



## Clinical Study of a New Design Percutaneous Transpedicular Biopsy System for Spinal Tuberculosis

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**Purpose:** Despite some spinal tuberculosis cases having typical imaging findings, histological/microbiological evidence is required for definitive diagnosis and management. Percutaneous biopsy is suitable for histopathologic and bacteriologic evaluation of vertebral lesions, as it is a quick and minimally invasive technique to obtain specimens from deep structures and is advantageous for open surgical biopsy. Based on a minimally invasive technique, herein, we describe a newly designed percutaneous transpedicular biopsy system for lumbar vertebral lesion biopsy.

**Methods:** Fifty-six patients who underwent percutaneous transpedicular vertebral biopsy under fluoroscopic guidance were evaluated. Biopsy specimens were obtained by passing a proprietary 6-mm diameter biopsy instrument through the pedicle and into the disease site under C-arm fluoroscopy. Specimens were sent for histological and bacteriologic analyses.

**Results:** There were 36 males and 20 female patients of mean age 47.64 years (range 22-80 years). Biopsies were performed on 56 lumbar vertebral bodies. The average operative time were 15.6 minutes (range 13-18 minutes). All 56 patients (54 tubercular pathology, one metastasis, and one osteoporotic fracture with chronic nonspecific inflammation) had definitive histological/ microbiological diagnosis. Two patients (3.57% of 56 patients) developed a biopsy site small hematoma.

**Conclusions:** A newly designed percutaneous transpedicular biopsy system was successfully used for lumbar vertebral biopsy under local anesthesia. It was easy to use and was safe with a low complication rate for definitive diagnosis of lumbar spinal tuberculosis and could be performed with minimal morbidity and high diagnostic yield as an outpatient procedure.

**Keywords:** Percutaneous Transpedicular Biopsy, Spinal tuberculosis, Local anesthesia, Novel Medical Device

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Conventionally, open biopsy procedures are preferred over closed procedures when performed on any part of the body because more tissue is available for histopathology by that manner. However, the majority of doctor prefer percutaneous biopsy of the spine because of the relative inaccessibility of vertebral body elements. Nevertheless, reported complications of closed paravertebral biopsy include hematoma, pneumo-

thorax and spinal nerve root injury<sup>(1-2)</sup>. At the same time, reported diagnostic success rates vary<sup>(1-2)</sup>. Percutaneous biopsy is suitable for histopathologic and bacteriologic evaluation of vertebral lesions<sup>(3-5)</sup>, as it is a quick and minimally invasive technique to obtain a specimen from deep structures that has relevant advantages versus open surgical biopsy, and complications are rare with this procedure.

## OBJECTIVE

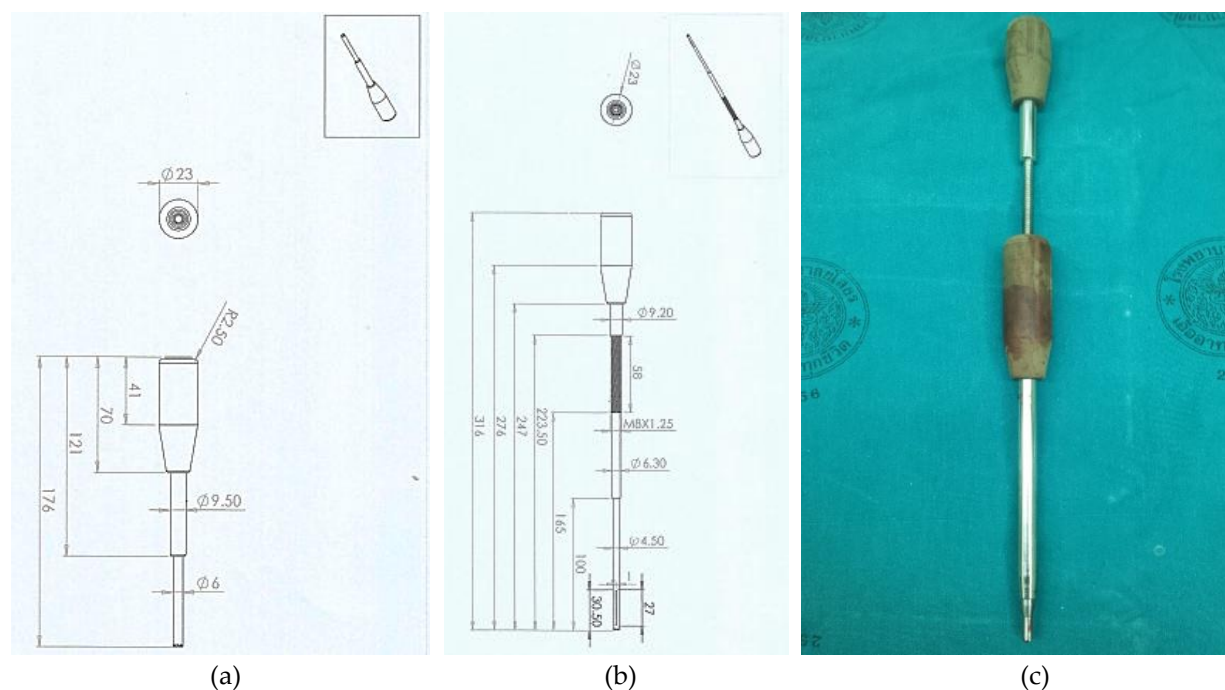
The primary objective of this study was to report the efficacy and safety of new design percutaneous transpedicular biopsy system. The secondary objective was to report the author's experience using this device.

## METHODS

Fifty-six consecutive patients with suspected lumbar spinal tuberculosis based on MRI findings (the official report suggest spinal tuberculosis) and underwent percutaneous trans-

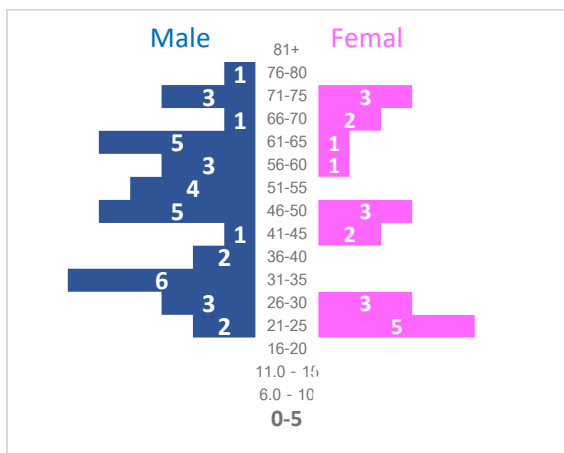
pedicular biopsy under fluoroscopic guidance procedures carried out between October 2014 and January 2019 were included in this analysis. Biopsy specimens were obtained after inserting a self-designed serrated 6-mm cannula with pointed trocar (Figure 1 a, b, c). The study population comprised 36 men and 20 women ranging in age from 22 to 80 years. Table 1,2 summarizes the clinical data.

All the procedures were performed in the prone position on a radiolucent operation table. This percutaneous procedure required a high-resolution image intensifier and a radiolucent operating table. The image intensifier was oriented until the X-ray beam was colinear with the sagittal pedicle angle, as determined from the lateral views of the vertebral body. A 'bull's eye' view of the pedicle was obtained in an antero-posterior (AP) view prior to initiating the procedure. Repeated AP and Lateral images were taken to ensure proper positioning.

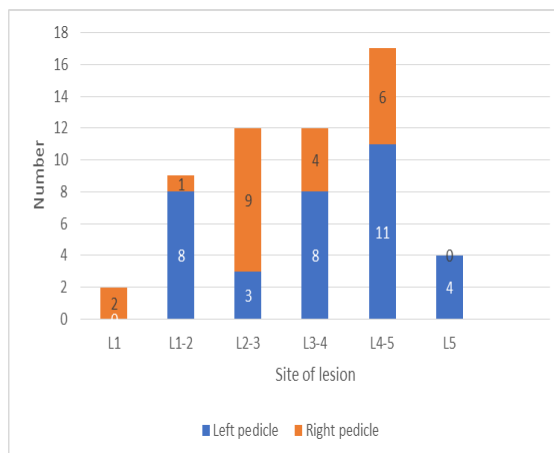


**Fig. 1.** New Design Percutaneous Transpedicular Biopsy System.  
 (a), (b) Graphic layout of the system.  
 (c) Self-designed serrated 6-mm cannula with pointed trocar.

**Table 1** Age and sex of the study population.



**Table 2** Site and number of the target pedicle.



**Fig. 2.** The target pedicle was tapping of a 3-mm Kirschner wire under fluoroscopic.



**Fig. 3.** The biopsy trocar was advanced into the target area.



**Fig. 4.** The saw tip of the cannula is made to pass about 80% of the AP diameter of the vertebral body.



**Fig. 5.** The biopsy sample after disengaging from self-designed serrated 6-mm cannula.



**Fig. 6.** The adequate specimens must contained of bony tissue more than 0.5 cm in length.

The target pedicle was marked in both its true AP and lateral views. Local anesthesia was obtained by injecting plain bupivacaine along the proposed needle tract. After a stab incision of the overlying skin, a tract was created into the deep fascia and muscle via hemostat. An entry point into the pedicle was created by gentle tapping of a 3-mm Kirschner wire under fluoroscopic guidance so the entry point lay on the supero-lateral margin of the pedicle in AP view or in Bull's eye view (Fig. 2). Correct position of the entry point was also confirmed in the lateral view and cephalocaudal inclination was adjusted to reach the target area for biopsy of the vertebral body. Once a correct entry point was ensured, the Kirschner wire was gently tapped into the pedicle under fluoroscopic guidance. Once the Kirschner wire reached the posterior border of the vertebral body in the lateral view, an AP image was obtained to ensure that the tip of the wire was at the center of pedicle and had not reached the medial edge of said pedicle. Next, a biopsy cannula 6-mm in diameter with a serrated edge was passed over the Kirschner wire via rotatory movement up to its tip. Its position was ensured once again both in AP and in lateral views. The Kirschner wire was then removed, and the biopsy trocar was advanced into the vertebral body via rotatory movement into target area (Fig. 3,4). The cannula tip is sharp and saw toothed, which allows tissue to enter the cannula. The saw tip of the cannula is made to pass about 80% of the AP diameter of the vertebral body. The cannula was rotated in a clockwise and anticlockwise motion several times to disengage the biopsy sample from the surrounding tissue. At this stage, a 10-ml syringe was attached at the backside of the cannula, then the plunger of the syringe was pulled out to its maximum, to create a suction effect inside the cannula, while withdrawing the cannula in a rotatory motion. The adequate specimens must contained of bony tissue more than 0.5 cm in length (Fig. 5,6). If adequate sample was not obtained on the first entry, then the cannula was reinserted after threading it over a blunt k-wire, then under image guidance, the direction of the cannula was altered to enable obtaining another sample. The specimens were sent for histological and microbiological

investigations in different containers after proper labeling. The wound was closed with a single stitch. All patients were discharged after a 6-hours observation period in the recovery room. Outpatients were interviewed on the 7th day after the procedure.

## RESULTS

Preoperative MRI of lumbar spine suggested 16 lytic lesions, 20 destructive lesions, 20 wedging, and 7 end-plate erosions. The specimens for diagnosis were obtained in all 56 patients. There were 36 males and 20 female patients of mean age 47.64 years (range 22-80 years). The average operative time were 15.6 minutes (range 13-18 minutes). All 56 patients (54 tubercular pathology, 1: metastasis, 1: osteoporotic fracture with chronic nonspecific inflammation) had definitive histological/microbiological diagnosis from their biopsy samples. Two patients (3.57% of 56 patients) developed a small hematoma at biopsy site. There were no perioperative complications encountered.

## DISCUSSION

One of the advantages of this method is that it not only accommodated a variety of biopsy instruments, but also provided 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. Further, greater latitude for angling instruments exists in the sagittal plane than in the axial plane because sagittal pedicle diameter is greater than transverse diameter<sup>(6)</sup>. An adequate amount of tissue can be obtained by this method for routine biopsy of the vertebral lesions.

Fidler and Niers<sup>(7)</sup> recommended an open transpedicular approach over a percutaneous procedure to facilitate block excision and to prevent damage to the pedicular wall with subsequent 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 both the morbidity and cost associated with an open procedure.

Complications associated with closed transpedicular biopsy include 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.<sup>(2)</sup> They also reported few cases of transient paresis, transient spinal analgesia, radiculopathy, paraplegia, meningitis and death. The incidence of complications post-biopsy was thought to be related to the use of large biopsy needles. No such complications were seen during this study, which is attributable to advances regarding the knowledge of vertebral morphometry and greater 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 surrounding neural elements underscores the importance of preserving the integrity of the medial and the inferior walls of the pedicle<sup>(8)</sup>.

This study has shown that the proprietary percutaneous transpedicular technique avoided the complications typically associated with closed biopsy, while retrieving greater volumes of specimen. The morbidity associated with this closed technique was also less, as it is percutaneous procedure. Finally, it was an outpatient procedure and our patients were discharged on the same day within a few hours after the procedure.

## CONCLUSION

A proprietary design percutaneous transpedicular biopsy system was successfully used for lumbar vertebral biopsy under local anesthesia. It was easy to use and, safe, with a low complication rate, yielding definitive diagnosis of lumbar spinal tuberculosis in all cases, and could be performed with minimal morbidity as an outpatient procedure. Bleeding was negligible. The decreased risk of hematoma, pneumothorax and nerve root injury makes this transpedicular approach an effective alternative to paraspin-

biopsy for lesions involving even central areas of the vertebral body.

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