

*Original Research Article*

# Evaluating Magnetic Resonance Imaging Findings in Cervical Spine of Patients with Neck Pain in Port-Harcourt, South-South Nigeria

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## Abstract

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Neck pain (cervicalgia) is one of the potentially disabling and expensive musculoskeletal disorders that is becoming increasingly common worldwide with enormous impact on individuals, families, communities, health care and jobs. The purpose of this study was to establish the pattern of Magnetic Resonance Imaging (MRI) findings in patients presenting with neck pain in Port-Harcourt south-south Nigeria and relating these findings with age and sex. This study was carried out in the radiology departments of University of Port-Harcourt Teaching Hospital and Transview Diagnostics Center Port-Harcourt over a 12month period. It is a cohort study of 130 patients' imaging findings after undergoing MRI for neck pain. Both normal findings as well as abnormal findings seen were documented on a datasheet. Statistical analysis was performed using Statistical Package for Social Sciences version 20.0. Pearson Chi-square, Fishers Exact or student's T tests were used as appropriate to compare age and sex with MRI findings. A p value of 0.05 was considered significant. Participants were from 19-76 years of age with mean age of  $55.4 \pm 11.3$  years. Males were 75.4% while females were 24.6%. Among the study population 88.5% had abnormal findings while 11.5% were normal. Spondylosis (67.7%) was the commonest MRI finding in the studied population and associated significantly with sex ( $p=0.0001$ ). Second most common finding was intervertebral disc degeneration (31.5%). Spondylosis is the most common cause of neck pain in our environment seen mainly among males while the second most common cause was intervertebral disc degeneration.

**Keywords:** Cervical spine, Magnetic resonance imaging, Neck pain

## INTRODUCTION

Neck pain (NP) is a musculoskeletal pain which is becoming more prevalent and may affect the physical, social, and psychological aspects of an individual, leading to a heavy impact on the family, job and society (Genebra et al., 2017). Its frequency is on the increase worldwide (Hoy et al., 2010; Hoy et al., 2010). The origin is multifactorial with degenerative changes, poor posture,

occupational activities, muscle sprain, sports and psychological factors as causes (Binder, 2007).

The cervical spine is the most mobile of the vertebral column and this makes it highly susceptible to degenerative changes (Danielle et al., 2014).

In studies done in Nigeria, age (Olarinoye-Akorede et al., 2015; Iheukwumere and Okoye, 2014) and occupat-

ion were found to be risk factors for degenerative disease (spondylosis), a major cause of neck pain. In Nigeria, (Anyanniyi et al. (2010). In their study, Neck pain occurrence and characteristic in Nigerian University Undergraduates, revealed a lifetime prevalence of 34.9% among Nigerian undergraduates.

Ogwumike and colleagues (Ogwumike et al., 2015) in their study, prevalence of neck pain in a rural community in north-western Nigeria showed a high male to female preponderance and Akinpelu et al. (2009). In their study, Prevalence and pattern of musculoskeletal pain in a rural community in south-western Nigeria also showed male preponderance.

Magnetic Resonance Imaging (MRI) acquires images in multiple planes, is best for studying intrinsic cord diseases as well as evaluation of soft tissues and discs. In addition, MRI requires no ionizing radiation, can excellently depict bone marrow signal, intervertebral discs, facet arthropathy and spinal stenosis (Joel et al., 2013). MRI is however not without limitations (David, 2007). It is expensive and not readily available, so benefit should always be weighed with cost. MRI is not very sensitive in detecting small calcifications and patients could be claustrophobic.

However, it would have been very difficult without MRI to diagnose and detect many causes of neck pain such as disc herniation, prolapse or exit nerve root compression to mention but a few, that need high soft tissue differentiation to identify (Mustapha et al., 2014). This study will help in determining the spectrum of MRI findings in patients that present in UPTH with neck pain and will relate these findings with demographic factors-age, sex and occupation of these patients.

## METHODOLOGY

A prospective cohort study of 130 patients' imaging findings after undergoing MRI for neck pain during a 12 months period in Radiology departments of University of Port-Harcourt Teaching Hospital (UPTH) and Transview Diagnostics Centre Port-Harcourt. Ethical approval was obtained from the ethical committee of the hospital and informed consent was taken from all subjects. MRI images of patients less than 18 years of age and those that did not give consent were excluded from the study.

Convenient non-random sampling method was used. The research participants whose MRI images were used for this study were recruited from general outpatients, orthopedic and surgery departments and were referred to the Departments of Radiology, University of Port-Harcourt Teaching Hospital (UPTH) and Transview Diagnostics also in Port-Harcourt with complaints of neck pain for MRI studies.

Demographic data were obtained using the patient's data sheet. Patients' images were acquired using 0.2 Tesla open magnet Siemens Magnetom Concerto 1994

model and 0.36Tesla Mindray open bore 2010 model (from UPTH and Transview Diagnostics respectively). Basic imaging was done using conventional spin echo pulse sequences to acquire images in axial, sagittal and coronal planes.

MRI findings included spondylosis, intervertebral disc degeneration, disc herniation (Figure 1), disc bulge, cord compression, spondylolisthesis (Figure 2), bone marrow change and nerve root compression.

## Analysis of Data

Data was entered into a computer spreadsheet after recording in the patients' data sheet. Statistical analysis was performed using Statistical Package for Social Sciences version 20.0.

Pearson Chi-square, Fishers Exact and student's tests were used as appropriate to compare age and sex with MRI findings. A p value of <0.05 was considered significant. Results were presented as mean  $\pm$  standard deviation, percentages, tables, and charts as appropriate.

## RESULTS

In this 12 months study period 88.5% of the study population had abnormal Magnetic Resonance Imaging findings while 11.5% of the population had normal imaging findings. Within the study population, abnormalities were seen to be increasing with age from 90.7% to 97.9% in the 5<sup>th</sup> and 6<sup>th</sup> decades which was statistically significant. ( $p=0.0001$ ) (Table 2). More abnormalities were seen in the male population (94.9% vs. 68.6% for male and female respectively) and this was also statistically significant ( $p=0.0001$ ) (Table 2). The most frequent finding observed in this study was spondylosis accounting for 67.7% of the abnormal findings (Figure 3). Males have significantly higher prevalence of spondylosis than the females, 76.5% vs. 40.6% respectively which was statistically significant ( $p=0.0001$ ). Populations within the age bracket of 61-70 (72.9%) were more affected.

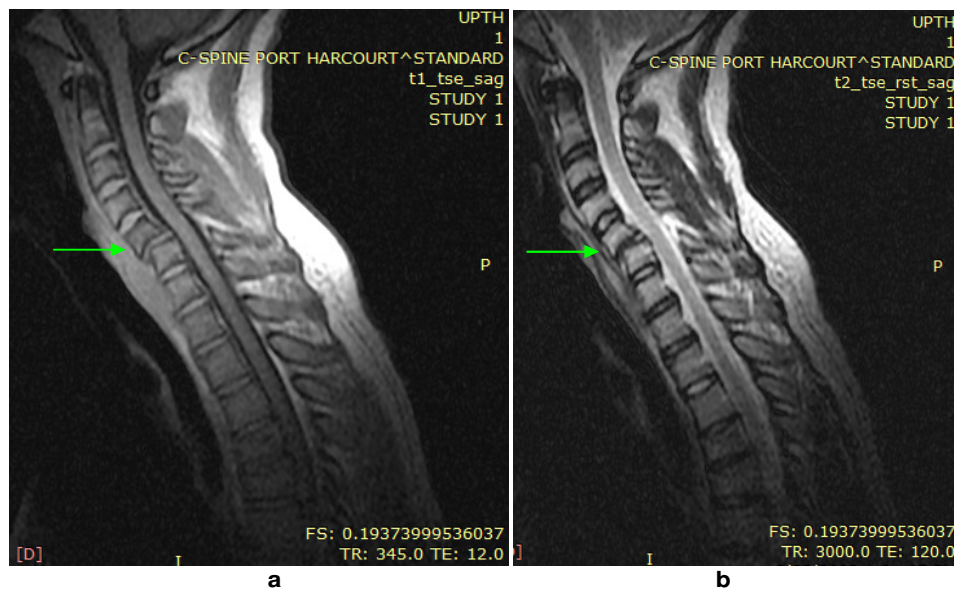
This was followed by intervertebral disc degeneration which was seen in 31.5 % of the study population with female to male predominance, 37.5% vs. 29.6% of the individual population respectively though this was not statistically significant. ( $p=0.403$ ). More participants within the age of 61-70years (43.8%) were affected.

Disc herniation was seen in 22.3% of the sample population. This finding was more frequent in males compared to females 21(21.4%) vs. 8(25.0%) respectively which was not statistically significant. ( $p=0.674$ ). Disc herniation was seen more in the age category of 51-60years (30.2%).

Disc bulge was seen in 10.8% of the study population with highest frequency in males and at the 6<sup>th</sup> and 7<sup>th</sup> decades of life.



**Figure 1.** T1W sagittal (a) T2 W sagittal(b) and axial(c) images of a 62-year-old man with multiple disc protrusions (arrows).



**Figure 2.** T1W (a) and T2W (b) Sagittal images of a 54-year-old man with anterior slip of C5 over C6 (arrow).

**Table 1.** Demographic characteristics of the study population. N=130

Variables	N	%
<b>Age (years)</b>		
≤ 20	1	0.8
21-30	4	3.1
31-40	13	10.0
41-50	19	14.6
51-60	43	33.1
61-70	48	36.9
71-80	2	1.5
Mean age ± Standard deviation: 55.4 ± 11.3; Age range: 19 -76 years		
<b>Sex</b>		
Male	98	75.4
Female	32	24.6
Male : Female ratio = 3.1:1		

Table 2. N=130

	MRI Findings		Total n (%)
	Abnormal n (%)	Normal n (%)	
<b>Age categories</b>			
≤ 20	0 (0.0)	1 (100.0)	1 (100.0)
21-30	2 (50.0)	2 (50.0)	4 (100.0)
31-40	7 (53.8)	6 (46.2)	13 (100.0)
41-50	18 (94.7)	1 (5.3)	19 (100.0)
51-60	39 (90.7)	4 (9.3)	43 (100.0)
61-70	47 (97.9)	1 (2.1)	48 (100.0)
71-80	2 (100.0)	0 (0.0)	2 (100.0)
<i>Fishers Exact: 25.303; p value: 0.0001*</i>			
<b>Sex</b>			
Male	93 (94.9)	5 (5.1)	98 (100)
Female	22 (68.6)	10 (31.2)	32 (100)
<i>Fishers Exact p value: 0.0001*</i>			

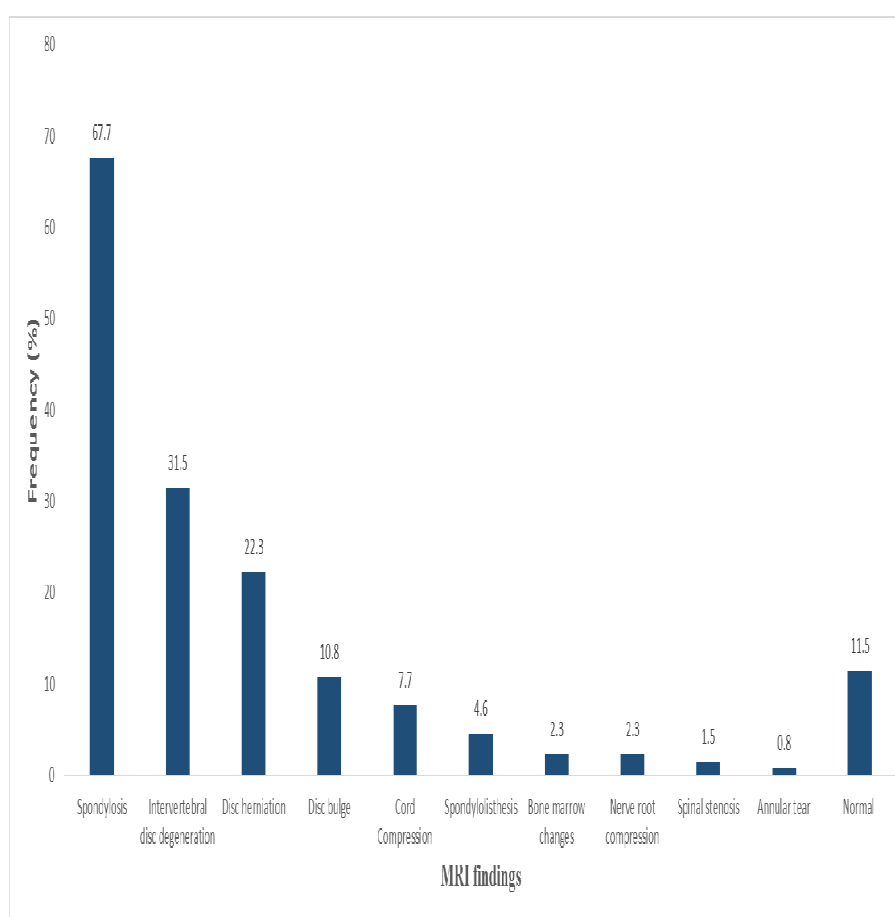


Figure 3. Bar chart showing distribution of the pattern MRI findings in neck pain.

Cord compression occurred in ten cases (7.7%) of the population. Spondylolisthesis was present in 4.6% of the cases. Three participants had vertebral bone marrow.

Nerve root compression occurred in 2.3% while spinal stenosis was present in two participants (1.5%). Annular tear which was indicated by high intensity zone was

observed in only one case (0.8%)

## DISCUSSION

The largest age group in this study population was within

51-60 years of age and the mean age of participants was  $55.4 \pm 11.3$  years. This finding is comparable with that of a previous study in which neck pain occurred commonly in the middle age group (45-65 years) (Binder, 2007). In the current study there is association between neck pain and increasing age which could be likely due to the normal aging process. Therefore, age is one of the predictors of neck pain (Sheila et al., 2008).

Neck pain was significantly common among males which accounted for 75.4% of this study population while females are 24.6% with male to female ratio of 3.1:1. This concurred with a study done in a rural community in Northwestern Nigeria by Ogwumike et al. (2015) where 76.2% of the study populations with neck pain were males. Akinpelu et al. (2009) their study also showed male preponderance though a study done by Hoy et al. (2010) on the global burden of neck pain in Sub-Sahara Africa showed female preponderance (60% vs. 41% in female and male respectively). Male preponderance in this study could be because males engage in more vigorous activities and are involved in more strenuous jobs than their female counterparts.

Spondylosis was observed as hypertrophy of the facet joints, anterior and posterior osteophytes evidenced by signal void on T1 Weighting. Osteophyte development is an attempt by the vertebral body to increase the weight bearing surface of the endplates (physiological mechanism of stabilization) Reyes-Llerena et al. (2000). The most common finding in this study was spondylosis which accounted for 67.7% of the study population and seen more in 5<sup>th</sup>-7<sup>th</sup> decades of life with increasing age. These agree with studies done by Olarinoye-Akorede et al. (2015) and (Al-Shatoury and Galhom, 2014). Spondylosis occurred more in males similar to previous studies (Olarinoye-Akorede et al., 2015; Iheukwumere and Okoye, 2014). This study also noted that 50% of the population within the age of 21-30 years had spondylosis in contrast to what the literature shows over the years. This could be attributable to change in lifestyle and poor posture associated with current increased use of computers, tablets and smart phones. Most cases are triggered by repetitive injury and stiffness because of lack of adequate movement and rest. More so spondylotic processes can start as early as in teenage age and progress as age advances (Olarinoye-Akorede et al., 2015).

Degenerative disc disease is a result of the natural aging process though it may also be caused by lifestyle, physical activity and genetics. Over time dehydration or desiccation of the disc occurs with chemical changes in the collagen and protein content resulting in stiffness and rigidity of the discs. There is increased vulnerability of the discs to tearing which leads to flattening and reduction in disc heights (Funman et al., 2015). Intervertebral disc degeneration was the second most common finding observed in this study affecting 31.5 % of the population. It affects more females than males and frequency

increases with increasing age. Multilevel involvement was noted in this study and these findings correspond with the study done by Matsumoto et al. (1988). Intervertebral disc signal loss on MRI depends more on age-related biochemical changes rather than structural changes and this is probably the reason why this finding increases with age. This age-related change may not have pathological consequences especially in the elderly.

Disc herniation occurs when there is localized displacement of nuclear material, cartilage or fragmented annular tissue beyond the intervertebral disc space. Protrusion, extrusion and sequestration are all forms of disc herniation (Ramachandran et al., 2013). Protrusion occurs when there is focal extension of the disc margin by herniation of nuclear material through a defect in the annulus while extrusion occurs when there is no continuity between the disc material beyond the disc space and that within the disc space, then when the displaced disc material loose completely any continuity with the parent disc, sequestration occurs (Funman et al., 2015). Disc herniation occurred in 22.3% of the study population. Equal sex distribution was seen in a study done by Funman et al. (2015). However the index study showed female predominance. In the current study disc herniation occurred mostly at 51-60 years of age in contrast to <40 years of age seen by (Funman et al., 2015).

Disc bulge occurs when there is generalized symmetrical or asymmetrical circumferential extension of the disc margin beyond the margins of the adjacent vertebral end plates (Funman et al., 2015). Disc bulge was seen in 10.8% of this study population with 15.8% of them within 40-50 years of age. Males have higher prevalence compared to females though not statistically significant. There is also no significant association between disc bulge and age.

Cord compression is seen as an abnormal high intensity area of the cord on T2 Weighting. In this study, 10 participants (7.7%) had cord compression. This agreed with the study done by (Olarinoye-Akorede et al., 2015). Females were seen to have a higher prevalence than males though age and sex had no significant association with cord compression.

When one vertebra slips forward or backward over the one below it, spondylolisthesis occurs. This could be secondary to trauma or degenerative change which is rarer than the former according to Christian et al in their study (Christian et al., 2004). Six (4.6%) individuals had spondylolisthesis. In the index study, affected individuals were between the ages of 41 and 70 years and all individuals with spondylolisthesis were males though not statistically significant. Males are mainly affected probably because they are more active than their female counterparts and as such are more exposed to repeated micro trauma which may predispose one to this condition. Age had no significant association with spondylolisthesis.

Signal intensity changes of vertebral end plates and

subchondral bone are often seen in MRI of individuals with degenerative disease. Magnetic Resonance Imaging is very sensitive in detecting bone marrow (Modic) changes of the end plates which are categorized into types 1 through 3. Type 1 represents neovascularization/edema, type 2 represents fatty change/necrosis of the endplate and type 3 is endplate sclerosis (Modic et al., 1988). The cause of Modic change is unknown but biomechanical and biochemical causes are suspected to be the underlying mechanisms. In this study only type 1 change (inflammation and oedema) was noted in 2.3% of the population. Mann et al. (2014) in their study linked Modic change with increasing age though on the contrary, noted type 2 changes were more prevalent. Finding of only type 1 change in this study may suggest that inflammatory changes in the disc may be involved in its initiation. Age had no significant association with bone marrow changes.

It is well established that Magnetic Resonance Imaging is more sensitive than any other imaging modality in detecting nerve root compression (ACR-ASNR-SCBT-MR Practice Parameter for the Performance of Magnetic Resonance Imaging of Adult Spine (2001). Nerve root compression may result from osteophyte, disc prolapse or ligamentum flavum hypertrophy (George, 2002). In this study however 2.3% of the population was affected, with 2/3<sup>rd</sup> of the population all males. Participants aged 51-60 years were commonly affected. Age and sex had no significant association with nerve root compression.

Magnetic Resonance Imaging is an important tool in assessment of spinal stenosis with accurate characterization and assessment of the morphology of spinal canal and intervertebral foramina (ACR-ASNR-SCBT-MR Practice Parameter for the Performance of Magnetic Resonance Imaging of Adult Spine (2001). Spinal canal stenosis was found in 1.5% of this study population but there was no clear association of this finding with age and sex. This is similar to the findings in a study done by Hsiang and Funman (2014).

Annular tear is seen on T2W Magnetic Resonance Imaging as a focus of a high intensity zone at the periphery of the disc. Annular tear suggests the presence of an internal derangement of the disc and is a source of pain. It occurs when the fibrous outer wall (annulus fibrosus) of an intervertebral disc is ruptured. This could be as a result of a traumatic injury following axial loading or occurring gradually as part of a natural aging process (Funman et al., 2015). In this study 0.8% of the population had an annular tear. This may occur as one gets older and the intervertebral discs that cushions the cervical vertebrae begin to lose their water content and become brittle with often resultant rupture of the outer wall. There is no distinct association of annular tear with age in the study population

## CONCLUSION

The commonest finding in individuals with neck pain in our environment is spondylosis accounting for 67.7% of the study population with male predominance. This is followed by intervertebral disc degeneration with higher prevalence in females accounting for 31.5% of the population. The prevalence of these findings was associated with increasing age.

There is significant association between abnormal MRI findings with age and sex and these abnormalities were common in males. Further studies by use of high field MRI machines for optimum image acquisition will be necessary in our environment.

## Conflict of Interest

The authors declare no conflict of interest or financial aid

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