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ORIGINAL ARTICLE

Transpedicular percutaneous biopsy of vertebral body lesions: a series of 71 cases

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Study design: This prospective study evaluates the effectiveness of transpedicular biopsy carried out under local anesthesia in obtaining diagnostic tissue from vertebral body lesions.
Objective: To describe the technique of percutaneous transpedicular biopsy carried out under local anesthesia under C-arm fluoroscopy and to report the author's experience.
Setting: Spine hospital, Ahmedabad, Gujarat, India.
Methods: Seventy-one patients who underwent transpedicular biopsy from T6 to S1 vertebral body lesions were evaluated. Biopsy specimens were obtained by passing a self-designed 5-mm diameter biopsy instrument through the pedicle into the site of the disease using C-arm fluoroscopy. Specimens were sent for histological and bacteriologic analyses.
Results: Biopsy was carried out for vertebral lesions of 51 men and 20 women. Sixteen of these lesions were seen in thoracic spine, 53 in lumbar and two in sacrum. The pathologic examinations revealed infections in 25, osteoporotic wedging in 21, metastasis in eight, plasmacytoma in three, multiple myeloma in four, non-Hodgkin's lymphoma in one and round cell tumor in one patient. Diagnosis was established in 63 of 71 patients (88.7%). Remaining eight patients were reported as chronic nonspecific inflammation, and were followed up for more than 6 months.
Conclusion: Percutaneous transpedicular vertebral biopsy under local anesthesia is an important tool in the evaluation of vertebral body lesions, especially in older population and can be performed with minimal morbidity and high diagnostic yield as an outpatient procedure.
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Keywords: percutaneous biopsy; vertebral body; transpedicular

Introduction

Percutaneous biopsy is suitable for histopathologic and bacteriologic evaluation of vertebral lesions,[1–3] as it is a quick and minimally invasive technique to obtain a specimen from deep structures and has relevant advantages to open surgical biopsy, and complications are rare with this procedure.

Despite increasing knowledge of vertebral morphometry and experience with transpedicular fixation, the pedicle has not been popularized as a channel for percutaneous vertebral biopsy. Conventionally, open biopsy procedures are preferred over closed procedures in any part of the body because more tissue is available for histopathology. However, the majority prefers percutaneous biopsy of the spine because of the relative inaccessibility of vertebral body elements. Nevertheless, reported complications of closed paravertebral biopsy include hematoma, pneumothorax and nerve root injury,[4,5] and at the same time, the reported diagnostic success rates vary.[4,5]

Craig[6] developed the technique and needle for surgical core biopsy of the vertebrae and this technique is widely used by orthopedic surgeons for biopsy of the vertebral lesions. The technique performed under general anesthesia uses a paravertebral approach and has been associated with significant hemorrhage or less frequent nerve damage.

Symptomatic marrow lesions of the vertebral body are identified during the screening of patients for backache, with modern radiological techniques, such as magnetic resonance imaging, computed tomography and bone scintigraphy. These provide a means for enhancing the diagnosis of marrow lesions. These techniques have high sensitivity but low specificity. Percutaneous transpedicular biopsy is a procedure with high specificity and high sensitivity. It is necessary for the confirmation of diagnosis obtained through imaging by subjecting the sample to histopathologic and bacteriological evaluations, and thus help in further management of these lesions.

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The goals of this study are to describe a precise technique for percutaneous transpedicular biopsy and to determine the efficacy of this technique to get an adequate volume of the vertebral body accessible through the pedicle. This technique is much relevant in today's age-quake era, as the geriatric population is increasing worldwide. As a result, the pathologies associated with old age like metastasis, osteoporosis and so on are being seen more and more in outpatient department, which many a times pose a big diagnostic challenge. This technique of transpedicular biopsy can provide high diagnostic rate, and thus further guide toward proper line of management.

We have extended our indications to drain and culture pus in koch's abscess and postoperative discitis in neurologically intact patients.

Materials and methods

A total of 71 transpedicular biopsy procedures were carried out between June 2005 and November 2007 by the senior author. Biopsy specimen obtained after inserting a self designed serrated 5mm cannula with pointed trocar (Figure 1). This included 51 men and 20 women ranging in age from 35 to 85 years. In all, 53 lumbar vertebral body lesions, 16 thoracic lesions and two sacral lesions ranging from T 6 to S1 levels were biopsied. Indications for biopsy included destructive lesions, lytic lesions and pathologic fractures, which are of doubtful diagnosis. Table 1 summarizes the clinical data. All cases were performed using image intensification under local anesthesia without sedation.

Anesthesia and intraoperative monitoring
All patients received bupivacaine for local anesthesia of the skin and periosteum. All patients were monitored with a pulse oximeter and automated blood pressure cuff in the presence of an anesthetist (Figure 2).

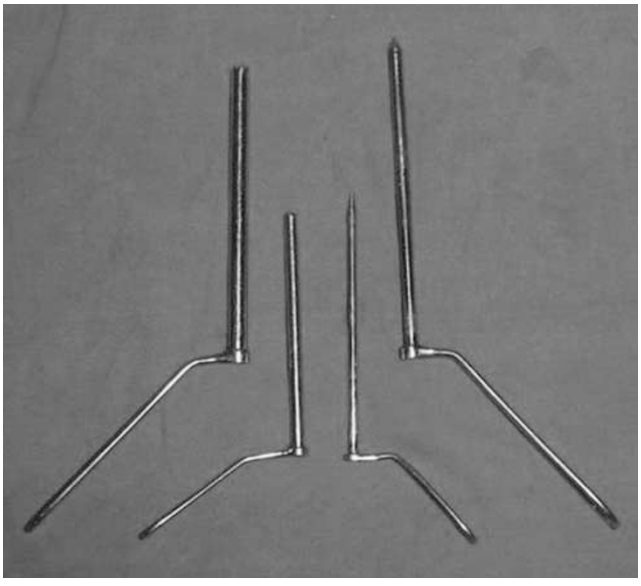

Figure 1 Serrated cannula with sharp pointed trocar and blunt trocar.

Radiographic guidance
Biopsy specimens were obtained using high-resolution image intensifier.

Biopsy technique
The percutaneous procedure requires a high-resolution image intensifier and a radiolucent operating table. The image intensifier is oriented until the X-ray beam is colinear with the sagittal pedicle angle determined from the lateral views of the vertebral body. A 'bull's eye' view of the pedicle

Table 1 Distribution of lesion and diagnosis

Level	*X-ray finding*		*Diagnosis*	
Thoracic	Lytic	4	Infection	7
	Destructive	5	Osteoporotic	1
	Wedging	4	Metastasis	3
	Erosion	2	Multiple myeloma/plasmacytoma	3
	Discitis	1	Others	0
			Inconclusive	2
Lumbar	Lytic	13	Infection	16
	Destructive	14	Osteoporotic	20
	Wedging	16	Metastasis	5
	Erosion	5	Multiple myeloma/plasmacytoma	4
	Discitis	5	Others	2
			Inconclusive	6
Sacral	Lytic	1	Infection	2
	Destructive	1	Osteoporotic	0
	Wedging	0	Metastasis	0
	Erosion	0	Multiple myeloma/plasma cytoma	0
	Discitis	0	Others	0
			Inconclusive	0

Figure 2 Entry in the pedicle.

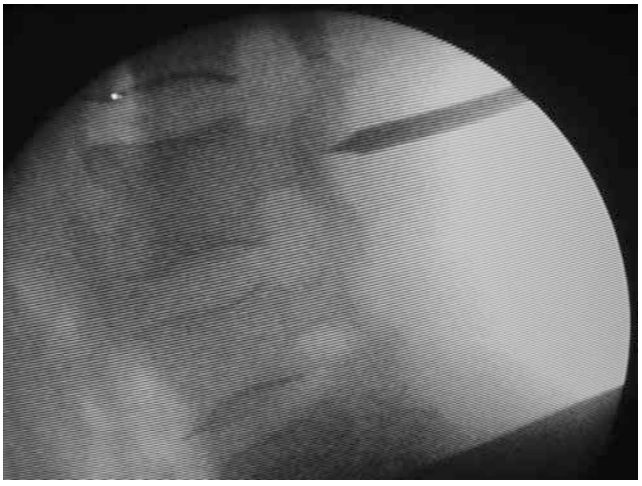

Figure 3 Entry in pedicle in centre—pedicle wall must be seen as one wall.

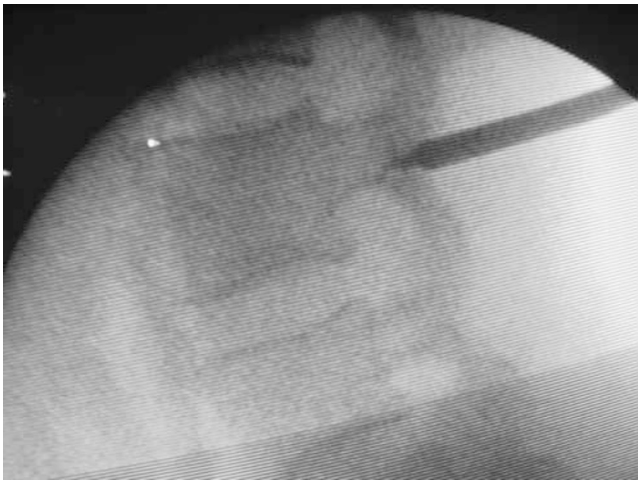

Figure 4 Forceful insertion or pain means touching the pedicle wall—change entry or direction.

must be obtained in an AP view. Repeated AP and Lateral images should be taken (Figures 3 and 5).

Local anesthesia is obtained by injecting plain bupivacaine along the proposed needle tract. A stab incision is made to allow passage of a cannulated serrated sleeve along with the trocar into the vertebral body through the pedicle (Figure 1). This procedure is similar to the insertion of pedicle screw by open technique or minimal invasive spine surgery technique. Smooth passage is usually obtained and no undue force is required after initial entry. If the insertion is forceful or difficult, change either the direction of the cannula or the entry site (Figures 4 and 6).

As the cannula and sleeve pass through the pedicle and enter the body (Figures 7 and 9), the trocar is withdrawn only when it has reached till the affected area of the vertebral body or pedicle (if affected), or after pedicle is penetrated (Figures 7 and 8). If patients complain of radicular pain during the procedure, it suggests irritation of the nerve root and the direction of the biopsy instrument should be

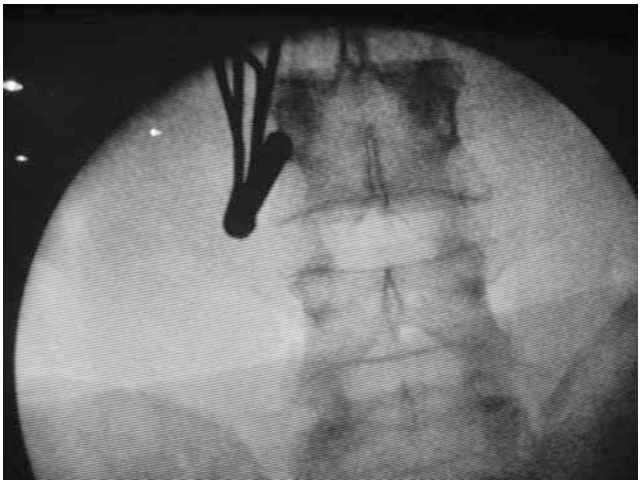

Figure 5 AP view must be checked before entering in pedicle.

Figure 6 Placement near the pedicle wall may be painful—avoid it.

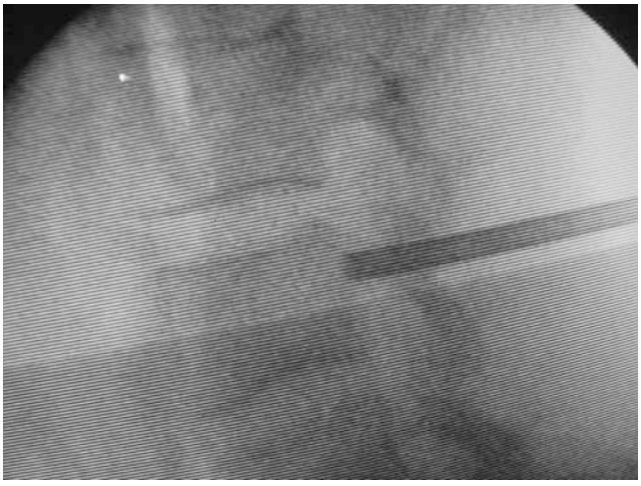

Figure 7 Remove the trocar before entering in the body—check in lateral view.

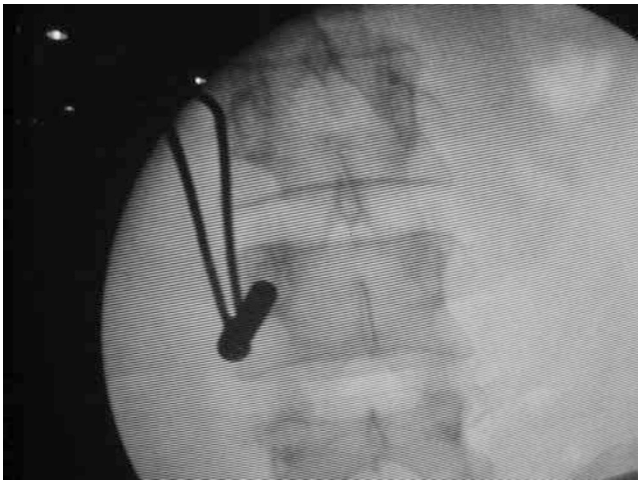

Figure 8 Remove trocar before entering in pedicle—AP view to check.

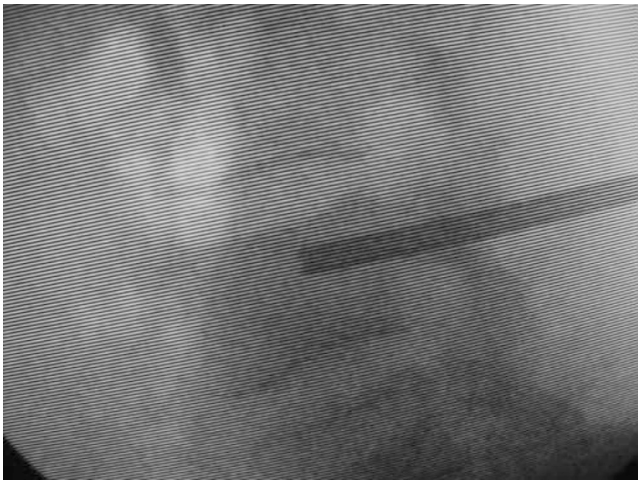

Figure 9 Rotating the canula—clock wise and anticlock wise with gentle push.

changed (Figures 4 and 6). The cannula tip is sharp and saw toothed, which allows tissue to get inside the cannula. Retrieval of osteopenic bone and pathologic tissue is enhanced as the tissue gets impacted inside the cannula (Figure 1). The saw tip of the cannula is made to pass about 80% of the anteroposterior diameter of the vertebral body or through the whole body, if abscess drainage is needed.

The cannula is rotated in a clockwise and anticlockwise motion several times to disengage the tissue from the surrounding tissue (Figure 9). At this stage, a 10-ml syringe is attached at the backside of the cannula, and the plunger of syringe is pulled out to the maximum to create a suction effect inside the cannula, while withdrawing the cannula in rotatory motion. This will prevent the retrieved soft tissue from pulling out of the cannula during withdrawal. The integrity of the medial and inferior walls of the pedicle must be preserved to prevent the spread of any infection, tumor or hematoma in the spinal canal. No drain or any sutures were required. If adequate sample (Figure 10) was not obtained on

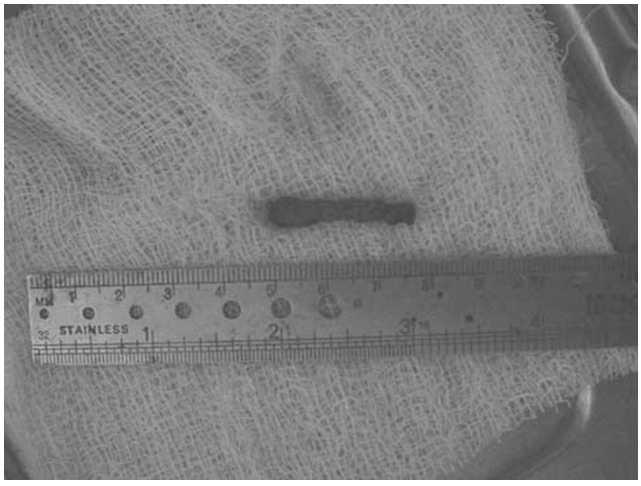

Figure 10 A bone piece of 2.5 cm recovered from the canula.

the first entry, then the cannula was reinserted after threading it over a blunt k-wire, and then under image guidance, direction of the cannula is altered to be able to obtain another sample. The operator and the assistants are protected from X-ray doses by lead apron and thyroid shield. The operating surgeon should perform this procedure first on the cadaver or anatomical model to get experience and confidence before performing on the patient.

Patient discharge and follow-up evaluation

All outpatients were discharged home after a 2-hours observation period in the recovery room. Subjective responses of in-patients were evaluated by means of routine checkup in the patient's room. Outpatients were interviewed over telephone on the day after the procedure.

We certify that all applicable institutional and governmental regulations concerning the ethical use of human volunteers were followed during the course of this research.

Results

Table 1 summarizes the results of the procedure. Adequate specimens for diagnosis were obtained in all 71 patients. Preoperative plain radiographs suggested 18 lytic lesions, 20 destructive lesions, 20 wedging, seven end-plate erosions and six discitis.

Diagnosis was established in 63 of 71 patients (88.7%). Histopathological examination revealed infections in 25 (21 tuberculosis and four bacterial), osteoporotic wedging in 21, metastasis in eight, plasmacytoma in three, multiple myeloma in four, round cell tumor in one and non-Hodgkin's lymphoma in one patient. Remaining eight patients were reported as chronic nonspecific inflammation and diagnosis was found to be inconclusive. These cases were put on prophylactic anti-tuberculous treatment because tuberculosis is common in Indian subcontinent. These patients were then followed up for a minimum period of 6 months.

There were no perioperative complications. In three cases, adequate sample could not be obtained by the first attempt,

and so cannula had to be reinserted in a new direction from the same pedicle.

Discussion

Historically, open biopsy maximizes tissue retrieval, providing the highest diagnostic success rate. The open biopsy is especially relied upon after failed needle biopsy or in selected presumed primary bone or cartilage tumors. However, the morbidity associated with an open surgical procedure has provided incentive for the development of closed needle biopsy techniques.

The first pedicular approach to the vertebral body was performed in 1928 by Duncan *et al.*,[7] whereas the first percutaneous biopsy was reported in 1935 by Robertson and Ball.[8] Only recently this method has been widely taken up.

In the study conducted by Kornblum *et al.*[9] in 1998, it was reported that with computed tomography (CT)-guided biopsy adequate specimens were obtained in 87% of cases. On the other hand, adequate sample were obtained in all the cases of this study. They also found that thoracic level percutaneous biopsies had a significantly lower accuracy rate.

Complications associated with closed transpedicular biopsy are bleeding, pneumothorax and neural injury. The incidence of pneumothorax after biopsy of the thoracic spine has been reported to be as high as 6.6% by Kattapuram *et al.*[5] They also reported few cases of transient paresis, transient spinal analgesia, radiculopathy, paraplegia, meningitis and death. The incidence of complications is thought to be related to the use of large biopsy needles. No such complications were seen during this study, which is attributable to the advances in the knowledge of vertebral morphometry and experience with transpedicular fixation. The pedicle can provide passage of biopsy instruments to the vertebral body without compromising vital structures placed at risk during the conventional closed biopsy of the spine. The anatomic relationship of the pedicle to neural elements underscores the importance of preserving the integrity of the medial and the inferior walls of the pedicle.[10]

Brugieres *et al.*[11] found reliability to be better in osteolytic lesions (94%) than in osteosclerotic lesions (75%). Ghelman *et al.*[12] reported that sclerotic lesions are more difficult to biopsy. They report an accuracy rate of 95% for lytic lesions, but only 42% for mixed lesions. Stroker and Kissan[13] found lower adequacy rates for biopsies in sclerotic lesions. They recommend pursuing sclerotic lesions at least in dense areas. Ghelman *et al.*[12] advocate the use of trocar instruments rather than spinal needles for sclerotic lesions.

Fidler and Niers[14] recommended an open transpedicular approach over a percutaneous procedure to facilitate block excision and to prevent damage to the pedicular wall with possibility of contamination of the epidural space or paravertebral structures. However, using the percutaneous techniques described in this study, these potential complications can be avoided, and the patient can be spared the morbidity and cost associated with the open procedure.

One of the advantages of this method is that it not only accommodates a variety of biopsy instruments but also provides access to any vertebral body lesion. It has been shown that instruments passed through one vertebral pedicle are able to access more than 50% of the volume of the vertebral body, including tissue directly anterior to the spinal canal. By performing this technique in multiple directions, more tissue can be obtained. Greater latitude for angling instruments exists in the saggital plane than in the axial plane because saggital pedicle diameter is greater than transverse diameter.[15] Adequate amount of the tissue can be obtained by this method for routine biopsy of the vertebral lesions.

Renfrew *et al.*[16] recommended CT-guided percutaneous transpedicular biopsy of the spine, when the location of a vertebral body lesion does not allow easy access by means of the posterolateral approach. This preference was based on the proximity of neural elements to the pedicle. However, high-resolution image intensifiers display sufficient detail of vertebral elements to allow protection of the medial and inferior walls of the pedicle during biopsy. Therefore, injury to neural elements can be avoided. In the current series, there were no outright advantages seen on CT guidance over image intensification. Aseptic environment of the operating room and cost effectiveness are an advantage of image intensification over CT scan.

Closed biopsy has become increasingly accurate as techniques and image modalities have evolved. Local anesthesia and an outpatient setting contribute to enhanced cost effectiveness. Consequently, percutaneous biopsy of spinal lesions has become the biopsy technique of choice, but not without rare but potential complications, such as nerve injury, bleeding, pneumothorax and inadequate tissue for diagnosis. This study has shown that the percutaneous transpedicular technique avoids the complications of closed biopsy, while retrieving greater volumes of specimen. The amount of tissue retrieved for histopathology contributes to a diagnostic success rate equivalent to the gold standard open technique, but with significant less morbidity.

The morbidity associated with closed technique is less, as it is percutaneous procedure. It is an outpatient procedure and our patients are discharged on the same day within few hours after the procedure. Some patients get excellent pain relief as obtained in core decompression in avascular necrosis in hip.

Conclusion

Percutaneous biopsy of central vertebral body lesions using a transpedicular approach is efficacious, safe and cost effective as it can be performed as an outpatient procedure. The decreased risk of hematoma, pneumothorax and nerve root injury makes the transpedicular approach an effective alternative to paraspinal biopsy for lesions involving even the central parts of the vertebral bodies.

The dimension of the pedicle allows passage of biopsy instruments to any vertebral body lesion and the retrieval of sufficient tissue for diagnosis. The use of local anesthesia helps in continuous monitoring of nerve root function, as the patient is awake and responds to painful nerve root stimuli. Bleeding is negligible. Another advantage of

transpedicular approach is that it avoids the spread of infection or tumor.

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