

# Role of Percutaneous Image Guided Biopsy in Spinal Lesions: Adequacy and Correlation with MRI Findings

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## ABSTRACT

**Introduction:** Although, MRI has increased our understanding of spinal pathologies, accurate diagnosis of spinal lesions need biopsy, so that early treatment can be initiated.

**Aim:** To evaluate the accuracy of biopsy, safety and yield of percutaneously done image guided spinal biopsy using a large bore needle and correlate between MRI findings and biopsy as well as the importance of various MRI findings in establishing the diagnosis.

**Materials and Methods:** All spinal lesions after clinical and MRI evaluation were subjected to Jamshidi Needle biopsy using 11 gauge needles. Biopsy material was sent for culture/sensitivity, AFB smear and histopathological examination. The outcome assessment included percentage of patients in whom diagnosis was changed after biopsy, yield in biopsy and complications of biopsy. MRI findings, biopsy findings and final diagnosis were correlated to know the sensitivity and specificity of MRI and biopsy diagnosis. Logistic regression analysis was used to study the importance of each of MRI findings in making a diagnosis.

**Results:** Forty five patients with spinal lesions underwent biopsy using an 11 gauge Jamshidi needle. Initial biopsy was inconclusive in 4 patients giving a positive yield in about 91.2%

of cases and a repeat biopsy ensured conclusive report in all cases. Following biopsy there was a change in diagnosis in 8% cases. MRI showed sensitivity of 85.71% and specificity of 93.54% for the diagnosis of malignancy and sensitivity of 85.71% and specificity of 86.48% for the diagnosis of tuberculosis. In contrast, initial biopsy had sensitivity of 92.85% and specificity of 100% for the diagnosis of malignancy and sensitivity of 71.42% and specificity of 100% for the diagnosis of infection. Logistic regression analysis showed good correlation between malignancy and posterior bulge in the vertebral body in the absence of a fracture ( $p = 0.007$ ), involvement of pedicles and posterior elements ( $p = 0.001$ ) and soft tissue extension ( $p = 0.002$ ); there was good correlation between infection and epidural abscess ( $p < 0.001$ ) as well as paradiscal involvement ( $p < 0.001$ ).

**Conclusion:** Image guided biopsy done with good technique helps in accuracy of diagnosis thus ensuring the correct treatment at the earliest and has minimal complications. This study also shows that presence of epidural abscess and paradiscal involvement in MRI are highly suggestive of infection, while pedicle involvement and posterior bulge of vertebral body before the onset of pathological fracture are suggestive of malignancy, but all spinal lesions should be biopsied to confirm the diagnosis.

**Keywords:** Image guided biopsy, Percutaneous biopsy, Spine pathology

## INTRODUCTION

Diagnosis of spinal pathologies was a major challenge till the advent of MRI, which has increased our understanding of spinal pathologies [1]. Pathological lesions like infection and tumours can be diagnosed in the early stages so that effective treatment can be given following MRI examination. In Indian population common spinal pathologies include tuberculosis and malignancy. While clinico-radiological diagnosis was considered to be sufficient to start anti-tubercular treatment in earlier days [2], with modern era of evidence based medicine, it is essential to establish the diagnosis by biopsy [3,4].

In practice, two clinical scenarios need biopsy evaluation, one to differentiate between benign and malignant lesions [3], and second to differentiate between malignant lesion from infections (most commonly tuberculosis) [5,6]. In differentiating benign and malignant lesions, presence of posterior vertebral body bulging, involvement of pedicles and presence of epidural mass in MRI can point to a diagnosis of malignancy, but these findings may not be highly reliable [7] and even in benign osteoporotic fractures when biopsy was done, some cases may show malignancy (0.4-3.8%) [8]. Similarly, sparing of disc with involvement of central part of vertebral body and collapse of vertebral body can occur in tuberculosis although are classical features of malignancies. Newer advanced imaging techniques like Diffusion weighted

imaging magnetic resonance (DWI-MR) imaging can improve the accuracy of differentiation between benign and malignant but even DWI MR Imaging has a specificity of 90% and cannot be accurate [9]. Positron Emission Tomography Computed Tomography (PET-CT) has emerged as a preferred investigation method when malignancy is suspected as it is noninvasive, can rule out malignancy with 100% specificity and also show more easily accessible lesions for tissue biopsy [10]. Although PET-CT can be considered as a preferred method for evaluating spinal lesion and then consider biopsy specifically in malignant lesions to establish tissue diagnosis, it is not available in all the centers and also very expensive. Biopsy also helps to rule out malignancy in patients with documented malignancy as these patients can also have osteoporotic fractures [8]. A proper and adequate biopsy not only ensures correct diagnosis, but also aids in starting appropriate treatment at the earliest.

However, biopsy has certain technical problems and it may be difficult to get sufficient tissue material to diagnose a particular pathology. Accuracy of biopsy varies from center to center. Kattapuram et al., in their study, found 92% accuracy, which increased to 97% with the use of a large bore needle [11]. Various biopsy techniques have been described including CT guided FNAC, CT or image guided needle biopsy and open biopsy. FNAC is a simple procedure which can be done as an OPD procedure,

but needs CT. Yield from FNAC can be poor requiring repeat biopsy. Rate of unsatisfactory specimens range from 15.3% to 19% [12]. Muijs et al., showed that yield of biopsy will be better with needle diameter more than 2.0mm [13]. While accuracy of large bore needle biopsy was higher, complications too are higher with large bore needle biopsy.

To summarize, although need for biopsy has been highlighted in most of articles, there are a few circumstances in which clinico-radiological diagnosis has been accepted and there are doubts about accuracy of biopsy in all patients; large bore needle biopsy has been shown to be more accurate, but there are concerns about technical challenges and complications.

Our hypothesis was that, with needle biopsy there is a possibility of change in diagnosis and hence biopsy is essential to make accurate diagnosis in all conditions. Our hypothesis was also to prove that an image guided large bore needle biopsy is a safe procedure and can get better yield and may be able to establish diagnosis conclusively in almost all cases provided correct technique of biopsy is followed. Secondary objectives of the study were to correlate different MRI findings with biopsy findings and study their sensitivity and specificity.

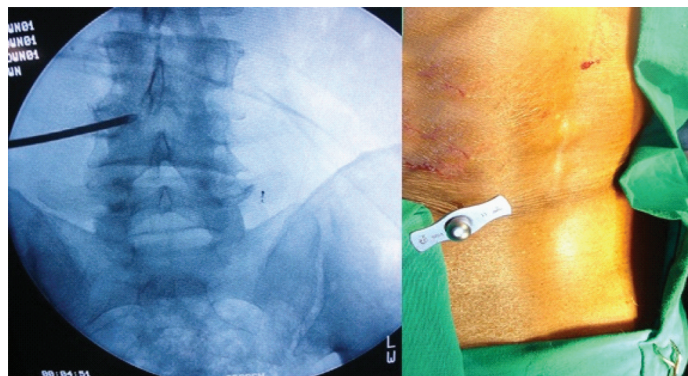
## MATERIALS AND METHODS

This retrospective study was conducted in associated hospitals of Manipal University from 2005 January to December 2014. An informed consent was taken from all patients. The inclusion criteria were, all those patients with spinal pathology following clinical and MRI evaluation and who were planned for biopsy. Patients who were diagnosed with degenerative disc disease with lumbar canal stenosis and patients who did not agree for biopsy were excluded from the study.

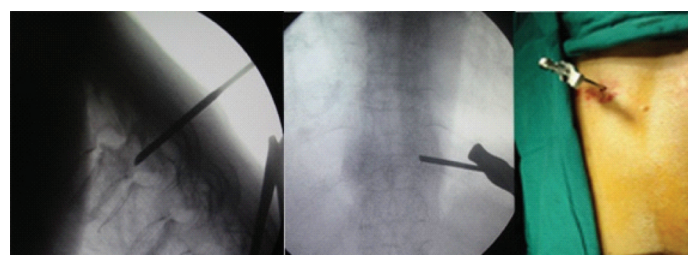
MRI findings were reported by a team of qualified radiologists and whenever there was conflict of opinion, a group of radiologists discussed the findings among themselves and gave a consensus report. As the centre has a well established radiology department with a team of radiologists, this is a practice the department regularly follows for reporting all MRIs whenever there is a difference between clinical and radiological opinion. The MRI findings included variables like site of pathology (paradiscal, body, posterior elements) presence or absence of fracture, posterior vertebral body bulge and involvement of pedicle and posterior elements, presence of epidural and paravertebral mass/abscess and involvement of multiple levels. This study was conducted retrospectively, but, author maintains a registry of all spine cases.

**Biopsy technique:** After obtaining consent, all patients were subjected to biopsy under local anaesthesia (supplemented with sedation in a few select patients depending upon patient's pain

tolerance for the procedure). A No. 11 sized 4.5 inch long Jamshidi needle under image guidance was used [Table/Fig-1]. The approach included extrapedicular approach for lumbar spine [Table/Fig-2] and transpedicular approach for thoracic spine [Table/Fig-3]. These techniques are well described in literature including author's own published paper [14]. After the needle pierces bone, stillet is withdrawn and the tip of needle is advanced into the lesion. The surgeon should study the MRI images clearly before the procedure to have a 3 dimensional orientation of pathoanatomical site within the vertebral body. With rotating movement a large piece of bone can be trapped inside the needle. With this technique, it is possible to obtain a good piece of bony tissue including small area of adjacent normal area which is important in providing better



[Table/Fig-2]: Extrapedicular approach to biopsy.



[Table/Fig-3]: Transpedicular approach to vertebral body for a suspected pathological fracture.

yield [15,16]. In a few incidences, we reintroduced the needle and aspirated to check for presence of pus.

The material was sent for histopathological examination and reported by qualified pathologists. Whenever there was conflict between MRI and biopsy report the findings were discussed again with pathologist to reconsider the diagnosis. This is the standard practice which our institution follows for all biopsy reports and revised diagnosis was considered as final. When biopsy report was inconclusive or inadequate a repeat biopsy was done. Biopsy materials were also sent for culture and sensitivity.

## STATISTICAL ANALYSIS

Statistical analysis was done using SPSS 16.0. Sensitivity and specificity of MRI and Biopsy was calculated, logistic regression analysis was carried out to find out significance of each of MRI findings.

## RESULTS

During the study period there were 45 patients with mean age of 67 years (26 to 87 Years), of which 25 patients were female.

The diagnosis arrived at the end of clinico-radiological examination, after first biopsy and final diagnosis (after completion of repeat biopsy and confirmation of the same by treatment response wherever required) were documented. Evidence of malignancy in biopsy specimen and evidence of tubercular bacilli were indicators of definitive diagnosis while patients who were diagnosed as tuberculosis based on granuloma as well as cases which were diagnosed as pyogenous infection and benign lesions



[Table/Fig-1]: A set of Jamshidi needles.

were followed up and treatment response was also considered as criteria for the confirmation of diagnosis.

[Table/Fig-4] shows diagnosis arrived at the end of MRI, at the end of first biopsy and final diagnosis. There was a change in diagnosis in 8 (17%) cases compared to clinico-radiological diagnosis and final diagnosis while in 4 cases (8.8%) first biopsy could not provide conclusive diagnosis. A repeat biopsy was done in all these patients and diagnosis was established. Thus, yield following first biopsy was 91.2%.

**Sensitivity and specificity of MRI and Biopsy:** [Table/Fig-5] shows sensitivity and specificity of MRI and initial biopsy in diagnosing malignancy and tuberculosis. MRI had sensitivity of 85.71% and specificity of 93.54% for the diagnosis of malignancy and sensitivity of 85.71% and specificity of 86.48% for the diagnosis of tuberculosis. In contrast, initial biopsy had sensitivity of 92.85% and specificity of 100% for the diagnosis of malignancy and sensitivity of 71.42% and specificity of 100% for the diagnosis of infection.

We analysed significance of each MRI findings towards making a diagnosis. MRI findings and their correlation with final diagnosis is shown in [Table/Fig-6].

Logistic regression analysis was done to find out the correlation between MRI findings and malignancy [Table/Fig-7] as well as MRI findings and infection [Table/Fig-8].

Four patients needed repeat biopsy, following repeat biopsy two were diagnosed as tuberculosis, one was reported as malignancy and one patient was diagnosed as benign. In both cases with tuberculosis, second biopsy was done by directing needle to paravertebral abscess area.

	MRI	Biopsy (first biopsy)	Final (Following repeat biopsy)
Benign (n)	19	21	22
Malignant (n)	14	13	14
Tuberculosis (n)	11	5	7
Pyogenous (n)	01	2	2
Inconclusive (n)		4	

**[Table/Fig-4]:** Diagnosis based on MRI, Biopsy and final diagnosis based on radiological and repeat biopsy findings.

	Sensitivity (%)	specificity (%)	Positive predictive value (%)	Negative predictive value (%)
Diagnosis of Malignancy based on MRI findings	85.71	93.54	85.71	93.54
Diagnosis of tuberculosis based on MRI findings	85.71	86.48	54.54	96.96
Diagnosis of Malignancy based on initial biopsy	92.85	100	100	96.87
Diagnosis of Infections based on initial biopsy.	71.42	100	100	95

**[Table/Fig-5]:** Sensitivity and specificity of MRI findings and initial biopsy report to diagnose malignancy as well as infections in relationship to final diagnosis.

MRI features	Benign (n)	Malignant (n)	Infection (n)	Total
Posterior bulge with pathological fracture	15	4	0	19
Posterior bulge without pathological fracture	0	5	2	7
Involvement of posterior elements/pedicles	1	12	2	15
Epidural/paravertebral abscess	1	1	9	11
Soft tissue extension	2	6	0	8
Paradiscal involvement	2	0	8	10
Central involvement	21	13	1	35
Multiple levels	8	7	2	17

**[Table/Fig-6]:** MRI findings and their correlation with final diagnosis.

Variable	p-value
Posterior bulge of vertebral body	0.007
Pathological fracture with posterior bulge of body	0.321
Involvement of pedicle and posterior elements	<0.001
Epidural abscess	0.096
Soft tissue extension (pre and paravertebral/epidural)	0.002
Multiple level involvement	0.156
Paradiscal involvement	0.022
Central involvement	0.022

**[Table/Fig-7]:** Logistic regression analysis of various MRI findings and presence or absence of malignancy.

Variable	p-value
Posterior bulge of vertebral body	0.660
Pedicle involvement	0.310
Epidural abscess	<0.001
Soft tissue extension	0.095
Paradiscal involvement	<0.001
Multiple level involvement	0.189

**[Table/Fig-8]:** Logistic regression analysis of various MRI findings and presence or absence of infection.

In the present study, there were 2 complications related to the biopsy procedure; both of them had transient nerve root weakness, which recovered after 3 weeks. Our technique of doing biopsy under local anaesthesia with patient being awake also could have helped in preventing complete neurological deficits. In one patient procedure was abandoned due to lack of co-operation from patient and subsequently, patient underwent the procedure under general anaesthesia. Three patients needed sedation during procedure due to severe pain.

## DISCUSSION

In any clinical scenario, differentiating between osteoporotic fracture and malignant fracture as well as differentiating between malignancy and infection are two difficult problems. Although it is possible to arrive at a reasonable diagnosis based on clinical and MRI findings, diagnosis may be uncertain in a few patients [6]. In the modern era of evidence based medicine, accuracy of diagnosis is very important, as it may lead to unnecessary treatment. Alison S. Smith et al., in their series found that MR findings of tubercular infection were more typical of neoplasm and feel clinical correlation is essential [17]. Need to establish diagnosis by biopsy was highlighted by other authors too before starting anti tubercular treatment [6,18].

Limitations in differentiating between malignant pathological fractures and osteoporotic fractures were highlighted by Tan SB et al., G Pozzi et al., [3,9]. G Pozzi et al., recommend DWI-MR imaging, although sclerotic metastases can be confusing and appear hypo intense [3,9].

Our study also supports this theory, we found that there was a change in diagnosis in 8 patients out of 45(17%), which is a significant number. We found that 2 cases were wrongly started on anti-tubercular treatment based on empirical treatment before presenting to us. While this could lead to unnecessary intake of tubercular drugs, may encourage drug resistant tuberculosis, it may also lead to progress of malignant lesion, which could make a big difference in converting a resectable lesion to non resectable lesion. One of the 2 cases was on empirical treatment (before presenting to us), had developed paraplegia and biopsy showed evidence of metastatic lesion; a timely biopsy and diagnosis could have prevented paraplegia. In suspected malignancy, biopsy is essential to establish tissue diagnosis and confirmation.

Based on our observations we strongly recommend biopsy in all patients. Biopsy has high specificity, for diagnosis of both

malignancy and infection, while has less sensitivity for the diagnosis of infection compared to MRI. Low sensitivity for tuberculosis was because of negative biopsy in 2 cases, which later turned out to be tuberculosis with repeat biopsy. These findings were consistent with other authors too, Rivas A et al., [19], found that biopsy has sensitivity of 86% and specificity of 100%. In view of high specificity, biopsy reports are reliable in initiating treatment. Although Gene Xpert MTB/RIF assay was not part of this study, with the emergence of drug resistant tuberculosis, there are strong recommendations for doing this assay on all samples in future, but, since ours was a retrospective study, we cannot address this issue.

One of the concerns for biopsy is its being an invasive procedure. However, biopsy can be performed with the help of an image or CT percutaneously. WCG Peh, opine that CT guided percutaneous biopsy is a safe and an affective technique for the evaluation of spinal lesions and useful in planning therapy [20]. While CT guided fine needle aspiration is simplest of all, the obtained sample tissue may not be adequate [12], image guided biopsy using a 11 gauge needle is also simple, can be performed with local anaesthesia and percutaneously. Large bore needle biopsy can be done under CT guidance also, but we feel biopsy in the operating room environment can be safer for a patient. Image guided biopsy is comparable with CT guided biopsy [21]. Our study focuses on effectiveness of a needle biopsy using Jamshedi needle, as this procedure can be done under local anaesthesia under image guidance and can get enough material for making a diagnosis thus avoiding complications of open biopsy.

There has been a debate on size of needle and adequacy of biopsy and safety of such image guided biopsy. In our series, we were able to get good material enough to make a diagnosis in 91.2% cases, while in remaining cases, we could establish diagnosis with a second biopsy. This was consistent with the observations of Eugenio Rimondi et al., who were able to establish diagnosis in 404 cases out of 430 cases, while in the remaining, a repeat biopsy helped in arriving at a diagnosis [22]. Eric Lis et al., found that in CT guided biopsy, 5% (22/392) cases needed repeat biopsy due to technical reasons [23]. There was 89% accuracy of biopsy, sclerotic lesions had poor accuracy. Leandro A. Espinosa et al., opine 11 gauge needle system can give adequate biopsy material [24]. In our series too, we have used 11 gauge needle and we directed the needle towards pathological lesion based on our analysis of MRI picture. In 2 cases there was paravertebral collection, while we biopsied intervertebral space, and as biopsy was inconclusive, it was repeated by directing the needle towards paraspinous area. This helped us to get a conclusive report.

A proper analysis of MRI to understand and get a three dimensional orientation of pathological site before biopsy, use of wide bore needle and image localization are essential to get a better yield. One should also try to include a small piece of normal tissue by passing the needle across the normal zone and abnormal zone while trapping the tissue within the needle. Thus, we feel with a proper technique it is possible to get a good yield (91.2%) and in cases where report is inconclusive, a repeat biopsy is definitely worthwhile. Biopsy procedure itself is a safe procedure with very few complications.

We compared various MRI findings and final diagnosis after biopsy. Presence of epidural abscess, involvement of paradiscal area were more in favor of infections, while posterior bulge of vertebral body without fracture and involvement of pedicles were more in favor of malignancies. Epidural abscess when present showed 100% accuracy for the diagnosis of infection, however all patients need not have epidural abscess and hence less sensitive. This study also has some limitations in that number of patients in sub variable classes is less and may need a larger study to support these observations.

Gupta et al., found that although paradiscal involvement was a feature of tuberculosis, but was also present in 6 of 19 patients who were diagnosed as metastasis [6]. Central involvement was present in 11 of the 41 patients who were diagnosed as tuberculosis. Presence of abscess was the only specific finding for tuberculosis and present in 22 of 41 patients. Problems of differentiating between bacterial and tubercular osteomyelitis was highlighted by Smith AS et al., and they feel clinical correlation is needed for the same [25]. In our series there was only one patient with bacterial osteomyelitis, and hence we cannot comment on this aspect, however we feel biopsy can establish the accurate diagnosis and prevent unnecessary anti tubercular treatment.

## LIMITATION

This study is a retrospective study, MRI and Biopsy findings could have been more research specific with a prospective design. As author maintains a spine registry, retrospective design would not have affected diagnostic accuracy and yield of biopsy, however, it is possible that some of the variables assessed for logistic regression analysis could have been more accurately captured with a prospective design. It is also difficult to generalise correlation between various MRI and Biopsy findings with the final diagnosis (using logistic regression analysis) in view of inadequate numbers in some of the categories. However, the focus of this work was to establish adequacy of an image guided needle biopsy and its role in diagnosis, this study clearly demonstrates the need for biopsy as well as safety and accuracy of an image guided large bore needle biopsy.

## CONCLUSION

Image guided Biopsy done with a good technique helps in achieving accurate diagnosis, ensures correct treatment at the earliest and has minimal complications. This study also shows that presence of epidural abscess and paradiscal involvement in MRI highly suggest possibility of infection, while pedicle involvement and posterior bulge of vertebral body before the onset of pathological fracture are more suggestive of malignancy, but all spinal lesions should be biopsied to confirm the diagnosis.

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