

# **Percutaneous Musculoskeletal Biopsy (PMSB)**

Histopathological and bacteriological studies are often needed in musculoskeletal lesions to establish a definitive diagnosis. In such cases Percutaneous Musculoskeletal Biopsy (PMSB) has become a routine procedure.

## **1) Advantage of PMSB compared to surgical biopsy :**

- No weakening of bone structures through the surgical removal. This is particularly true in weight-bearing bones and in children, thus avoiding immobilization or osteosynthesis. No limitation of activity.
- No or minimal soft-tissue injury.
- No extensive hospitalization, procedure on an out-patient basis.
- No general anesthesia, the PMSB can easily be performed under local anesthesia and neuroleptanalgesia.
- Minimal recovery time
- No scars
- Lower cost

## **2) Indications**

Percutaneous bone biopsy is performed whenever pathologic, bacteriologic or biological examination is required for diagnosis or treatment. The major indications are the following :

- Primary or secondary bone tumors
- Osteitis
- Septic Arthritis, discitis

## **3) Contraindications**

The expected results of biopsy should be significant compared to the risks of the procedure. Careful review of imaging findings and of previous studies should assist the radiologist in avoiding unnecessary biopsies. Well-known contraindications are the following :

- Bleeding diatheses
- Biopsies of inaccessible sites ( odontoid process, anterior arch of C1 )
- Soft tissue infection

#### 4) Guidance: focus on dual guidance

Percutaneous cementoplasty, like other interventional procedures, is usually performed with a single imaging technique: fluoroscopy or CT, both of which have advantages and drawbacks.

Fluoroscopy offers multiple planes and direct imaging with the disadvantages of poor soft-tissue contrast and non-negligible radiation exposure for both patient and operator. CT is well-suited for precise interventional needle guidance because it provides good visualization of bone and surrounding soft tissues. It also avoids damage to adjacent vascular, neurological, and visceral structures. The disadvantages of this method are single-plane and delayed imaging.

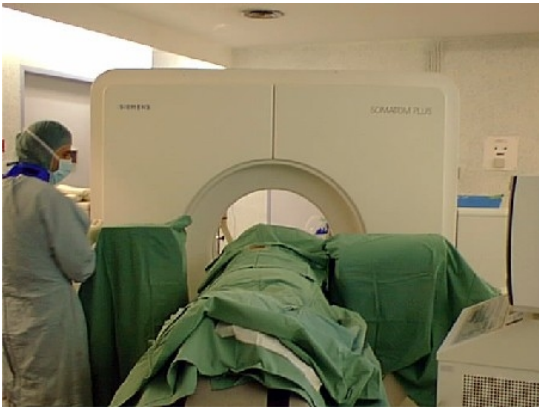


Fig 5: PMSB Dual guidance CT and fluoroscopy



Fig 6: PMSB Dual guidance fluoroscopy and CT

To address these concerns on a routine basis, a combination of CT and fluoroscopy for interventional procedures has been recommended. For fluoroscopy, a mobile C-arm is

used, positioned in front of the CT-gantry. By using a rotating fluoroscope and CT, the structure to be punctured can be visualized three dimensionally and with exact differentiation of anatomic structures, which in many cases is not possible with fluoroscopy alone. Two mobile monitors were placed in front of the physician, displaying the last stored image and the fluoroscopic image. The operator can switch from CT to fluoroscopy and vice versa at any time.



Fig 7: PMSB CT pathway



Fig 8: PMSB CT control

In percutaneous biopsy, the intervention begins with CT and is continued with fluoroscopy. Fluoroscopy is associated to CT whenever drilling is necessary.

## 5) Pathway

A CT scan is performed to localize precisely the lesion. The entry point and the pathway are determined by CT, avoiding nervous vascular and visceral structures.

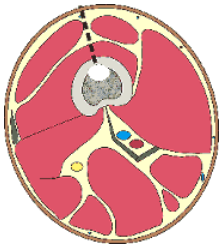


Fig 9: PMSB pathway

For peripheral long bone biopsy, the approach has to be orthogonal to the bone cortex. This approach angle avoids slippage with the tip of the needle. For minimizing as much as possible the tissue lesions during pass through, the shortest way should be chosen. The approach must avoid nervous, vascular, visceral, tendinous structures, and if possible muscular and, if not required, articular structures.

For flat bones such as scapula, ribs, sternum and skull we use an oblique approach angle of 30 to 60 degrees. This oblique approach angle is a compromise. The tangential approach is preferred to avoid damage to underlying structures whereas orthogonal angle avoids slippage with the tip of the needle.

For the pelvic girdle we use a posterior approach avoiding sacral canal and nerves.

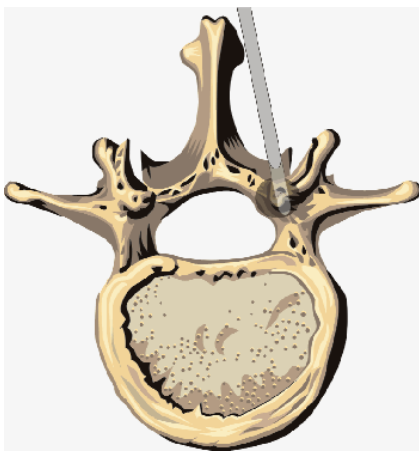


Fig 10: Posterior arch oblique approach

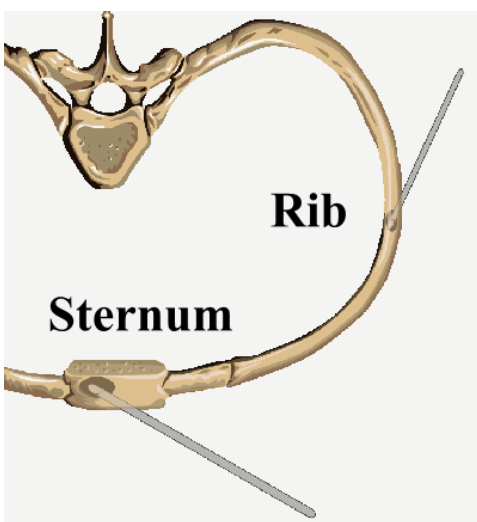


Fig 11: Rib oblique approach

For vertebral body biopsy, different approach routes can be selected depending on vertebral level : the anterior route for cervical level, the transpedicular and intercostovertebral route for the thoracic level, the posterolateral and the transpedicular route for the lumbar level. For the neural posterior arch we use a tangential approach to avoid the damages to underlying neural structures.

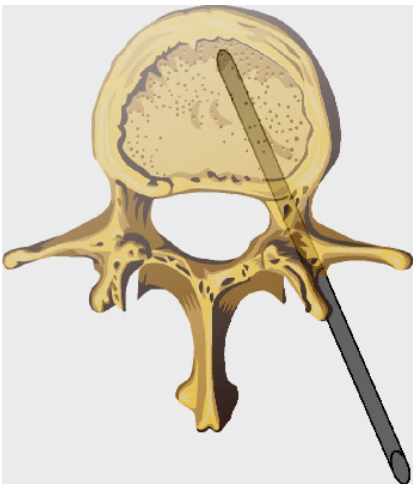


Fig 12: Transpedicular

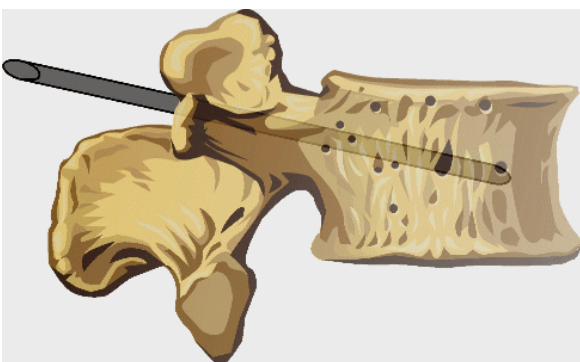


Fig 13: Transpedicular route

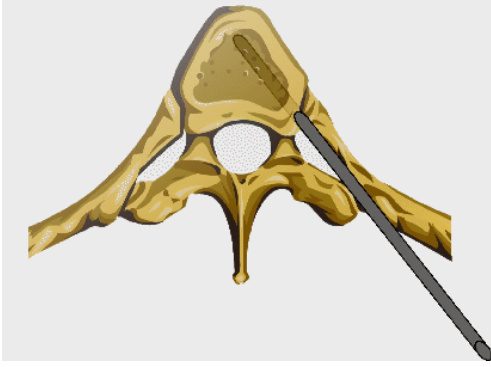


Fig 14: Intercostovertebral route

## 6) Anesthesia and bone puncture



Fig 17: PMSB local anesthesia

Bone biopsy is usually performed under local anesthesia. Neuroleptanalgesia may be necessary for painful lesions. General anesthesia is used only in children . The procedure is carried out under strict sterility. The skin's subcutaneous layers, muscles and the periosteum are infiltrated by local anesthesia ( 1% lidocaine ) with a 22-gauge needle. The position of the 22-gauge needle is checked by fluoroscopy and CT. For bone puncture the biopsy needle is guided safely under CT guidance. Fluoroscopy is used in conjunction with CT whenever drilling is necessary. Cortical perforation may require the aid of a surgical hammer.

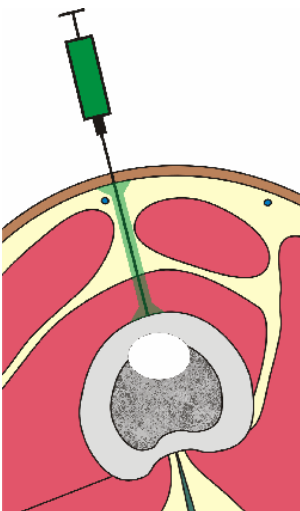


Fig 15:PMSB local anesthesia

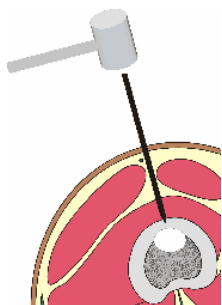


Fig 16: PMSB puncture

## 7) Biopsy needle and bone penetration

For peripheral bone biopsy

- Subperiosteal or cortical lesions without ossification are directly punctured with a 14-gauge needle.
- In cases with mild ossification or small cortex surrounding the lesion we use a 14-gauge Ostycut bone biopsy needle and penetration is performed with a surgical hammer (Ostycut, Angiomed / Bard, Karlsruhe, Germany).
- In cases of mild condensation, and for primary tumors or lymphoma we use a 8-gauge trephine needle (Laredo type).
- In cases of dense ossification, or of dense cortical bone surrounding the lesion, drilling was necessary. In these cases we use a 2-mm diameter hand drill or a 14-gauge Bonopty Penetration set (Radi Medical Systems Uppsala, Sweden).

For vertebral body biopsy

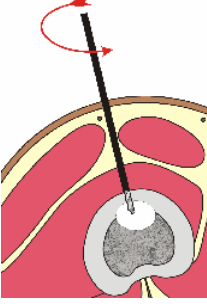
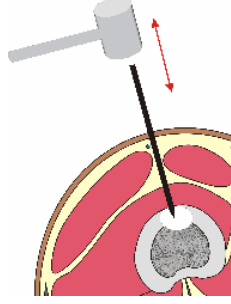
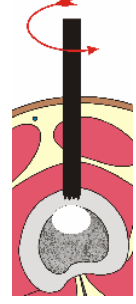
- We use an Ostycut bone biopsy needle and penetration is carried out with a surgical hammer (Ostycut, Angiomed / Bard Karlsruhe, Germany). We use a 14 gauge needle in cervical thoracic and lombar level.

- In cases of mild condensation, and for primary tumors or lymphoma we use a 8-gauge trephine needle (Laredo type).
- In cases of dense ossification, surrounding the lesion, drilling is necessary. In these cases we use a 2-mm diameter hand drill or a 14-gauge Bonopty Penetration set (Radi Medical Systems, Uppsala, Sweden).

For soft tissue biopsies

- True cut 14 to 16-gauge needles are used (Temno allegiance)

Fig 18:

		
<p>PMSB drilling with Bonopty penetration set</p>	<p>PMSB : Ostycut needle, penetration performed with surgical hammer</p>	<p>PMSB : trephine drilling</p>

## 8) Biopsy

CT images are repeated to confirm the correct placement of the needle tip. Then sampling is performed. For pathological examination the specimen is fixed in 10% formalin. Material is sent for histology. If bacteriological analysis is necessary the specimens are not fixed and sent for culture.

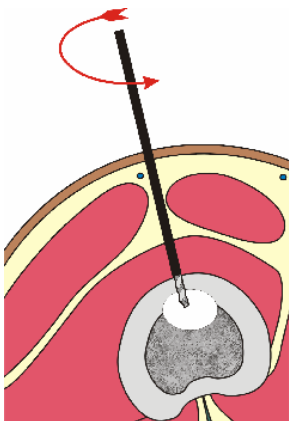




Fig 18: biopsy

## 9) Complications

Complications of PMSB are very rare. Possible and reported complications are :

- The major complication is septic osteitis. To avoid this complication, severe sterility during the intervention is mandatory.
- Hematoma
- Reflex sympathetic dystrophy
- Neural and vascular injuries.
- Pneumothorax

Murphin et al, in a large review of 9500 percutaneous skeletal biopsies, identified 22 complications ( 0.2% ). They reported 9 pneumothoraxes, 3 cases of meningitis, 5 spinal cord injuries. Serious neurological injury occurred in 0.08% of procedures. Death occurred in 0.02%.

Only two complications were observed among our 180 patients These consisted of paravertebral hematomas which resolved spontaneously. This low level of complications seems to be related to the systematic use of dual guidance providing precise and real-time control.

## 10) Results

From 1987 to 1999, 180 percutaneous musculoskeletal biopsies were performed on an out-patient basis. There were 63% female and 37% male patients ranging in age from 17 to 87 years ( mean 58.4 years ). Biopsy was performed in 55% of the cases for lytic lesions, in 24% of the cases for condensing or mixed lesions, in 18% of the cases for vertebral compression fractures. Biopsy was made in 68% of the cases for vertebral , in 17% of the cases for pelvic girdle and in 14% of the cases for peripheral long bone lesions. Vertebral lesions were at cervical in 3% of the cases, in 15% of the cases at thoracic level, in 45% of the cases at lumbar level and in 7% of the cases at sacral level. Only two complications were observed among our patients These consisted of paravertebral hematomas which resolved spontaneously. Specificity for diagnosis was 100 %, sensitivity was 93.9 %, positive predictive value was 100 %, negative predictive value was 87.5%.

Lesion type	Lytic	Condensing or mixed	Vertebral compression fractures	Other
Number %	55%	24%	18%	4%

Location	Vertebral	Pelvic girdle	Peripheral long bones
Number %	68%	17%	14%

Level	Cervical	Thoracic	Lumbar	Sacrum
Number %	3%	45%	45%	7%

Results	
Sensitivity	93.9 %
Specificity	100 %
P.P.V.	100 %
N.P.V.	87.5 %

## 11) Cases

### Case 1 Osteolytic metastasis, Osticut needle.



Case1 : CT pathway

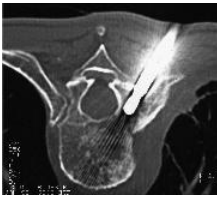


Case1 : biopsy, CT control

## Case 2 Transpedicular trephine biopsy, lymphoma



Case 2 : local anesthesia



Case 2 : trephine, CT control

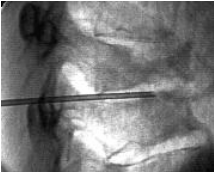


Case 2 : trephine, fluoroscopic control

## Case 3 Diskal biopsy, discitis

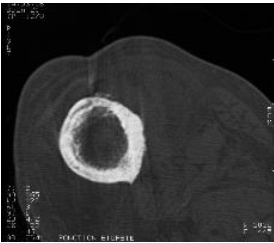


Case 3 : diskal biopsy CT control

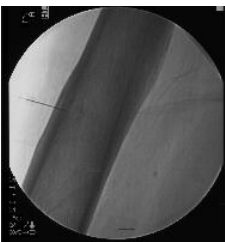


Case 3 : diskal biopsy fluoroscopic control

**Case 4 Percutaneous biopsy. Indication : osteitis. Lesion of the femur.  
Technique : orthogonal route, 8-gauge trephine needle (Laredo type).**



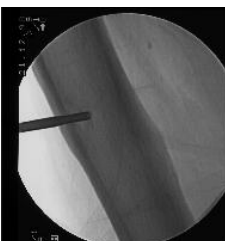
Case 4 : CT before biopsy



Case 4 : local anesthesia



Case 4 : trephine drill fluoroscopic control



Case 4 : sampling fluoroscopic control



Case 4 : sampling CT control

**Case 5 Cervical vertebral biopsy, lateral approach. Result : eosinophilic granuloma**



Case 5 : CT eosinophilic granuloma

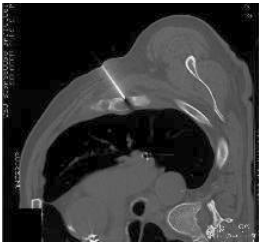


Case 5 : CT control

**Case 6 Percutaneous biopsy of an osteolytic lesion of rib. Technique : oblique route, Ostycut bone biopsy needle. Results : myeloma**



Case 6 : CT osteolytic lesion of rib

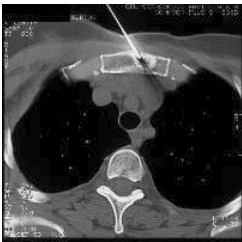


Case 6 : biopsy, CT control

**Case 7 Percutaneous biopsy of an osteosclerotic lesion of the sternum.  
Technique : oblique route, Ostycut bone biopsy needle. Results : breast  
cancer metastasis**

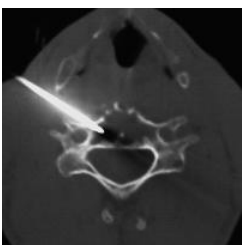


Case 7: CT osteosclerotic lesion of the sternum

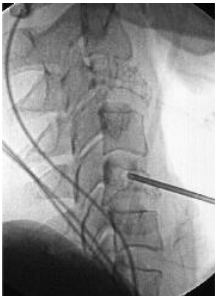


Case 7 : biopsy, CT control

**Case 8 Cervical vertebral biopsy, antero-lateral approach. Result :  
myeloma**



Case 8: CT control



Case 8: fluoroscopic control