).

Other findings on MRI image included postero lateral osteophytes, reported in 30% with single disc involvement in 6.5% (L5-5% and L1-1.5%) and multiple disc involvement in 23.5% which included L4-L5 (14%), L1-L4 (2.0%), L3-L4 2.0%, L3- L5 (4%) and L2-L5 1.5%. Table 3 shows spinal stenosis in 27.5%, involving multiple discs, the stenosis varied from mild to severe. There was mild stenosis (9.5%) in L1-L3, moderate stenosis in L2-L3 (8.5%) and L2-L5 (4.5%), severe stenosis in L4-L5 (2%), L3-L5 (2%) and L3-L4 (1%). There was increased stenosis with increased age, in patients less than 60 years 90 (38.29%) and in those older than 60 years 20 (57.14%).

DISCUSSION

The study has demonstrated that the mean age for presentation with low back pain was 54.5±12.5 years and disc abnormality is not an uncommon finding on MRI image with a prevalence of 66% (178). The prevalence however was observed to be higher than values of 33% (22) reported in a group of asymptomatic individuals by Boden *et al*. [15]. Our study population had earlier presented with low back pain. This observation confirms previous reports of an association between disc abnormalities and low back pain [16-18]. This was further emphasized by Jensen *et al.* [18] when they compared individuals without a history of low back pain and those with history of low back pain. The authors observed disc protrusion in 27% (26) versus 54% (15) and disc extrusion in 1% (1) versus 26% (7) of MRI patterns. Similarly, autopsy findings in patients with at least 1 month history of disabling back pain were shown to have more pathology, which included symmetric disc degeneration, annular ruptures, endplate defects, osteophytes and facet joint degeneration compared to autopsy findings in subjects that were asymptomatic. Endean *et al.* [19] in a systematic review demonstrated that disc protrusion was associated with low back pain, followed by disc degeneration, annular tear and nerve root displacement or compression.

We have also demonstrated that disc abnormalities increased with age; in patients less than 60 years and older than 60, disc desiccation was 63.83% (150) versus 80% (28), disc degeneration 21.70% (51) versus disc degeneration- 62.86% (22) and spinal stenosis 90 (38.29) versus spinal stenosis 57.14% (20). This was similar to observations made by Boden *et al*. [15]. They reported disc herniation in 20% (11) versus 36% (5), disc stenosis in 1.89% (1) versus 21% (3) and disc degeneration or disc bulging in 0% (0) versus 7.14% (1). There has been documented report that prevalence of disc protrusion was lower at younger ages [21]. The association between age and development of disc abnormalities was reported by other scholars [18, 22].

This study has demonstrated that disc desiccation 178 (66%) occurred most commonly in MRI images of Nigerians with low back pain. This was followed by disc height reduction (62%) and disc herniation (59.7%). In contrast, other researchers reported disc herniation and disc bulge in asymptomatic individuals [16, 18], while disc degeneration in patient with low back pain [20].

Yong *et al.* [20] demonstrated in 56 patients with low back pain disc degeneration 52 (91.2%) occurred commonly in MRI images of Japanese. This was followed by intervertebral disc herniation in 36 (63.2%) which included disc protrusion in 18 (50%), disc extrusion in 7 (19.4%), a combination protrusion and extrusion in 10 (27.8%) and protrusion and sequestration 1 (2.8%). Spinal stenosis was observed in 34 (59.6%) and foramina narrowing in 17 (29.8%). This may be due to age and racial difference, our study involved patients with a mean age of 54.5±12.5 (31-70) years while their patients had a mean age of 42 (18-80) years. They included older individuals of

80 years. Genetic factors such as vitamin D receptor (VDR) and genes which code for molecules that contribute to or affect the integrity/function of the extra-cellular matrix have been implicated in degenerative disc disorders.

We studied a group of Nigerian patients (black Africans), while they studied Chinese patients (Asians), these group of individuals are made up of different genetic code. Further studies will be required in future on the effect of race on MRI findings of individuals with low back pain.

This study has demonstrated that the prevalence of disc height reduction, disc degeneration, protrusion and extrusion was highest at L4-L5 and L5, while that of disc desiccation and herniation was at L1-L5 and L4-L5. This is consistent with findings by other researchers [21, 22]. Rehman *et al.* [21] observed that the prevalence of disc prolapse was highest at L4-L5 in 48 (96%) and at L5-S1 in 2 (4%) of cases. In another study the prevalence of disc degeneration was highest at L4-L5 (20%) and L5/S1 (20%) when compared to other disc levels. We have demonstrated that disc abnormalities such as reduction in disc height, disc protrusion and disc degeneration are associated with low back pain. Therefore the role of MRI in providing valuable information regarding the underlying aetiology of low back pain cannot be underestimated.

CONCLUSION

This study has demonstrated a high prevalence of disc abnormalities in the lumbar spine on MRI scan of patients with low back pain. Thirty-four percent of those examined had a normal disc at all levels. About 55.4% had disc desiccation in at least one intervertebral disc.

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