Fluoroscopy Guided Percutaneous Transpedicular Biopsy for Thoracic and Lumbar Vertebral Body Lesion: Technique and Safety in 23 Consecutive Cases.

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ABSTRACT

Background

Though some vertebral lesions have typical imaging findings, histological/ microbiological evidence are required for definitive diagnosis and management, specially for tumor and infective lesions so that wrong diagnosis and wrong treatment can be avoided. Conventionally, open biopsy methods are used. With availability of CT scan, MRI, percutaneous transpedicular vertebral biopsy has now become popular as a minimally invasive technique for biopsy of vertebral lesion.

Objective

To describes technique and to analyzes safety and feasibility of percutaneous transpedicular vertebral biopsy with fluoroscopy guidance for thoracic and lumbar vertebral body lesions.

Method

Twenty three patients who underwent percutaneous transpedicular vertebral biopsy under fluoroscopy guidance were retrospectively evaluated for demographic data, indication for biopsy, anatomical locations, histological/microbiological diagnosis, complications and final outcome of treatment. True positive, true negative, false positive and false negative cases were defined.

Result

There were 17 males and 6 female patients of mean age 47 (range 22-73 years). Biopsies were performed in 17 dorsal and six lumbar vertebral bodies. Adequate sample were obtained in all cases. Seventeen patients (12: tubercular pathology, 1: primary tumor, 3: metastasis, 1: osteoporotic fracture) had definitive histological/ microbiological diagnosis. Four patients had no granuloma and tumor. Two had histological features of chronic non specific inflammation. True positive cases were 17, true negative were four and false negative case were two. Overall accuracy was 92%. One patient developed small hematoma at biopsy site.

Conclusion

Fluoroscopy guided percutaneous transpedicular biopsy of is a safe procedure with high adequacy and accuracy and low complication rate for thoracic and lumbar vertebral body lesion.

KEY WORDS

Fluoroscopy, transpedicular biopsy, vertebral body.

INTRODUCTION

Diagnosis of vertebral lesion remains a challenge. Radiological investigations like plain X rays, CT scan, MRI scan and bone scan are primary test to investigate for underlying pathology in vertebra. Though some vertebral lesions have typical imaging findings, histological and microbiological evidence are required for definitive diagnosis and management, specially for tumor and infection. In developing countries with high prevalence rate of tuberculosis, tubercular spondylitis are often diagnosed and treated empirically on clinical and radiological criteria. However, its sensitivity and specificity of these criteria are low.[1] In the view of increasing incidence of multi drug resistance tuberculosis, HIV co-infection and higher percentage of atypical tuberculosis (up to 30%), histological and microbiological diagnosis are crucial for proper diagnosis and treatment of spinal tuberculosis to avoid wrong diagnosis and wrong treatment.[1-3] Conventionally, open methods are used for vertebral lesion for adequate sampling. Duncan et al. in 1928 used first time transpedicular approach for vertebral biopsy.[4] With advent of better imaging modalities such as CT scan, fluoroscopy and MRI, percutaneous transpedicular vertebral biopsy has now become popular minimally invasive technique for biopsy of vertebral lesion.

The current study describes technique and analyzes safety and feasibility of percutaneous transpedicular vertebral biopsy with fluoroscopy guidance for thoracic and lumbar vertebral body lesions.

METHODS

Twenty three consecutive patients who underwent percutaneous transpedicular vertebral biopsy under fluoroscopy guidance in between July 2013 to June 2015 were retrospectively evaluated for demographic data, indication for biopsy, anatomical locations, histological and microbiological diagnosis, procedure related complications and final outcome of treatment during subsequent follow up. Data were retrieved from hospital record system of Dhulikhel hospital and the hospital where author (DS) performed biopsy as a visiting spine surgeon. Two patients who were already on treatment for tubercular spondylitis without improvement were also included in the present study. True positive (clinical and histological/microbiological diagnosis are same), true negative (normal bone), false positive (diagnosis made by the biopsy but subsequently ruled out) and false negative (no definitive histological/microbiological diagnosis but showed improvement on treatment according to clinico-radiological diagnosis) cases were defined as described by Kamei Y et al.[5]

Technique

All the procedures were performed in prone position on radiolucent operation table under general anesthesia. The target pedicle was marked in both true anterio-posterior (AP) and lateral view. After stab incision on skin, a tract was created into deep fascia and muscle by a hemostat. Entry point into the pedicle was created by gentle tapping of 3 mm Kirschner wire under fluoroscopy guidance so the entry point lies on supeiro-lateral margin of pedicle in AP view or Bull's eye view (Fig. 1a). The correct position of entry point was also confirmed in lateral view and cephalo-caudal inclination was adjusted to reach target area for biopsy of vertebral body (Fig. 1b, 1c).

Once correct entry point was ensured, Kirschner wire was gently tapped into the pedicle under fluoroscopy guidance. Once Kirschner wire reached at posterior boarder of vertebral body in lateral view, AP image was obtained to make sure that the tip of the wire was at the center of pedicle and had not reached the medial edge of pedicle (Fig. 2a, 2b). Now, a biopsy cannula of diameter 3.5 mm with serrated edge was passed over the Kirschner wire with rotatory movement up to the tip and its position was ensured once again both in AP and in lateral views (Fig. 3a,3b,3c). Kirschner wire was removed and biopsy trocar was advanced into to the vertebral body with rotatory movement into target area (Fig. 4a,4b). Gentle cepahalo-caudal and medio-lateral rocking movements of the cannula dislodged the bone from the body. Biopsy cannula was withdrawn and specimen trapped into the cannula was

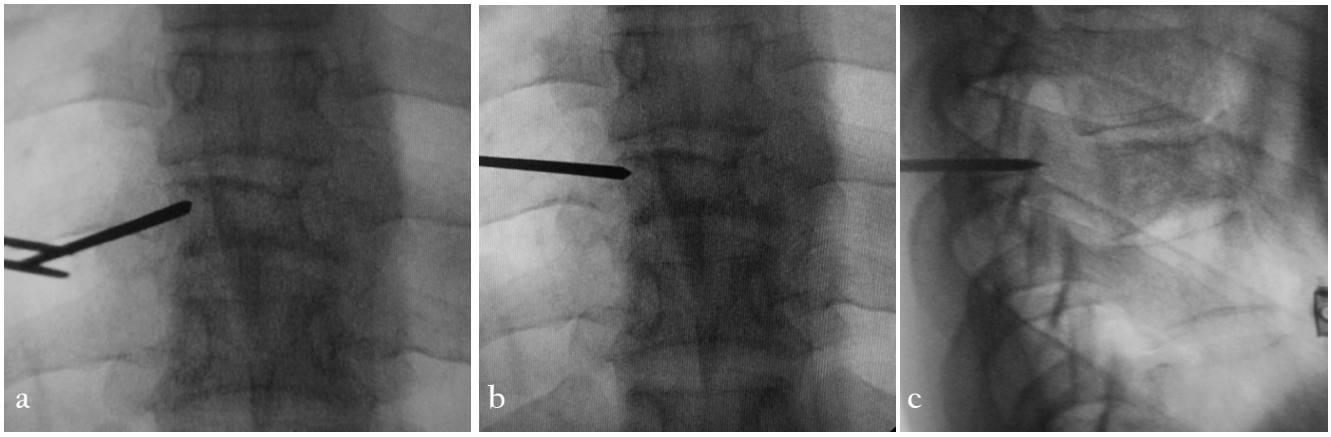

Figure 1. Entry point at superio-lateral edge of pedicle in AP view (1a,1b) and confirmation of cephalo -caudal trajectory in lateral view (1c).

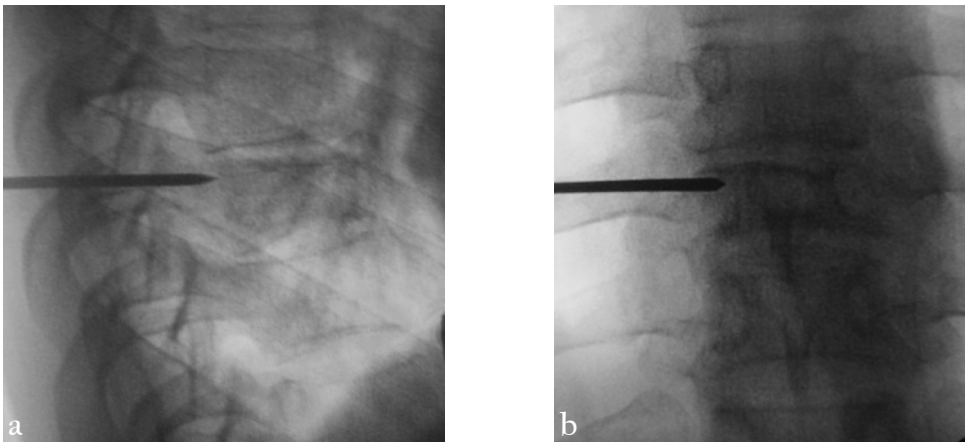

Figure 2. **Kirschner wire tapped up to posterior boarder of vertebral body (2a) and position confirmed on AP view (2b).**

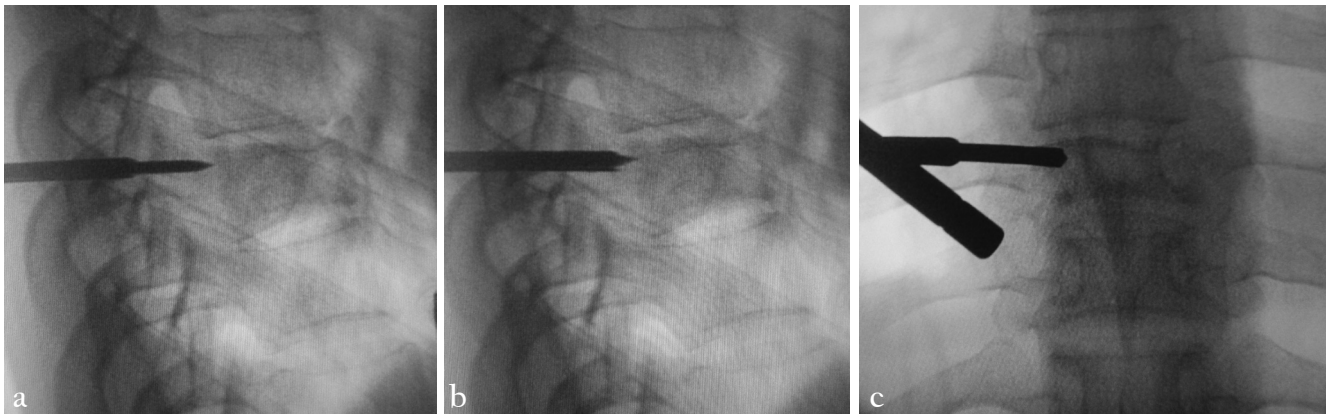

Figure 3. **Biopsy cannula passed over Kirschner wire up to posterior boarder of vertebral body (3a, 3b) and its position confirmed in AP view.**

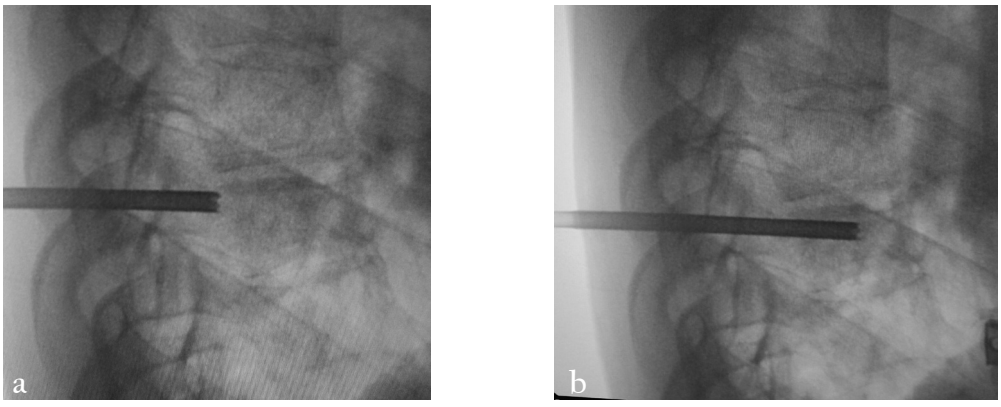

Figure 4. **Kirschner wire removed (4a) and biopsy cannula advanced into target area (4b).**

removed with a blunt trocar (Fig. 5). Imprint cytology was prepared by rolling specimen on a glass slide. Aspiration of cannula with 10 ml syringe provided material to prepare slides for cytology. If sufficient material was not obtained, the biopsy tract was changed with similar technique. Alternatively, we used an arthroscopic punch or grasper through the same tract under fluoroscopy guidance and specimens were retrieved (Fig. 6). If required, different area of the vertebral body could be reached for biopsy by rotating blade of arthroscopic punch or grasper. The specimens were sent for histological and microbiological investigations in different container after proper labeling. Wound was closed with a single stich.

RESULTS

There were 15 male and eight female patients with mean age of 47(range 22-73 years). Anatomical location, clinic-radiological diagnosis and indication for biopsy, histological and/microbiological diagnosis are shown in the table 1. One patient developed small hematoma at the biopsy site but did not required evacuation. None of the patients had neuro-vascular injury, pneumothorax and instrument related complications or sinus tract formation during follow up.

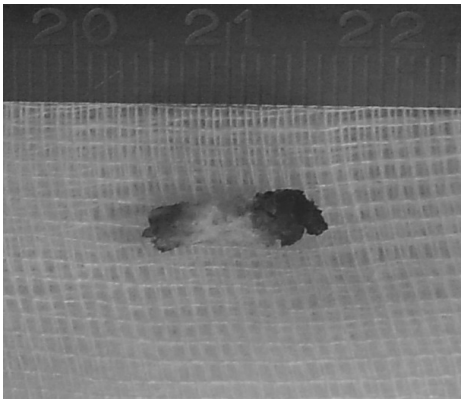

Figure 5. **Biopsy specimen retrieved from cannula.**

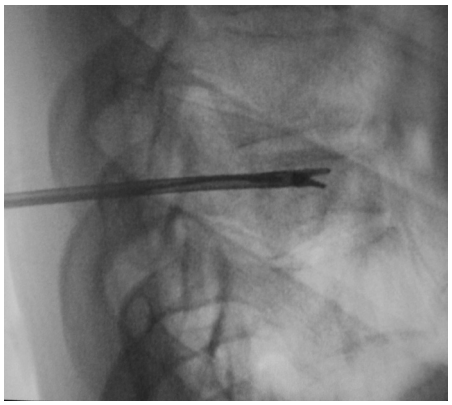

Figure 6. **Alternatively arthroscopic punch can be used to get specimen.**

Table 1. Total no patients, anatomical locations, clinico-radiological diagnosis and histological/microbiological diagnosis

Gender	No. of patients
Male	15
Female	8
Anatomical location	
Dorsal spine	17
Lumbar spine	6
Clinico-radiological diagnosis	
Infective lesion	16
Primary tumor	2
Metastasis	5
Histological/microbiological diagnosis	
Infective lesion	12
Primary tumor	1
Metastasis	3
Osteoporotic fracture	1
Chronic non specific inflammation	2
No granuloma and no tumor lesion	4

None of the samples were reported inadequate by pathologist. Out of 23 patients, 17 (74%) had histological diagnosis among which 12 (71%) had tubercular pathology, 4 (24%) had tumor lesion and one patient (5%) had diagnosis of osteoporotic fracture. Four patients had no evidence of tuberculosis and tumor and hence considered normal bone and two had histological features of chronic non specific inflammation. In the view of strong clinical and radiological suspicion of tubercular pathology, those two patients with chronic non specific inflammation were put on anti-tubercular therapy and showed improvement in subsequent follow up. True positive cases were 17, true negative were four and false negative case were two. Overall accuracy was 92%. Two patients with previous clinio-radiological diagnosis of metastasis revealed tubercular pathology. Only one patient had stain and culture positive for *Mycobacterium tuberculosis.*

DISCUSSION

Transpedicular biopsy is a recommended technique for obtaining vertebral body specimens. Better imaging modalities and better understanding of pedicle morphology and anatomy has made percutaneous transpedicular biopsy safe and accurate technique for vertebral biopsy Accuracy has been reported up to 93.8% which is comparable to the present study (92%).[6] The procedure can be performed under local anesthesia as a daycare procedure and is a minimally invasive technique. However, we performed all the procedure under general anesthesia in the present study. Though there are definitive advantages of local anesthesia, orthopedic surgeons who are in the initial phase of this technique, general anesthesia provide better control over the pain than local anaesthesia. The most important benefit of performing this technique under local anaesthesia is immediate recognition of any inadvertent injury to neural structure during the procedure. Other possible complication such as pneumothorax, vascular injury, pseudo-aneurysm, sinus track formation, transient paresis has been reported in literature. Bleeding diathesis is contraindicated for this procedure.[5,7]

CT scan, fluoroscopy or MRI has been used for image guidance. CT scan provides better image quality and small lesion can be reached more accurately. However, increased radiation exposure to the patients and physician, cost, availability and difficulty on adjusting into CT gantry machines during biopsy are some of the issues related with CT guidance. Fluoroscopy is easily available in most of the centers, provides real time image while passing the guide wire and biopsy trocar. When this procedure is performed in operation theatre either in general anaesthesia or local anaesthesia, any unexpected complications such as bleeding, pneumothorax or vascular injury can be immediately addressed which could be difficult in CT scan room in radiology department. Nourbakhsh A et al. compared CT scan fluoroscopy for percutaneous vertebral biopsy for adequacy, accuracy and complication in a meta analysis and reported CT scan slightly superior than

fluoroscopy (adequacy: 92.6% Vs 90.1.% , accuracy: 90.2% Vs 88.1%, and complications: 3.3% Vs 5.3%) but none of them were statistically significant.[8] Even in thoracic spine, accuracy has been reported up to 93.8% by Kamei Y et al.[5]

Various kinds of biopsy instruments are available for percutaneous vertebral biopsy. Adequate bone sample with minimal crushing effect should be primary target of biopsy instruments. In the present study, we designed a biopsy cannula with serrated tip to cut the bone. We routinely used 3.5 mm diameter cannula. A 3 mm Kirschner wire of suitable length was used as a guide pin to pass a biopsy trocar. Chooi YS et al had used 2 mm Steinman pin as guide pin.[9] These instruments are cheap and reusable as compared to expensive disposable instruments. We did not encounter instrument related complication in our series.

Though Fyfe IS et al, based upon cadaveric study, reported higher accuracy when core diameter of biopsy specimen was ≥ 2 mm, the choice of diameter of biopsy trocar should be based up on anatomical site and suspected underlying pathology.[10] Diffuse involvement of vertebral body is less likely to be missed out even by small diameter biopsy cannula. Small diameter biopsy cannula may be sufficient for infective and metastatic lesions but larger diameter required for sclerotic bone metallic bone disease or primary bone tumor.[6] Watt JP et al. have found no impact on culture yield for tubercular spondylitis on biopsy core length. Similarly larger diameter cannula obscures image, macerates soft tissue and increases chance of breeching of pedicle wall. Hence primary aim of percutaneous transpedicular biopsy is to obtain adequate specimen without increasing the potential complications. In the current study, none of the specimens were reported inadequate by pathologist. Kim BJ et al. had reported 97.1% adequate sampling by fluoroscopy guided transpedicular biopsy.[11]

In certain occasion, first attempt of percutaneous transpedicular biopsy may fail to obtain adequate specimen or may fail to reach target area. In such situation, repeated attempt of transpedicular biopsy with different tract is recommended. However, we used arthroscopic punch or grasper through the same transpedicular tract to get specimen. Certain area of vertebral body are considered inaccessible for trajectory of percutaneous transpedicular biopsy such as vertebral body just anterior to spinal canal and inferior and superior edge of posterior body.[5,12] Since the mouth of arthroscopic punch or grasper can be rotated in different direction, larger are of vertebral body could be assessed. But bones obtained with arthroscopic punch or grasper can give rise to crush artifacts in histological examination and should be discussed with pathologist before reporting. In six cases, arthroscopic punch or grasper was used to retrieve when initial specimen was thought to be inadequate in the present series.

This study, as a retrospective study with few numbers of patients carries selection bias and should be interpreted carefully. However, the main objective was to describe technique and evaluate safety and feasibility of technique of fluoroscopy guided percutaneous transpedicular biopsy of vertebral lesion Large number of patients involving multiple surgeons and centers should be studied for more precise results.

CONCLUSION

Fluoroscopy guided percutaneous transpedicular biopsy of is a safe procedure with high adequacy and accuracy and low complication rate for thoracic and lumbar vertebral body lesion.

REFERENCES

1. Colmenero JD, Ruiz-Mesa JD, Sanjuan-Jimenez R, Sobrino B, Morata P. Establishing the diagnosis of tuberculous vertebral osteomyelitis. *Eur Spin J* 2013; 22(4):S579-S586.
2. Dunn R, Zondagh I. Spinal tuberculosis: Diagnostic biopsy is mandatory. *S Afr Med J* 2008;98(5):360-2.
3. Watt JP, Davis JH. Percutaneous core needle biopsies: The yield in spinal tuberculosis. *S Afr Med J* 2014;104(1):29-31.
4. Duncan GA, Ferguson AB. Benign giant cell tumor of the fourth lumbar vertebra: a case report. *J Bone Joint Surg (Am)* 1936; 3: 769-72.
5. Kamei Y, Nishida J, Mimata Y, Shiraishi H, Ehara S, Satoh T, et al. Core Needle Percutaneous transpedicular Vertebral Body Biopsy : A Study of 128 Cases. *J Spinal Disord Tech* 2015;28:E394–E399S.
6. Moller S. Kothe R, Wiesner L, Werner M, Ryther W, Delling G. Fluroscopy-guided transpedicular trocar biopsy of spine-results, review and technical notes. *Acta Orthopædica Belgica* 2001;67(5): 488-499.
7. Mifune Y, Yagi M, Iwasaki Y, Doita M. Pseudoaneurysm of Lumbar Artery following a Vertebral Biopsy: A Case Report. *Case Reports in Radiology* 2012;127124:4.
8. Nourbakhsh A, Grady JJ, Garges KJ. Percutaneous Spine Biopsy: A Meta-Analysis. *J Bone Joint Surg (Am)* 2008;90(8): 1722-5.
9. Chooi YS, M Kamil OI, Fazir M, Kob SC. Percutaneous transpedicular biopsy of spine. *Med J Malaysia* 2007; 62(1):46-8.
10. Fyfe IS, Henry APJ, Mullholland RC. Closed vertebral biopsy. *J Bone Joint Surg (Br)* 1983;17:140-3.
11. Kim BJ, Lee JW, Kim SJ, Lee GY, Kang HS. Diagnostic Yield of Fluoroscopy-Guided Biopsy for Infectious spondylitis. *AJNR Am J Neuroradiol* 2013:34:233-8.
12. Dave BR, Nanda A, Anandjiwala JV. Transpedicular percutaneous biopsy of the vertebral lesions: a series of 71 cases. *Spinal Cord.* 2009;47:384-9.