

## Diagnostic Value of Plain Radiographs in Patients with Low Back Pain of Non-traumatic Origin at a National Teaching and Referral Hospital in Kenya.

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**Background:** Low back pain is a commonly recognized problem worldwide. Plain radiography is used in many of these patients as an initial investigative and evaluative tool. However, it was not known how truly useful this investigation was in making definitive diagnosis for non traumatic low back pain. The main objective of the study was to determine the value of plain radiographs in patients presenting with low back pain that is of non-traumatic origin.

**Methods:** A prospective study 102 consecutive patients with low back pain was conducted at the Kenyatta National Hospital (KNH) from 1<sup>st</sup> February 2013 to 30<sup>th</sup> May 2013. Data was collected using a structured questionnaire and analyzed. Plain radiograph films were reviewed by two qualified radiologists.

**Results:** The mean age of patients presenting with low back pain was 50.9 years, with a male to female ratio of 1:2.4. Majority of the patient had chronic low back pain. There was a high rate of positive radiological findings (98%). The most common findings included muscle spasm, osteoporosis, reduced lumbar lordosis, spondylosis, disc degenerative disease and osteophytes.

Assessment of inter-rater variability showed good level of agreement on presence of spondylolisthesis and vacuum phenomenon ( $k=0.71$ ), moderate agreement on reduced disc space, reduced lumbar lordosis, spondylosis ( $k=0.42-0.56$ ) and poor agreement on film quality, infections, tumor metastasis, osteophytes, prolapsed intervertebral disease (PID), osteoporosis, scoliosis, muscle spasm and sacroilitis ( $k=0.13-0.21$ )

**Conclusion:** Most of the patients presenting to KNH with low back pain have a chronic type and therefore have increased probability of having positive radiological findings. There was a poor ability to diagnose infectious causes, inflammatory conditions, transitional vertebrae and tumor metastasis. In such cases, more advanced imaging such as CT scan and MRI may be required.

### Introduction

Low back pain is a global and increasing problem<sup>1,2,3</sup>. It is the most prevalent musculoskeletal condition and most common cause of disability in developed nations<sup>4,5</sup>. Plain radiographs are utilized by many clinicians in the initial evaluation of patients presenting either as outpatients or inpatients with low back pain.

Several studies related to the utility of plain radiographs in low back pain have been done in other countries, particularly in the west, very few have been done in Africa, and none in the East African region<sup>6,7,8</sup>. It has also been noted that inter- and intra-observer variation among radiologists in interpretation of plain radiographs of the lumbosacral spine may actually mislead clinicians and reduce the usefulness of the investigation<sup>9,10</sup>.

The aim of this study was to determine the rate of positive radiological findings on plain x-rays as well as ascertain factors that determine utility of the plain radiographs in patients with non-traumatic low back pain.

## Patients and Methods

A prospective study, with convenient sampling of consecutive patients conducted at Kenyatta National Hospital. KNH is a metropolitan, tertiary, referral and teaching hospital with 2000 bed capacity. Patients above 18yrs of age presenting to Orthopaedic clinics and wards at Kenyatta National Hospital with non-traumatic low back pain who gave consent and had available lumbosacral radiographs were included in the study. Those with low back pain of traumatic origin were excluded. All eligible patients were enrolled into the study until the required sample size of 102 calculated using Fischer's formula was obtained.

The principle investigator with the help of a research assistant obtained information from orthopaedic clinics and wards on patients presenting with non-traumatic low back pain, having fulfilled the inclusion criteria and having been referred for plain lumbosacral radiographs. Lumbosacral radiographs taken were submitted for reporting by two independent qualified radiologists. The study was limited to use of only anteroposterior (AP) and lateral views. Analysis of the radiographs by two different qualified radiologists was aimed at quality control as well as assessing inter-rater variation. This was to ascertain whether there was significant variability in the reporting of the x-ray films by different radiologists.

Data was collected using a structured questionnaire. It was then entered and analyzed using Stata/1C program Version 11.0. A P-value of <0.05 was considered significant. The inter-rater strength of agreement was analyzed using kappa. Values <0.20 indicated poor strength of agreement, 0.21-0.40 indicated fair level of agreement, 0.41-0.60 indicated moderate agreement, 0.61-0.80 indicated good agreement, whereas values between 0.81-1.00 indicated very good agreement. Co-ordination between getting the radiograph from the patient and having it interpreted on time by the radiologists proved challenging but not an obstacle. In spite of the study duration being short, we believe the sample size is adequate to make fair conclusions.

Approval to conduct the study was sought from the Department of Orthopaedic Surgery, University of Nairobi as well as Kenyatta National Hospital, Ethics and Research Committee (KNH/UoN-ERC).

## Results

This study recruited a total of 102 cases. The ages of patients ranged from 19 to 88 years with a mean age of 50.9 years (SD  $\pm$  13.9). Most patients were aged between 40-49 years (26.5%) and 50-59 years (25.5%). The youngest (19-29 years) and oldest ( $\geq$  70 years) age groups accounted for 6.9% and 8.8% of the participants, respectively. The male to female ratio was 1:2.4. Six patients experienced low back pain for less than 12 weeks with 4 (3.92%) reporting pain for 6-12 weeks and 2 (1.96%) reporting pain lasting less than 6 weeks. Most (94.12%) patients presented with low back pain that had lasted for more than 3 months. The most common red flag on presentation was motor and or sensory weakness of the lower limbs in 65 (63.7%) patients. Others included weight loss more than 6 months (5.9%), urinary/ fecal incontinence or retention (3.9%) and fever (3.9%) among others. No patients reported immunosuppression or history of intravenous drug abuse.

The same x-ray films were submitted for reporting by the two independent radiologists, but in 9 cases, radiologist B intimated that more views (largely cone views) were required to arrive at a better diagnosis.

Overall, the two radiologists were in agreement that majority of the radiographs (91 out of the 102) were of good-to-excellent reportable quality, with only 4 radiographs being considered to be of poor quality by radiologist B (see table 8). Statistically, this translates to 89.2% agreement with a k-value of 0.12 (see table 9 below).

**Radiological finding**

On average, 98.04% of radiographs had positive radiological findings and only 1.96% were normal radiographs. According to the plain radiograph findings, muscle spasm was the commonest occurring finding according to radiologist A(69.6%), followed by osteoporosis and reduced lumbar lordosis (both at 58.8%), spondylosis (55.9%), disc degenerative disease (41.2%)[reduced disc space 32.4%, end-plate sclerosis 4.9%, vacuum phenomenon 3.9%], multilevel osteophytes (28.4%), spondylolisthesis and increased lumbar lordosis (both at 13.7%). The least occurring findings include osteomyelitis (0%), tuberculosis (0-5.8%), tumor metastasis (0.98%), prolapsed intervertebral disc (0.98%),discitis (1.96%), scoliosis (1.96%), ankylosing spondylitis (1.96%), transitional vertebrae (7.8%)[lumbarisation 2.9%, sacralisation 4.9%], sacroilitis (8.8%) and normal lumbar lordosis (12.75%).

There was a slight difference in order of occurrence of findings according to radiologist B. The commonest finding was spondylosis (51%), disc degenerative disease (45.1%)[reduced disc space 27.5%, endplate sclerosis 11.8%, vacuum phenomenon 5.8%], osteophytes 40.2%, reduced lumbar lordosis (36.3%), muscle spasm (26.5%), spondylolisthesis (18.6%), scoliosis (15.7%) and osteoporosis (13.7%). Infections, tumor metastasis and transitional vertebrae still were the least occurring findings according to radiologist B.

**Degenerative disc disease**

There is a higher degree of agreement among the two radiologists on diagnosis of vacuum phenomenon followed by reduced disc space and a very poor agreement on diagnosis of end-plate sclerosis as evidenced by kappa values.

The strongest inter-rater agreement among the two radiologists was on the diagnosis of vacuum phenomenon with a kappa value of 0.71 and a total agreement of 92%. There was only moderate degree of agreement on the presence of reduced disc space and a poor agreement on end-plate sclerosis. (Table 1).

**Spondylolisthesis, tumor metastasis, osteophytes and PID**

There was a strong degree of agreement on both the presence and absence of spondylolisthesis between the two radiologists, with a poor level of agreement on presence of tumor metastasis, osteophytosis and PID (Table 2).

**Table 1.** Inter-rater agreement on degenerative disc disease

Radiologic feature and $\kappa$ (Kappa) statistic	Radiologist		Agreement		Total
	A	B	Yes	No	
	n/ N (%)	n/ N (%)	N	N	%
Vacuum phenomenon $\kappa = 0.71$	4/102 (3.9%)	6/102 (5.8%)	1	93	92%
End-plate sclerosis $\kappa = 0.17$	5/102 (4.9%)	12/102 (11.8%)	2	87	87%
Reduced disc space $\kappa = 0.56$	33/102 (32.4%)	28/102 (27.5%)	21	62	81%

**Table 2.** Inter-rater agreement on spondylolisthesis, tumor metastasis, osteophytes and PID

Radiologic feature and $\kappa$ (Kappa) statistic	Radiologist		Agreement		
	A	B	Yes	No	Total
	n/ N (%)	n/ N (%)	N	N	%
Spondylolisthesis $\kappa = 0.71$	14/102 (13.7%)	19/102 (18.6%)	12	82	92%
Tumor metastasis $\kappa = NA$	1/102 (0.98%)	4/102(3.9%)	0	97	95%
Osteophytes $\kappa = 0.19$	29/102 (28.4%)	41/102 (40.2%)	16	48	63%
Prolapsed intervertebral disc $\kappa = NA$	1/102 (0.98%)	0/102(0%)	0	101	99%

**Table 3.** Inter-rater agreement on spondylosis, osteoporosis, muscle spasm, sacroilitis

Radiologic feature and $\kappa$ (Kappa) statistic	Radiologist		Agreement		
	A	B	Yes	No	Total
	n/ N (%)	n/ N (%)	N	N	%
Spondylosis $\kappa = 0.55$	57/102 (55.9%)	52/102 (51%)	43	36	77%
Osteoporosis $\kappa = 0.13$	60/102 (58.8%)	14/102 (13.7%)	12	40	51%
Muscle spasm $\kappa = 0.13$	69/ 102 (67.6%)	27/ 102 (26.5%)	22	28	49%
Sacroilitis $\kappa = 0.13$	9/102 (8.8%)	3/102 (2.9%)	1	91	90%

### Infections

There was no evidence of osteomyelitis in the reported films. Radiologist B made a diagnosis of Tuberculosis of the lumbar spine in 6 cases and only one case of discitis, while radiologist A diagnosed two cases of discitis and no cases of TB.

There was a 97% agreement among the two radiologists that there was no discitis and a 94% agreement that there was no tuberculosis of the lumbosacral spine, but very poor agreement on presence of either. There was poor agreement among the two radiologists on the presence of normal, reduced or increased lumbar lordosis as well as scoliosis. It was difficult to ascertain inter-rater agreement on presence of transitional vertebrae and ankylosing spondylitis though there was a 93% and 98% agreement on the absence of either, respectively.

A moderately strong inter-rater agreement exists on occurrence of spondylosis on the plain radiographs, but a very poor level of agreement on occurrence of osteoporosis, muscle spasm and sacroilitis. There was a high level of agreement (90%) on the absence of sacroilitis, but a poor agreement on its presence ( $\kappa=0.13$ ) (Table 3).

### Discussion

From the study, the most common findings include muscle spasm (67.6%), osteoporosis (58.8%), reduced lumbar lordosis(58.8%), spondylosis(51-56%), disc degenerative disease(41.2-45.1%) and osteophytes(40.2%).In contrast, the study by Mulimba<sup>8</sup> found loss of lumbar lordosis in 15%, scoliosis in 8%, reduced disc space in 1.8% and osteophytes in 27%. In

Uganda, Galukande<sup>9</sup> found that 19.1% had PID with resultant nerve root compression, 17.2% had a mixture of findings (TB, Brucellosis and degenerative changes) and 1.5% had indeterminate cause.

This study demonstrates that plain radiography was poor in diagnosing infectious causes (Osteomyelitis (0%), discitis (0.98-1.96%), tuberculosis (0-5.8%)), tumor metastasis (0.98-3.9%), transitional vertebrae (1.96-4.9%) and inflammatory conditions such as sacroilitis and ankylosing spondylitis. These findings correlate poorly with the study done by Igbinedion and Akhigbe<sup>4</sup>, but are similar to the one done by Ansary et al in Bangladesh<sup>5</sup>. This could be explained by different patient characteristics and dynamics as well as the fact that majority of the patients presented with more than 3 months of low back symptoms.

There was a high rate of positive radiological findings (98.04% for both radiologists), with only 1.96% normal findings. The Nigeria study<sup>4</sup>, found only 4.5% normal findings. As alluded to earlier, this finding could be related to the fact that majority of the patients seen presented with chronic symptoms, thereby increasing chances of positive radiological findings.

On assessment of inter-rater agreement among the two radiologists who independently reported the films, the study revealed that there was good inter-rater agreement on presence of spondylolisthesis and vacuum phenomenon ( $k=0.71$ ). There was only moderate degree of agreement on presence of reduced disc space ( $k=0.56$ ), reduced lumbar lordosis ( $k=0.42$ ) and spondylosis ( $k=0.55$ ). However, there was only fair-to-poor agreement on film quality ( $k=0.12$ ), presence of infections, tumor metastasis ( $k=NA$ ), osteophytes ( $k=0.19$ ), prolapsed intervertebral disc, endplate sclerosis ( $k=0.17$ ), transitional vertebrae, scoliosis ( $k=0.21$ ), osteoporosis, muscle spasm and sacroilitis ( $k=0.13$ ).

Espeland and his colleagues<sup>7</sup> also found the best inter-rater agreement on spondylolisthesis and osteophytes as was in our study.

It is therefore evident that some factors that determine the diagnostic yield of plain radiographs in respect to low back pain include:

1. Duration of symptom presentation: The more chronic the duration, the higher the likelihood of positive radiological findings.
2. Inter-rater variability
3. Quality of the film
4. Radiograph views: from this study, the utilization of only AP and lateral views seemed adequate in the diagnosis in majority of cases.
5. The underlying pathology: whereas plain radiography seemed useful in cases of mechanical low back pain, its usefulness may be limited in infectious and inflammatory conditions, tumor metastasis and nerve root compressions.

## Conclusion

Most of the patients seen at KNH presented with chronic low back pain and this increased the probability of having positive radiological findings on plain radiographs. However, the usefulness of this investigative tool is limited by factors such as inter-rater variability in terms of film interpretation, film quality, underlying pathology and views taken, among others.

As such, plain radiographs should not be over-relied on by clinicians despite the fact that they still remain a very important screening tool for patients presenting with low back pain. More advanced imaging such a CT scan and MRI may be required.

## Recommendations

1. Despite the fact that this study revealed high rates of positive radiological findings, clinicians ought to be encouraged to adhere to the already established international protocols on when to refer patients for radiography.
2. In cases of suspected infectious and inflammatory conditions of the lumbosacral spine, clinicians should be encouraged to undertake other investigative modalities since plain radiographs may have a limited role in their diagnosis.

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