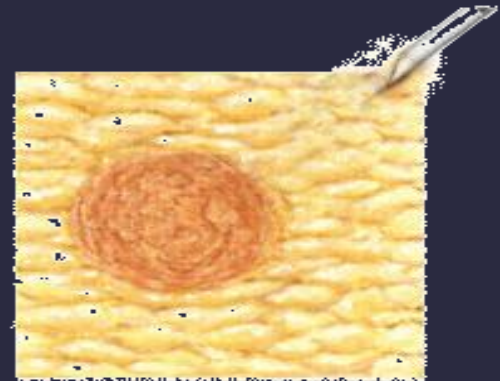


Αρχές και αναγκαιότητα της κλειστής κατευθυνόμενης βιοψίας

Dimitrios K Filippiadis MD, PhD, MSc, EBIR
Assistant Professor of Diagnostic and Interventional Radiology
2nd Radiology Dpt, University General Hospital "ΑΤΤΙΚΟΝ"
Medical School, National and Kapodistrian University of Athens



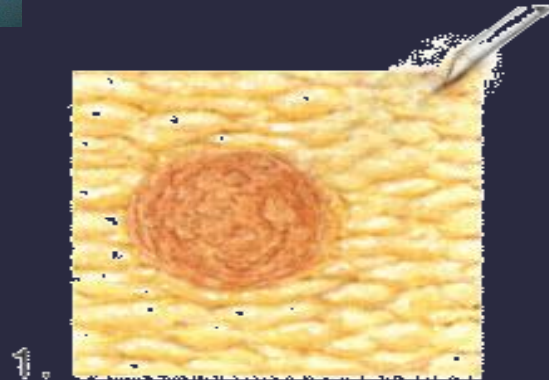


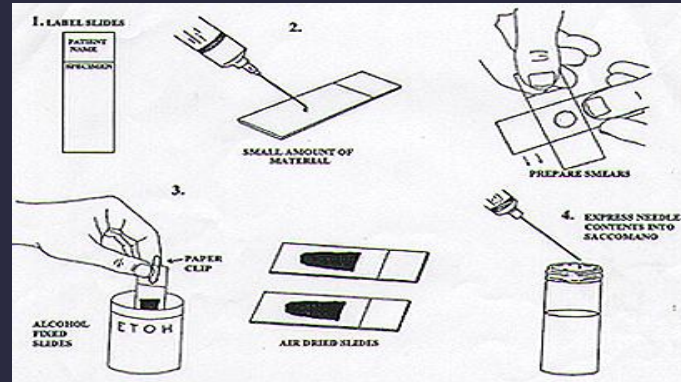
ΔΙΑΔΕΡΜΙΚΕΣ ΒΙΟΨΙΕΣ

- Διαδερμική βιοψία διά βελόνης: εισαγωγή βελόνας εντός αλλοίωσης αγνώστου υποβάθρου με σκοπό τη λήψη κυττάρων ή ιστικού τεμαχίου
 - Αναρρόφηση διά λεπτής βελόνης (<20-22G): απόκτηση κυττάρων προς κυτταρολογικό έλεγχο
 - Ιστική βιοψία: απόκτηση ιστοτεμαχιδίου με βελόνη διαμέτρου >20G προς παθολογοανατομική εκτίμηση



20-22 G NEEDLES

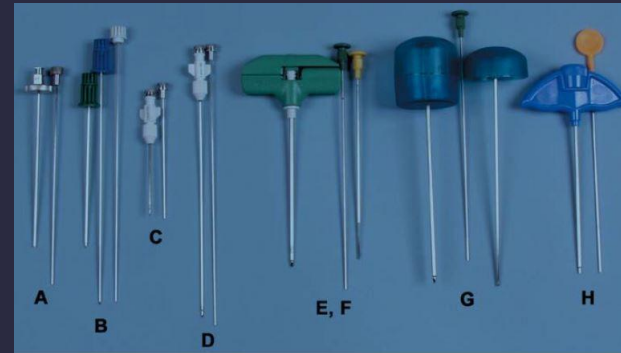
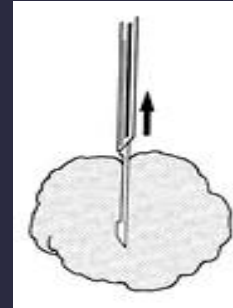




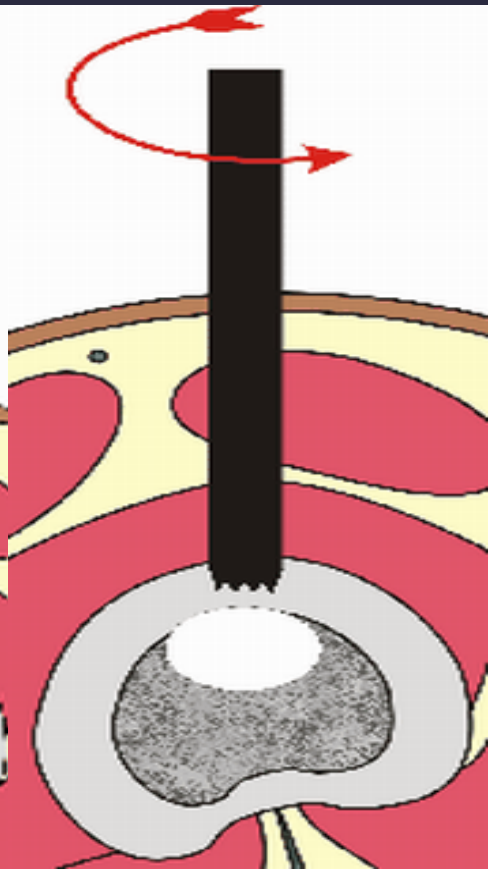
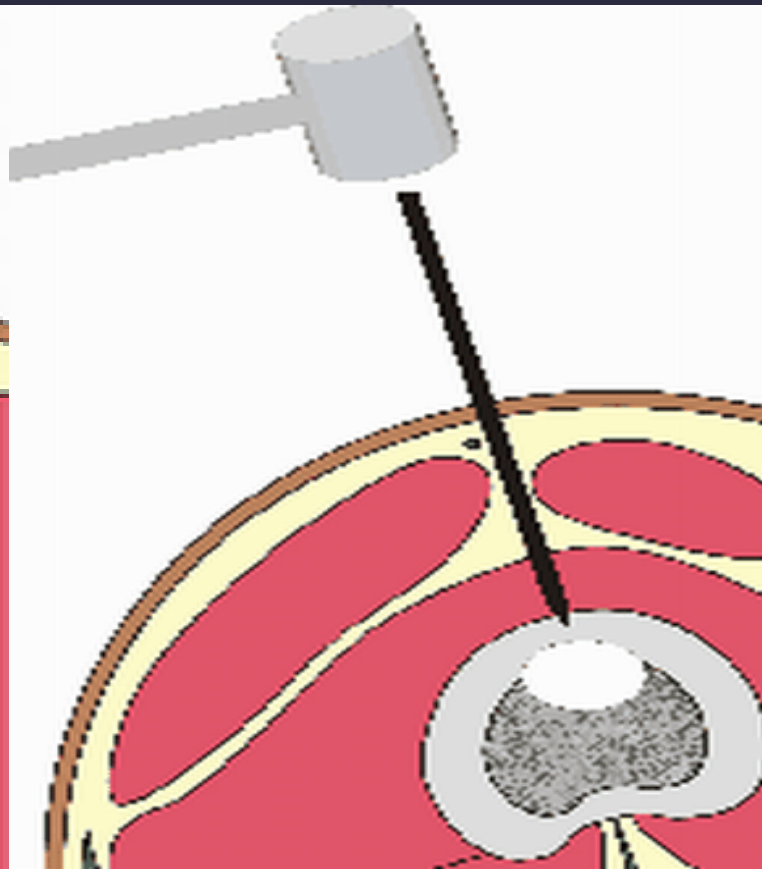
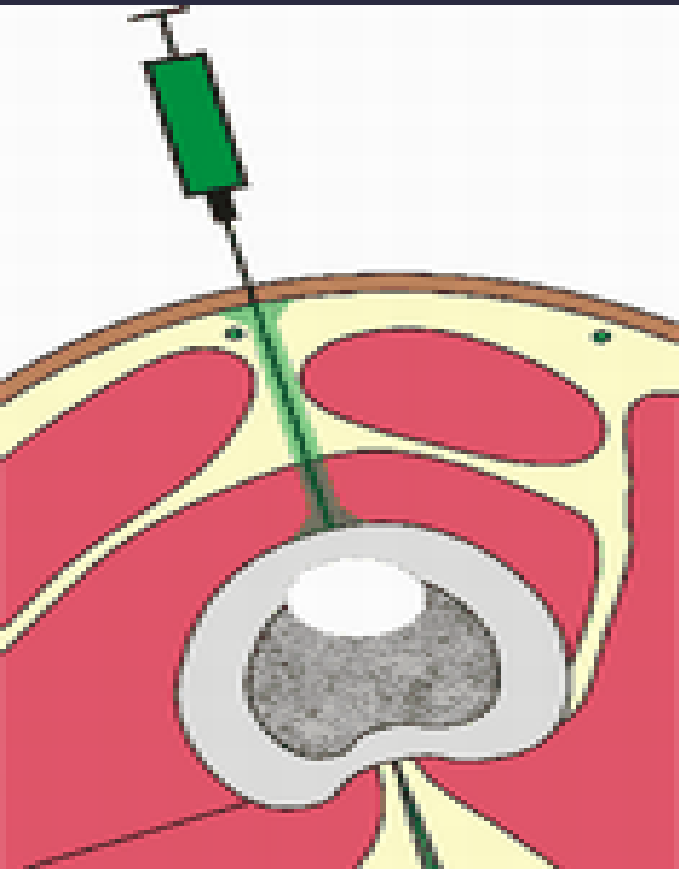


ΒΙΟΨΙΑ ΜΕ ΒΕΛΟΝΑ ΜΕ ΤΕΜΝΟΝ ΑΚΡΟ (CORE NEEDLE BIOPSY)

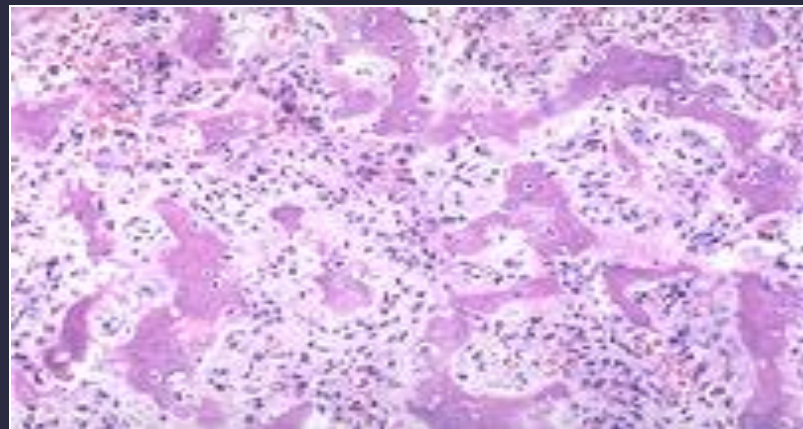
Βελόνες cut 10-18 G



Techniques for sampling bone







MSK BIOPSY

- More than 1.4 million patients are diagnosed with cancer annually in the United States
- Skeletal system: third most important filter for cancer metastases after lungs and liver

MSK BIOPSY

- Spine: the most common site of osseous metastatic disease
- WHY SPINE?
 - Presence of vascular red marrow in adult vertebrae
 - Communication of deep thoracic and pelvic veins with valveless vertebral venous plexuses

MSK BIOPSY

- Robertson and Ball (mid 1930s) posterolateral percutaneous approach
- Fluoroscopically guided needle biopsy of the spine: 1949 -
- CT guided biopsy of the spine: 1981-

MSK BIOPSY

- Favourable risk-benefit ratio
- Technically feasible
- Sampling from different parts of the tumor
- Adequate for both histopathologic and molecular evaluation
- Potentially result in change of therapy

MSK BIOPSY

Table 1 Sensitivity and specificity of imaging modalities in bone metastasis

Imaging modality	Sensitivity (%) ^[12]	Specificity (%) ^[12]
18F NaF-PET/CT	100	97
MRI	95	90
SPECT	87	91
18F FDG-PET	98	56
CT	74	56
Bone Scintigraphy	78	48

Imaging of bone metastasis: An update

World J Radiol 2015 August 28; 7(8): 202-211

ISSN 1949-8470 (online)

Gerard J O'Sullivan, Fiona L Carty, Carmel G Cronin

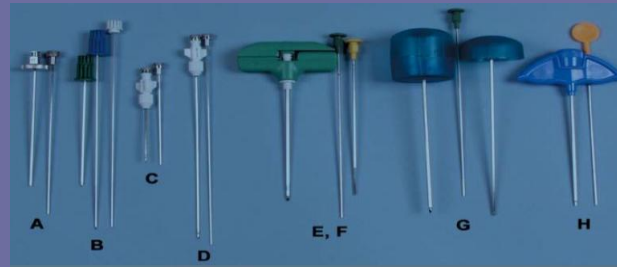
MSK BIOPSY

ISSUES TO CONSIDER PRIOR TO BIOPSY:

- Review recent cross sectional imaging (x rays, CT, MRI, PET/CT)
- Lesion shape / location / lytic vs blastic
- SINS
- Vascularity
- Close by sensitive structures

MSK BIOPSY

- Select the image guidance method optimal for the biopsy
- Assess the appropriate needle trajectory that would likely give the greatest diagnostic yield
- Choose the most appropriate biopsy system and type of anesthesia



IMAGING GUIDANCE

- U/S (real-time imaging)
- Fluoroscopy (real-time imaging)
- CT (CT fluoro) (high-resolution images, 3D)
- Flat panel cone-beam CT (more accurate and faster)
- MR (thermal monitoring capacity)

IMAGING GUIDANCE



IMAGING GUIDANCE

Table 1
Advantages and Disadvantages of the Imaging Modalities Used to Guide Celiac Plexus Block

Modality	Advantages	Disadvantages
Fluoroscopy	Simple to perform	Anatomic structures overlap; does not allow distinction between the pancreas, blood vessels, tumors, and lymph node metastases, thus increasing risk for complications; diffusion of neurolytic solution is not clearly displayed
US	Simple and inexpensive; the aorta, celiac artery, and SMA are clearly identified; diffusion of neurolytic agent may be seen without contrast medium	Operator dependent, retroperitoneal organs (including the pancreas) are not clearly identified
Multidetector CT	High contrast and spatial resolution; clearly depicts retroperitoneal structures and extent of tumor; celiac plexus may be directly identified; needle puncture site and needle course may be planned in advance; depicts the exact location of the needle tip and surrounding structures, helping avoid vital organ damage; accurately depicts diffusion of neurolytic agents; CT fluoroscopy allows real-time monitoring of the procedure	Risk for radiation exposure
MR imaging	Superior soft-tissue resolution, contrast material not necessary, no ionizing radiation	Expensive, limited availability, requires MR imaging-compatible equipment
Endoscopic US	Real-time monitoring of neurolytic agent injection, use of an anterior approach avoids neurologic complications	Operator dependent, invasive, risk for complications (eg, gastric perforation, pancreatitis), snowstorm effect may hinder visualization of the celiac plexus

IMAGING GUIDANCE

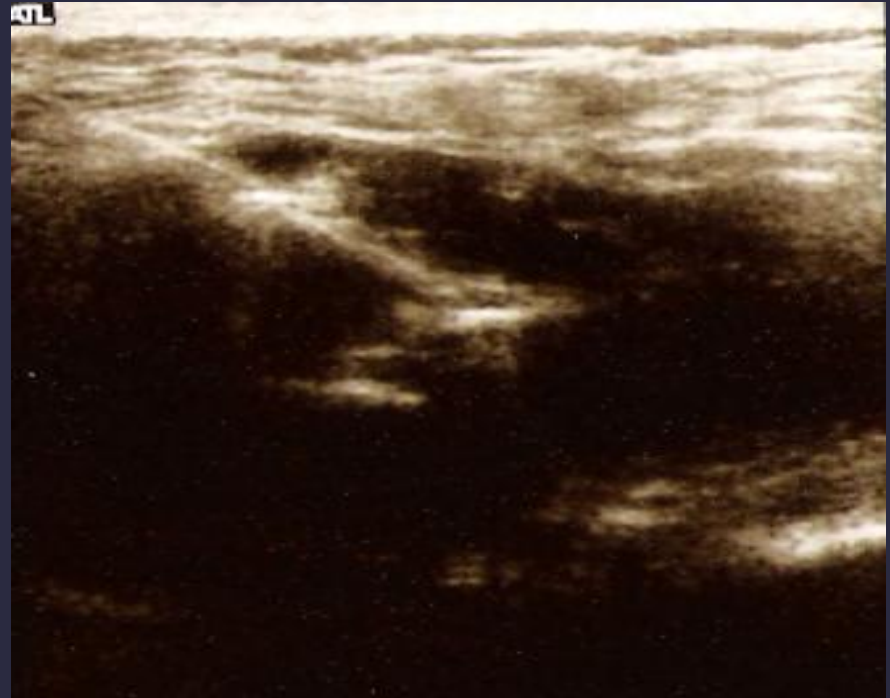
Advantages

- No radiation exposure
- Rapid image acquisition
- Widespread availability

Disadvantages

- Difficult imaging in some patients
- Image quality
- Difficult visualization (esp. of the iceball)

IMAGING GUIDANCE



IMAGING GUIDANCE

Advantages

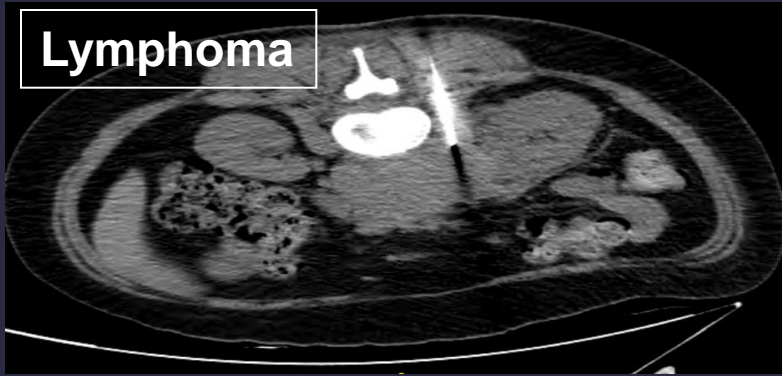
- Widely available
- Rapid image acquisition
- Better visualization of cryoprobe/RF electrode

Disadvantages

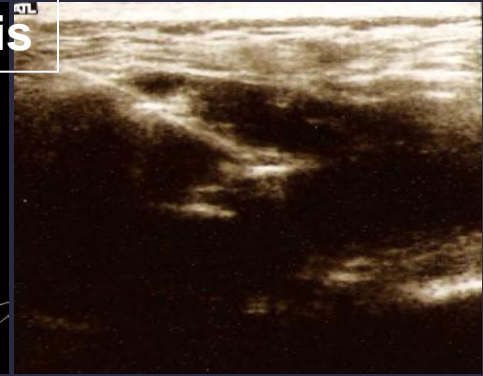
- Radiation exposure

MSK BIOPSY

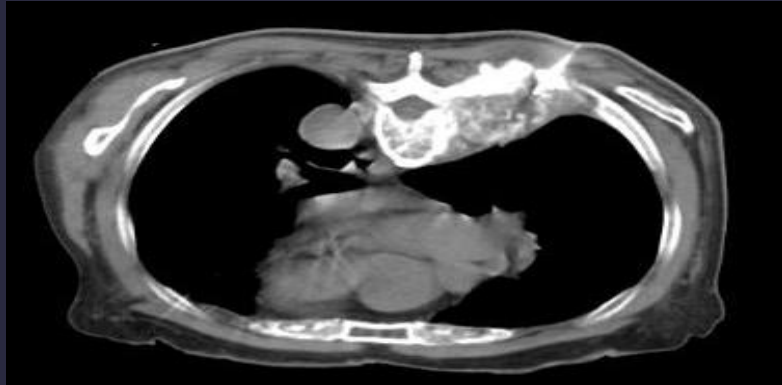
Lymphoma



Gastric Ca metastasis



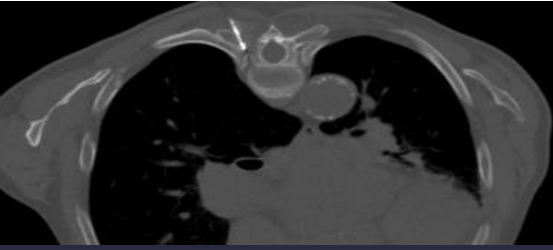
Urinary Bladder Ca metastasis



Multiple Myeloma



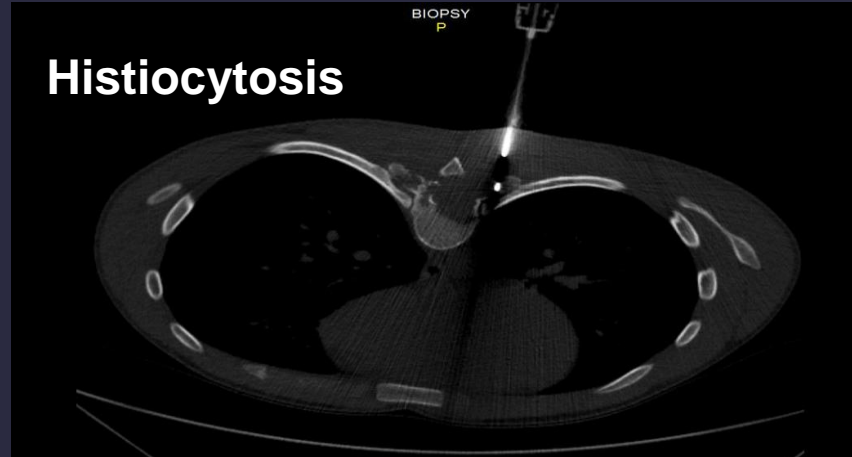
MSK BIOPSY



Bronchogenic Ca meta



Histiocytosis



IMAGING GUIDANCE

MR

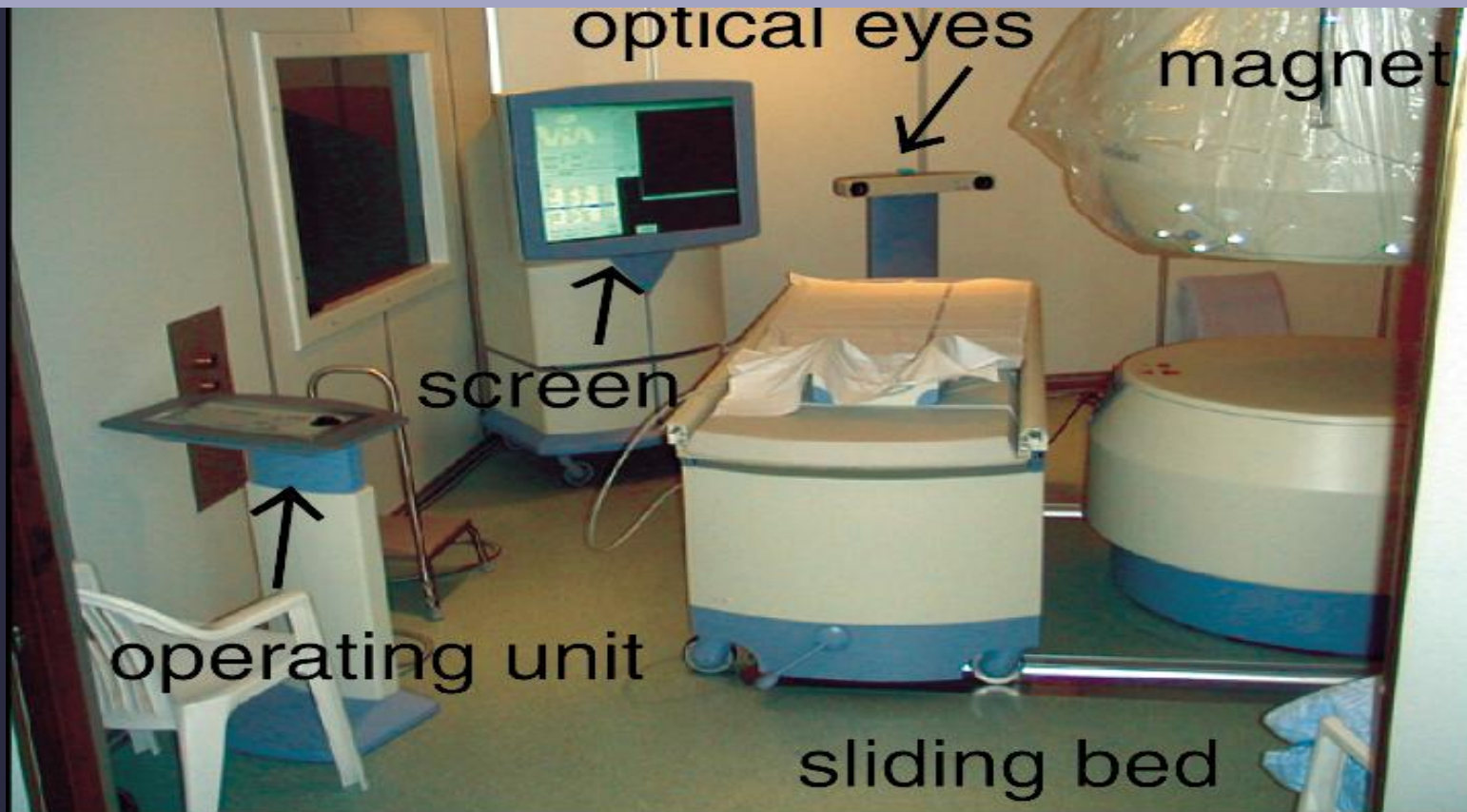
Advantages

- Best visualization of probe/RF electrode
- No radiation exposure
- Best visualization of iceball
- Image in sagittal and coronal plane
- Thermal monitoring capacity

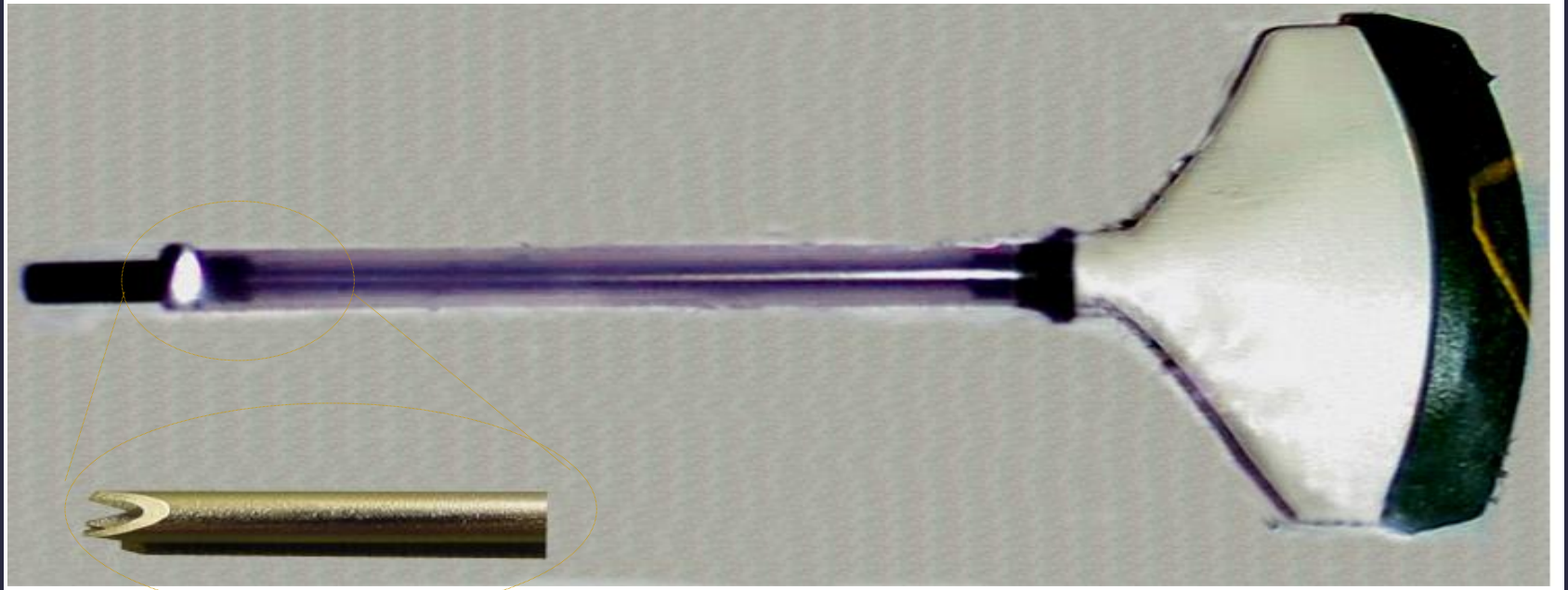
Disadvantages

- Small working area
- Limited availability
- Longer duration

IMAGING GUIDANCE

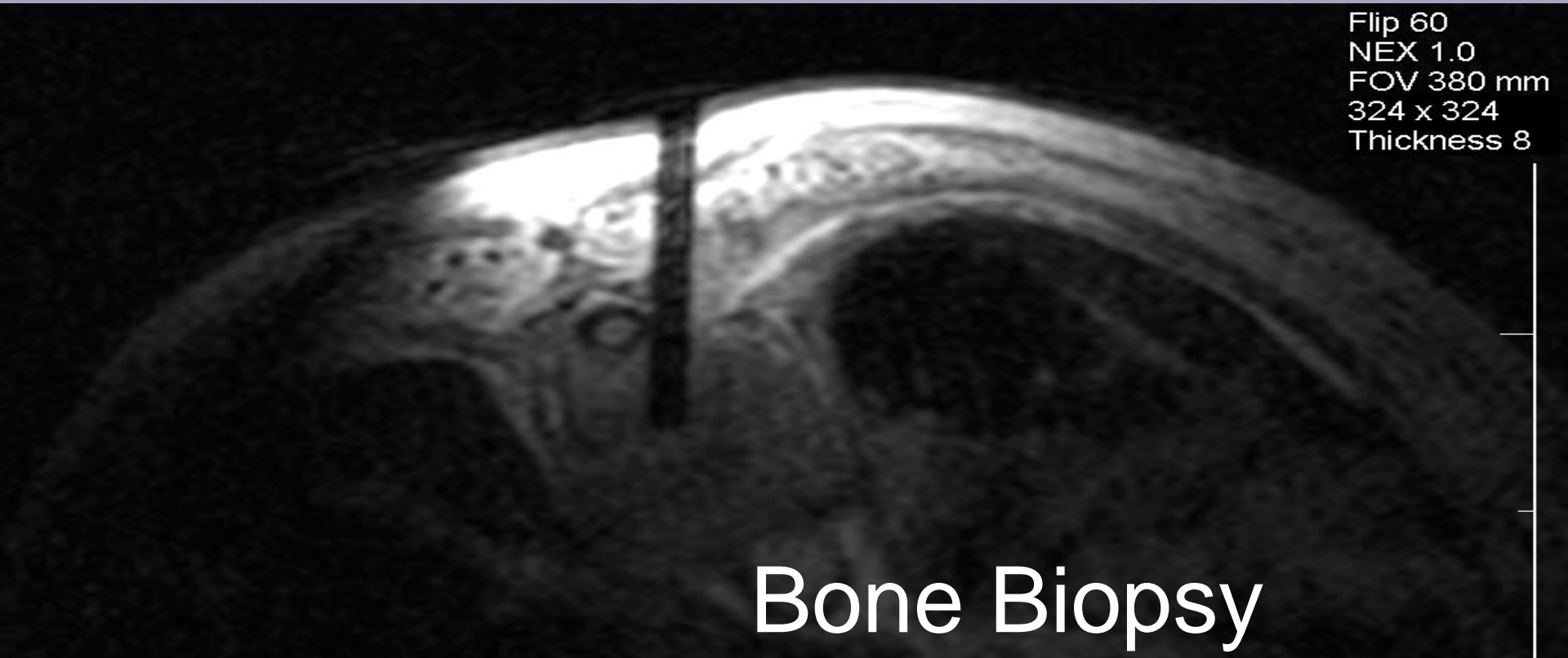


IMAGING GUIDANCE



Titanium Biopsy Systems

IMAGING GUIDANCE



Flip 60
NEX 1.0
FOV 380 mm
324 x 324
Thickness 8

Bone Biopsy

MSK BIOPSY

Cardiovasc Intervent Radiol (2016) 39:290–295
DOI 10.1007/s00270-015-1216-y



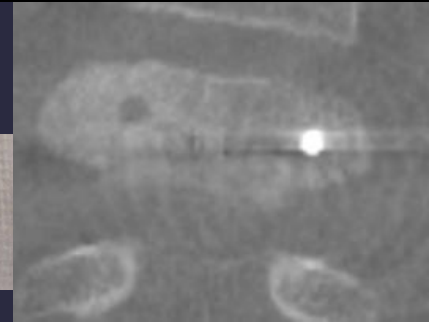
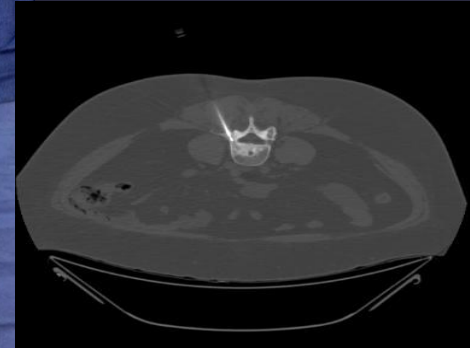
TECHNICAL NOTE

Fluoroscopy-Guided Percutaneous Vertebral Body Biopsy Using a Novel Drill-Powered Device: Technical Case Series

Adam N. Wallace¹ · Rafael A. Pacheco¹ · Anderanik Tomasian¹ · Andy C. Hsi² · Jeremiah Long¹ · Randy O. Chang³ · Jack W. Jennings¹



Breast Ca
metastasis

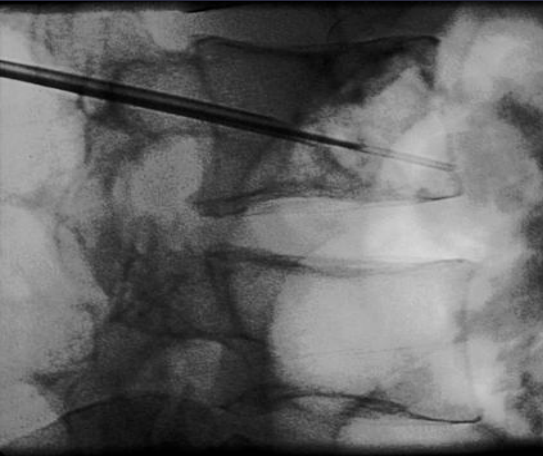


- Reduce procedure time and radiation exposure
- Easily cuts through even sclerotic bone lesions
- Obtain more bone core

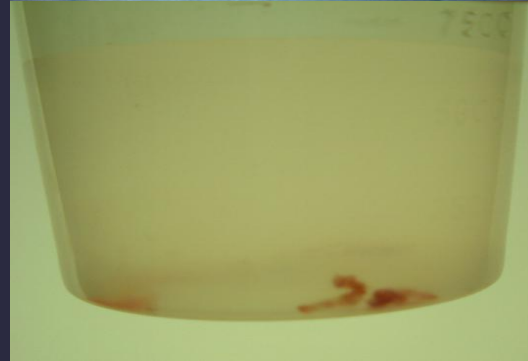
MSK BIOPSY



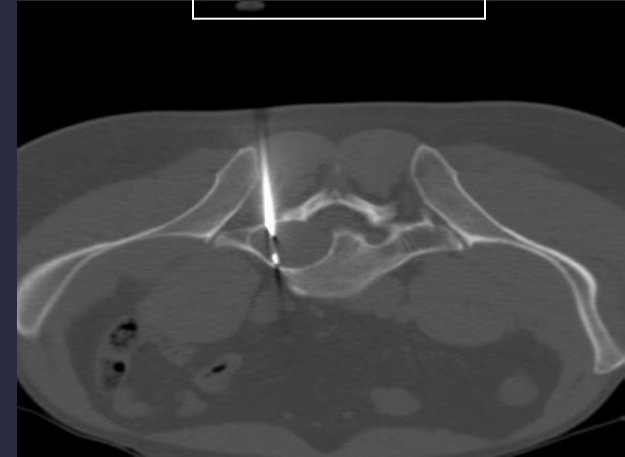
MSK



Multiple Myeloma



Neurinoma



MSK BIOPSY

Targeting of metabolic and progressing lesions

Target the periphery of the lesion

After each core, aspirates or bleeding back through the large needle

- **CONSIDER PATIENT SAFETY**

MSK BIOPSY

- Percutaneous biopsy of intramedullary lytic lesions that do not have a soft tissue component **may only yield blood clots**
- Specimens containing principally blood clots were obtained in **20.8% of cases** with percutaneous needle biopsy providing diagnosis **for a diagnostic yield of 75%**



MSK BIOPSY

- Coagulopathy (INR>1.5, PT>1.5 times control, platelets<50.000/mm³)
- Systemic infection – skin infection at puncture site
- Significant spinal cord compromise at the biopsied level (theoretical risk of causing or aggravating a myelopathy)
- Epidural tumor in the spinal canal (risk of tissue swelling/bleeding and further spinal cord compromise)

MSK BIOPSY

- Confirm metastatic tumor involvement of the spine in a patient with a known primary neoplasm - Confirm diagnosis of multiple myeloma
- Determine a lesion with intermediate or aggressive imaging features
- Assess benign vs pathologic compression fracture

MSK BIOPSY

- routine biopsy at osteoid osteoma ablation



MSK BIOPSY

- Overall accuracy 77-97%
- Higher positive recovery rates for osteolytic lesions
- Lower positive recovery rates for sclerotic lesions
- Lower accuracy rates does **not** necessarily indicate suboptimal technique or invalid procedure

MSK BIOPSY

Cumulative Diagnostic Yield for Bone and Soft-Tissue Lesions with Increasing Number of Specimens

Lesion-related or Technical Factor	Cumulative Diagnostic Yield according to No. of Specimens Obtained (%)						No. of Specimens to Reach Diagnostic Yield Plateau
	1	2	3	4	5	6	
All lesions (<i>n</i> = 151)	65	71	75	77	77	77	4
General lesion subtype							
Soft tissue (<i>n</i> = 63)	67	71	73	76	76	76	4
Bone (<i>n</i> = 88)	64	70	77	77	77	77	3
Bone lesion subtype							
Sclerotic (<i>n</i> = 28)	39	46	57	57	57	57	3
Lytic (<i>n</i> = 60)	75	82	87	87	87	87	3
Lesion size (cm)							
≤2 (<i>n</i> = 24)	42	50	54	54	54	54	3
>2 To 5 (<i>n</i> = 57)	67	72	74	75	75	75	4
>5 (<i>n</i> = 70)	71	77	84	86	86	86	4
Biopsy needle gauge							
14 (<i>n</i> = 6)	67	67	67	83	83	...	4
15 (<i>n</i> = 68)	54	63	72	72	72	72	3
16 (<i>n</i> = 30)	67	73	73	77	77	77	4
18 (<i>n</i> = 47)	79	81	83	83	83	83	3
Imaging guidance modality							
CT (<i>n</i> = 133)	65	71	76	77	77	77	4
US (<i>n</i> = 18)	67	72	72	78	78	78	4

Wu JS et al. Bone and soft tissue lesions: What factors affect diagnostic yield of image guided core needle biopsy. Radiology. 2008; 248: 962-970.

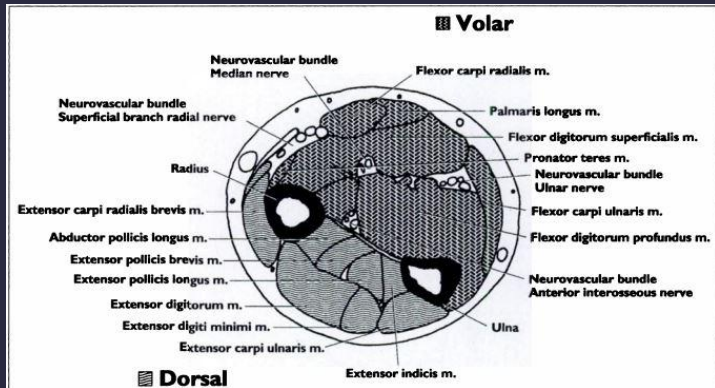


BONE BIOPSY: respect compartmental anatomy

Perspective

Compartmental Anatomy: Relevance to Staging and Biopsy of Musculoskeletal Tumors

Mark W. Anderson^{1,2}, H. Thomas Temple^{2,3}, Robert G. Dussault^{1,2}, Phoebe A. Kaplan^{1,2}



APPENDIX 2: Anatomic Compartments

General

- Skin and subcutaneous fat
- Bone
- Parasosseous space
- Joint

Upper Extremity

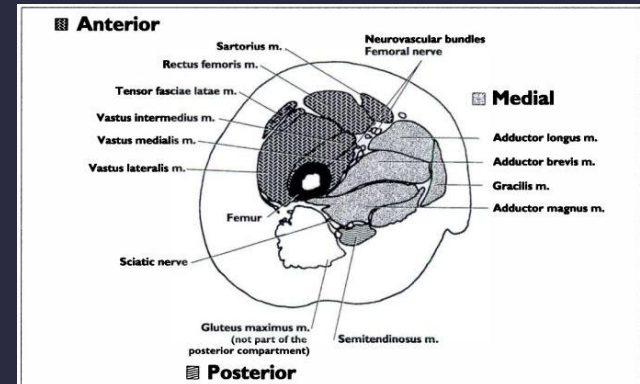
- Periscapular tissue
- Upper arm: anterior and posterior
- Forearm: dorsal and volar
- Hand: palmar tissue

Pelvis

- Individual bone or muscle

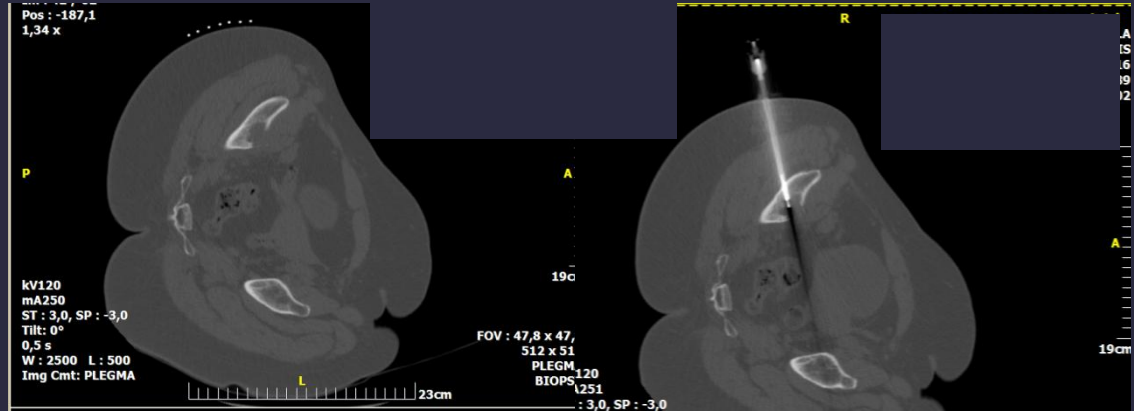
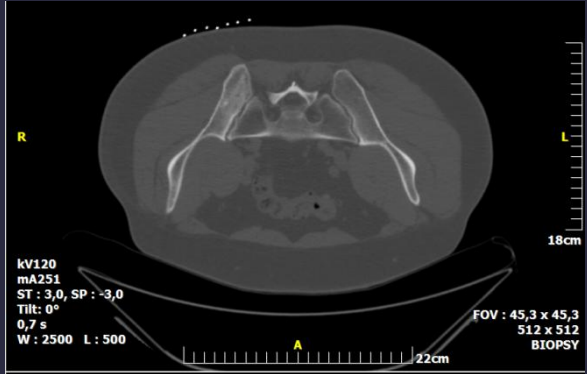
Lower Extremity

- Thigh: anterior, posterior, and medial
- Lower leg: anterior, deep posterior, posterior, and lateral
- Foot: plantar tissues (medial, central, and lateral)





BONE BIOPSY: respect compartmental anatomy





BONE BIOPSY: respect compartmental anatomy

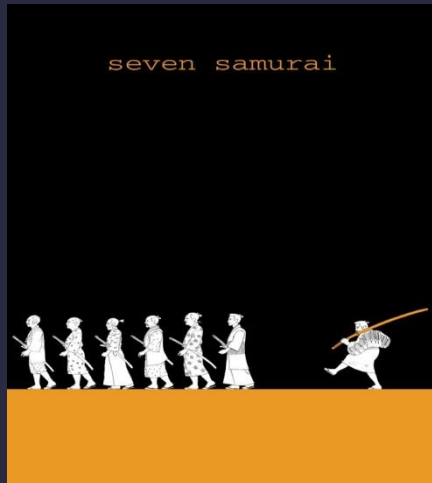


STEPS TO A SOLUTION:

Talk to your surgeon to determine the ideal approach route

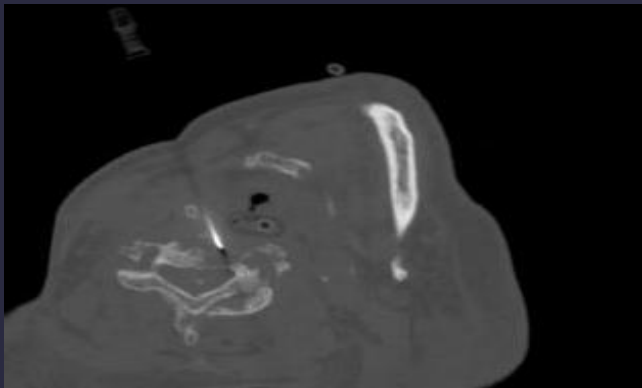
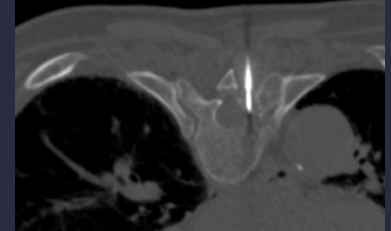
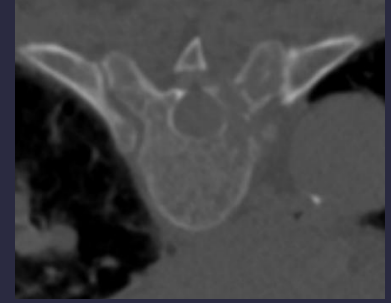
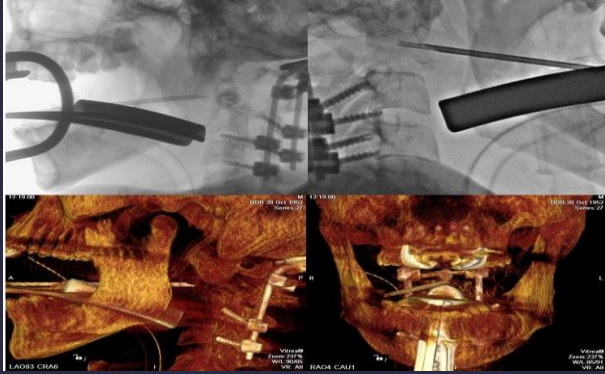
SPINE BIOPSY

SPINE BIOPSY TARGET

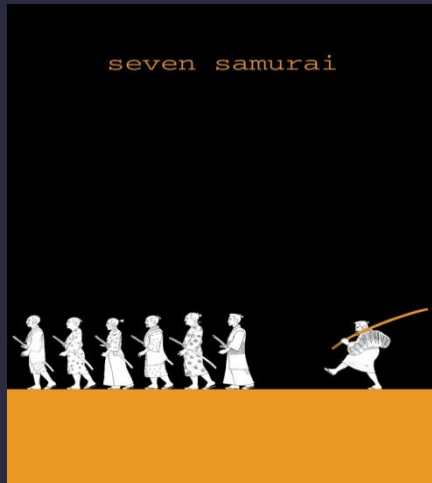


1. Vertebral body
2. Posterior vertebral arch
3. Intervertebral disc
4. Facet joint
5. Paraspinal mass
6. Epidural space – neural foramen
7. Spinal cord

MSK BIOPSY



SPINE BIOPSY TARGET

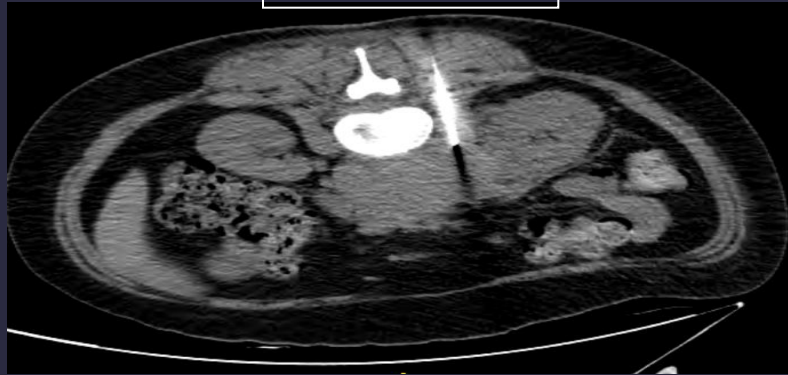


1. Vertebral body
2. Posterior vertebral arch
3. Intervertebral disc
4. Facet joint
5. Paraspinal mass
6. Epidural space – neural foramen
7. Spinal cord

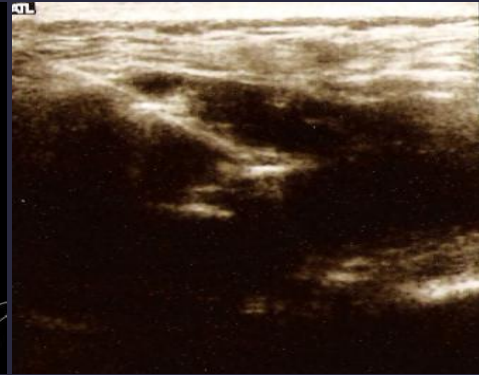
SPINE BIOPSY TARGET CONSIDERATIONS

PARASPINAL MASS

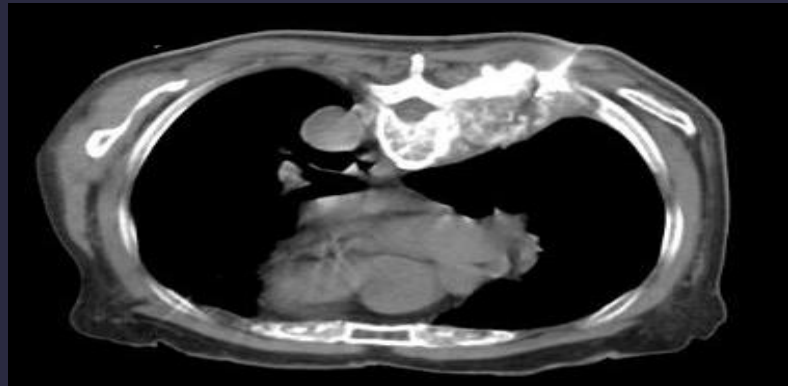
Lymphoma



Gastric Ca metastasis



Urinary Bladder Ca metastasis



Multiple Myeloma

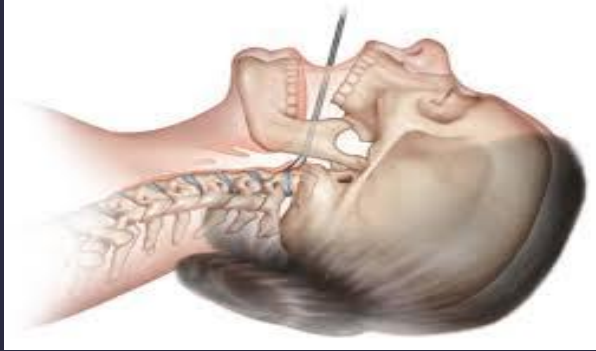


SPINE BIOPSY TARGET CONSIDERATIONS

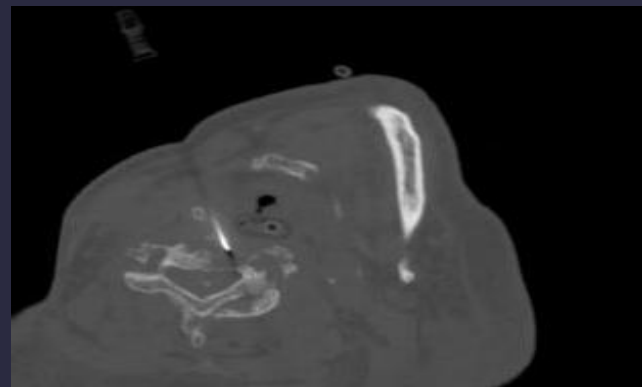
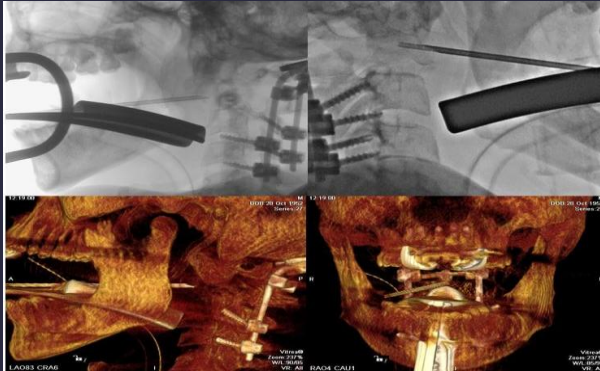
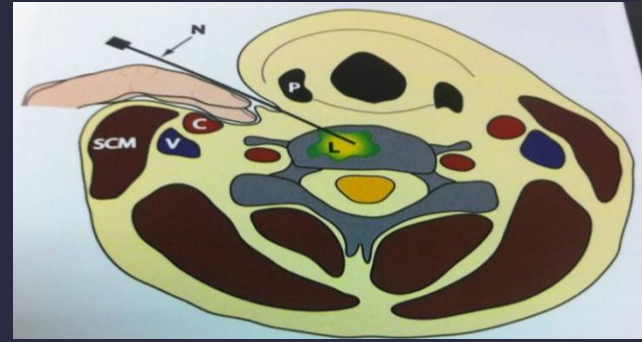
VERTEBRAL BODY

CERVICAL SPINE APPROACH

TRANS-ORAL

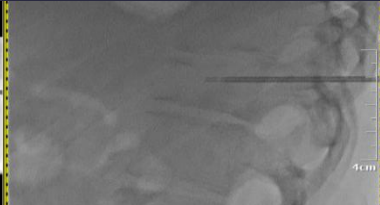
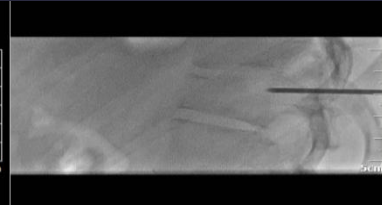
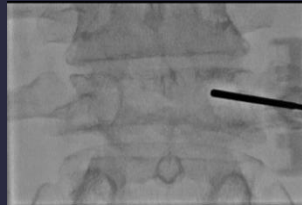
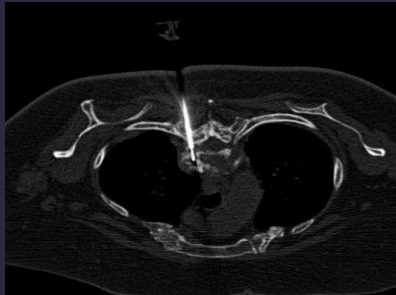
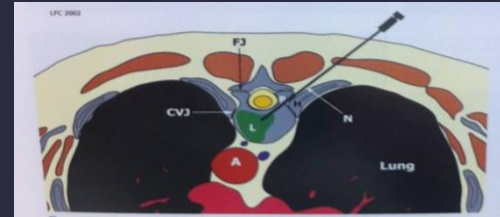
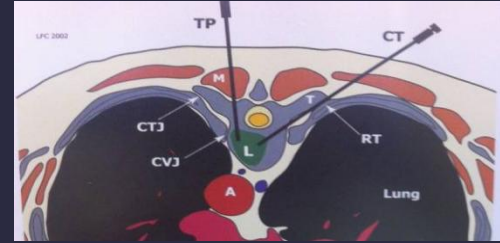


ANTERO-LATERAL



THORACIC SPINE APPROACH

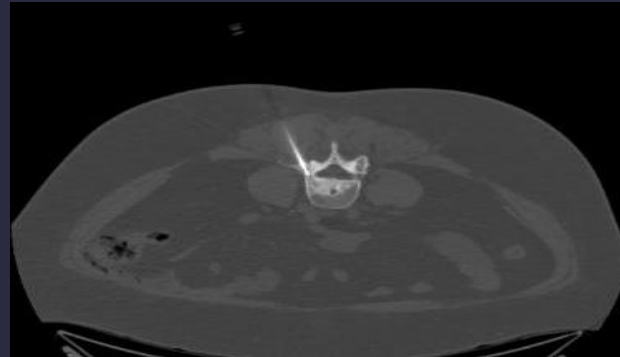
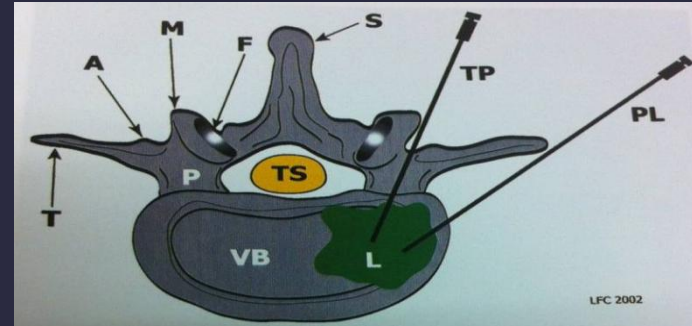
**COSTOVERTEBRAL
COSTOTRANVERSE JOINT
INTERCOSTAL
TRANS-PEDICULAR**



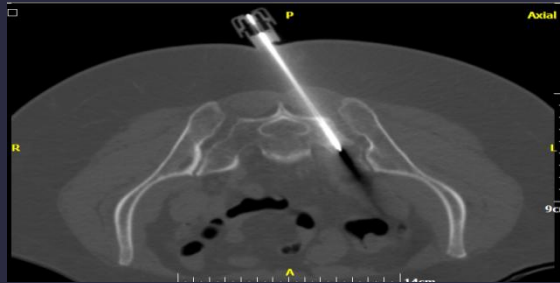
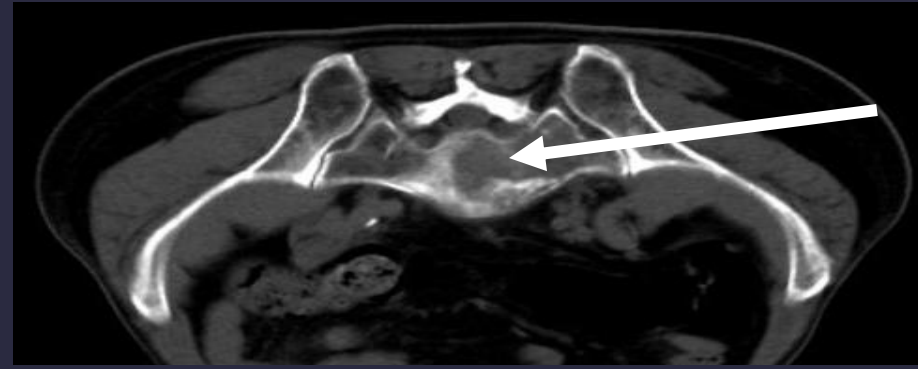
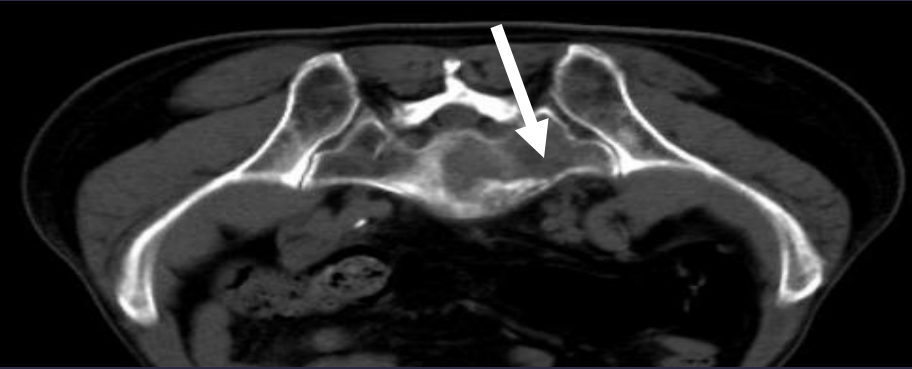
LUMBAR SPINE APPROACH

POSTEROLATERAL

TRANS-PEDICULAR



SACRAL SPINE APPROACH



Blood Clots

- Percutaneous biopsy of intramedullary lytic lesions that do not have a soft tissue component **may only yield blood clots.**
- Specimens containing principally blood clots were obtained in **20.8% of cases** with percutaneous needle biopsy providing diagnosis allowing appropriate further management in 62 cases, **for a diagnostic yield of 75%.**



BIOPSY AND SPONDYLODISCITIS

- De Lucas et al (2009):
 - Diagnostic rates obtained in patients with previous antibiotic treatment were **significantly lower (23% vs. 60%, $p=0.013$)**..... this technique yields a **lower diagnostic rate** than previously reported biopsy of neoplastic vertebral lesions, especially if performed in patients with **previous antibiotic treatment**
- Pupaibool et al (2015):
 - The microbiological yield of image-guided needle biopsy varies between **36% and 91%**... Image-guided spinal biopsy had a **sensitivity of 52.2%** and a **specificity of 99.9%**

Culture or Histological sample?

The results of our study support the conclusion that **both** microbiologic and histologic evaluation of bone biopsy specimens **should be performed** in cases of suspected osteomyelitis.

We found the **sensitivity of culture alone** in the diagnosis of osteomyelitis to be **42%**, and the **sensitivity of combined** culture and histologic examination to be **84%**.

BIOPSY AND SPONDYLODISCITIS

Downloaded from <http://pmj.bmj.com/> on December 22, 2014 - Published by group.bmj.com

607

ORIGINAL ARTICLE

Therapeutic impact of percutaneous spinal biopsy in spinal infection

J J Rankine, D A Barron, P Robinson, P A Millner, R A Dickson

Postgrad Med J 2004;**80**:607–609. doi: 10.1136/pgmj.2003.017863

See end of article for authors' affiliations

Correspondence to:
Dr James J Rankine,
Department of Clinical
Radiology, St James's
University Hospital, Beckett
Street, Leeds LS9 7TF, UK;
james.rankine@leedsth.nhs.uk

Submitted
8 December 2003
Accepted 16 January 2004

Objective: To investigate the therapeutic impact of percutaneous spinal biopsy in patients with suspected spinal infection.

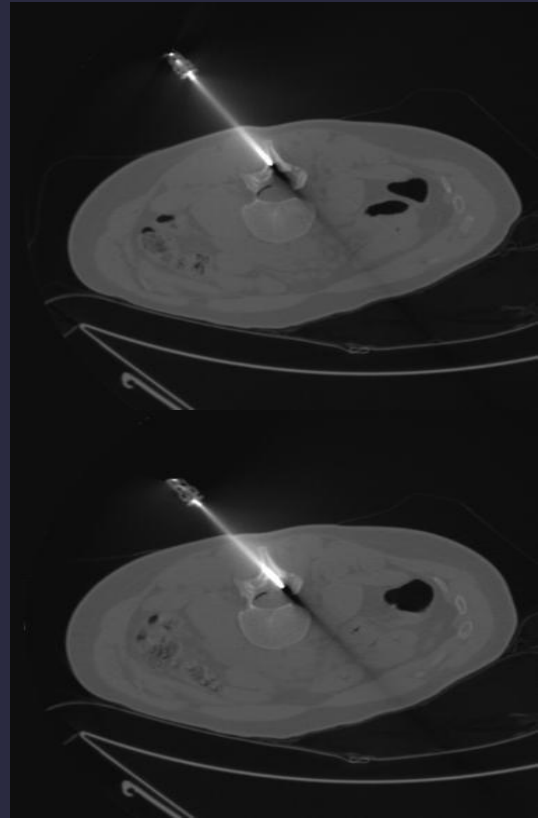
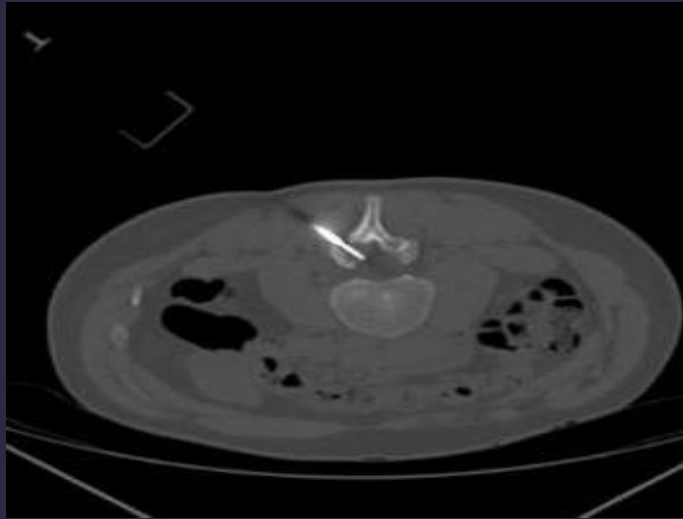
Design and patients: A review of the case notes and imaging features of 36 patients who underwent percutaneous spinal biopsy was performed. From this group 20 patients with a prebiopsy diagnosis of spinal osteomyelitis were identified. Management before biopsy was noted including the use of antimicrobial therapy. The results of the histology and microbiology were noted along with the subsequent diagnosis and management.

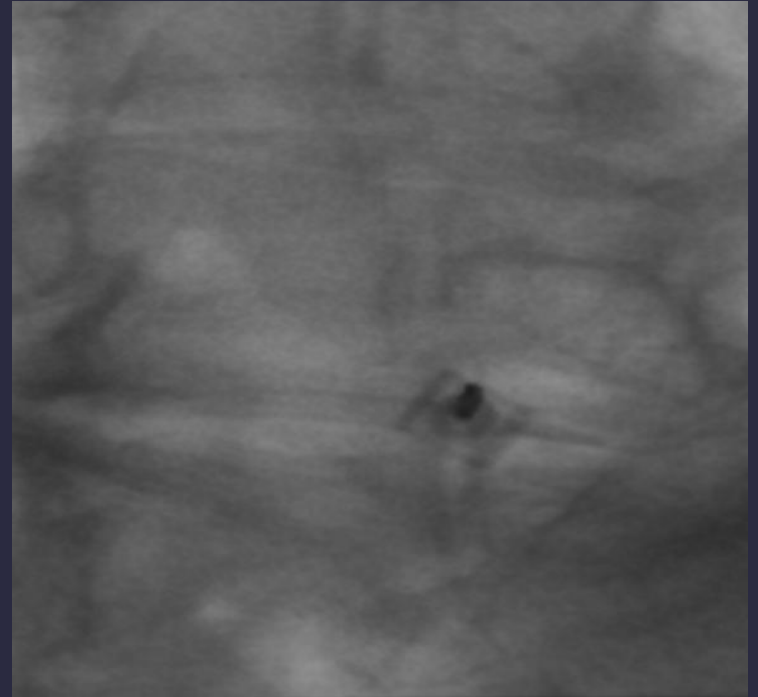
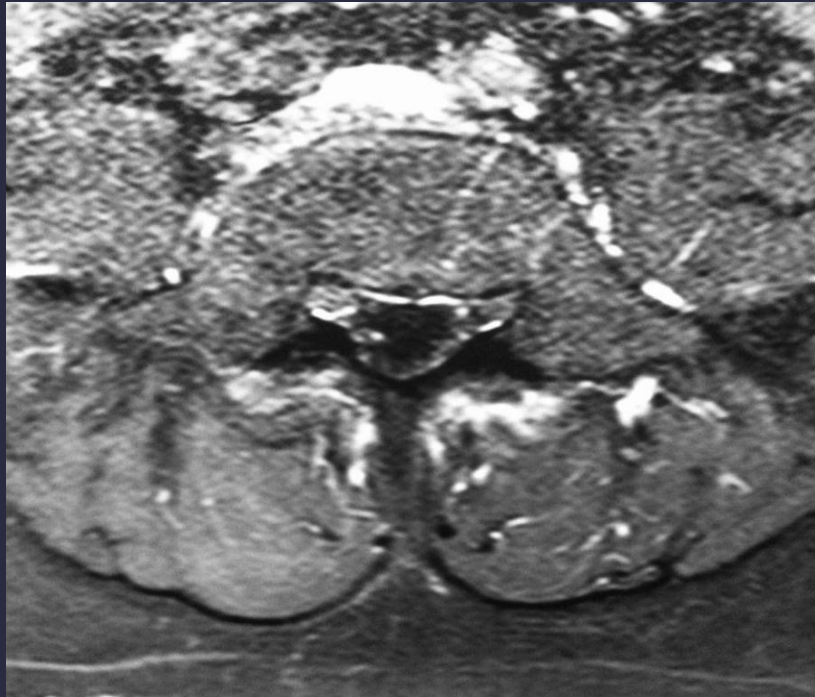
Results: Eight of the 20 patients (40%) had received antibiotics before the biopsy. An organism was isolated in 8/20 cases (40%). Of the eight patients on antibiotics, two grew an organism (25%), including one case of candida in a patient receiving flucloxacillin. Out of 12 patients not on antibiotics there were six cases where an organism was isolated (50%). The result of the biopsy led to a change in management in seven of the 20 patients (35%).

Conclusions: Many clinicians are treating spinal osteomyelitis empirically with antibiotics before biopsy, but this reduces the chance of isolating an organism and determining antibiotic sensitivity. Despite this biopsy led to a change in management in 35% of cases.

SPINE BIOPSY TARGET CONSIDERATIONS

FACET JOINT



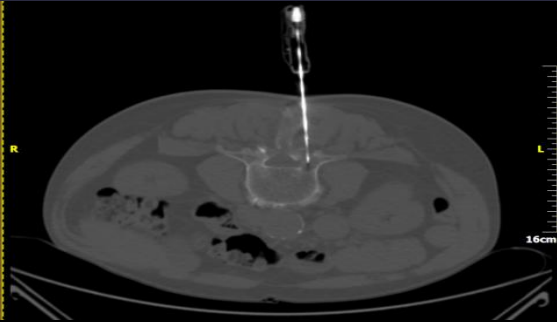
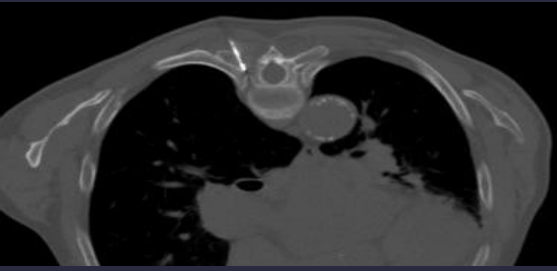


Septic arthritis of the facet joint

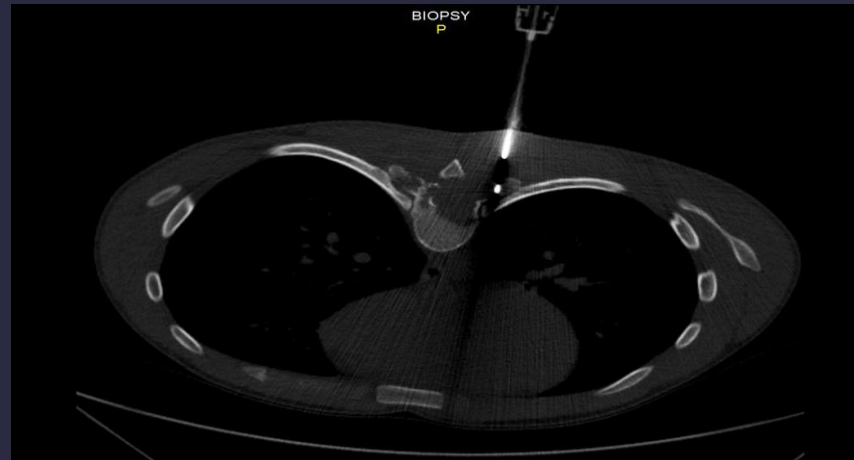
SPINE BIOPSY TARGET CONSIDERATIONS

POSTERIOR VERTEBRAL ARCH

Bronchogenic Ca meta

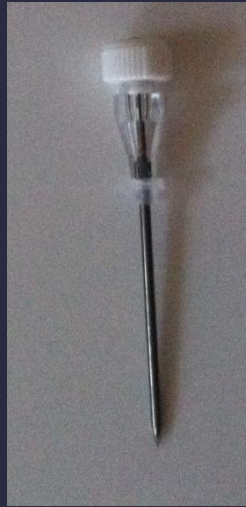
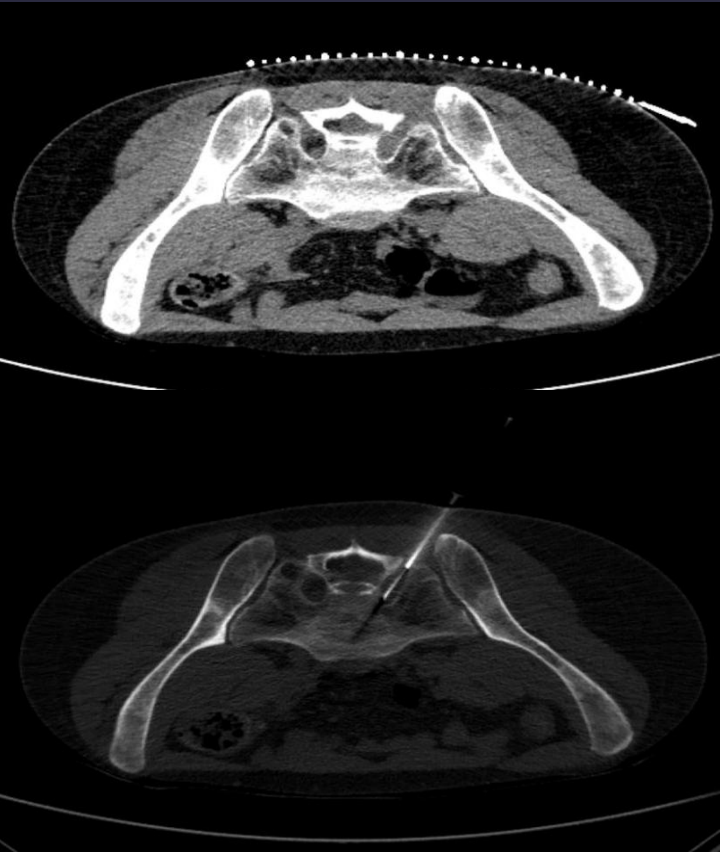


Histiocytosis



SPINE BIOPSY TARGET CONSIDERATIONS

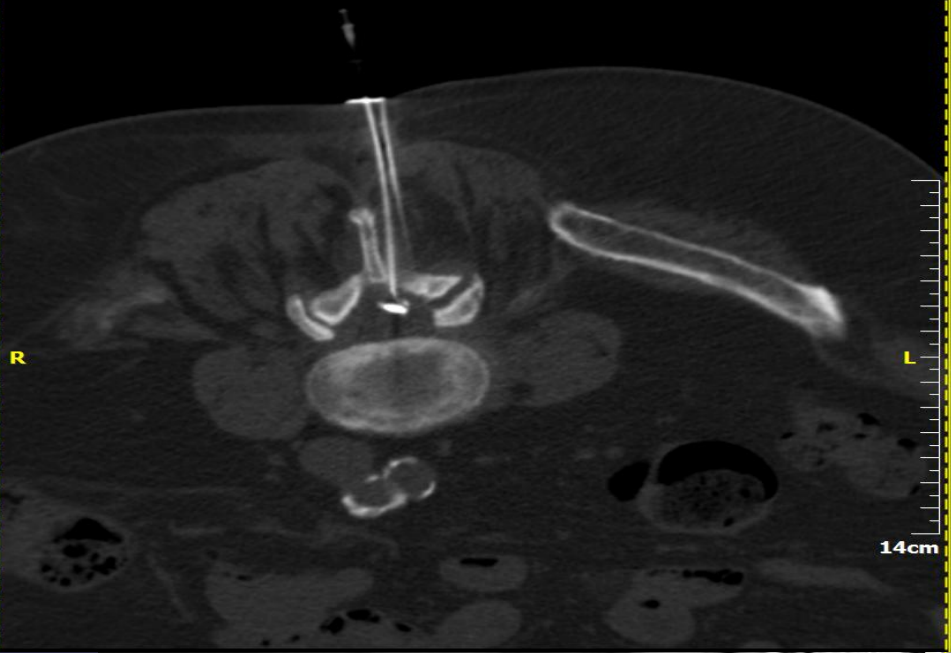
NEURAL FORAMEN
EPIDURAL SPACE



(221,416): -76

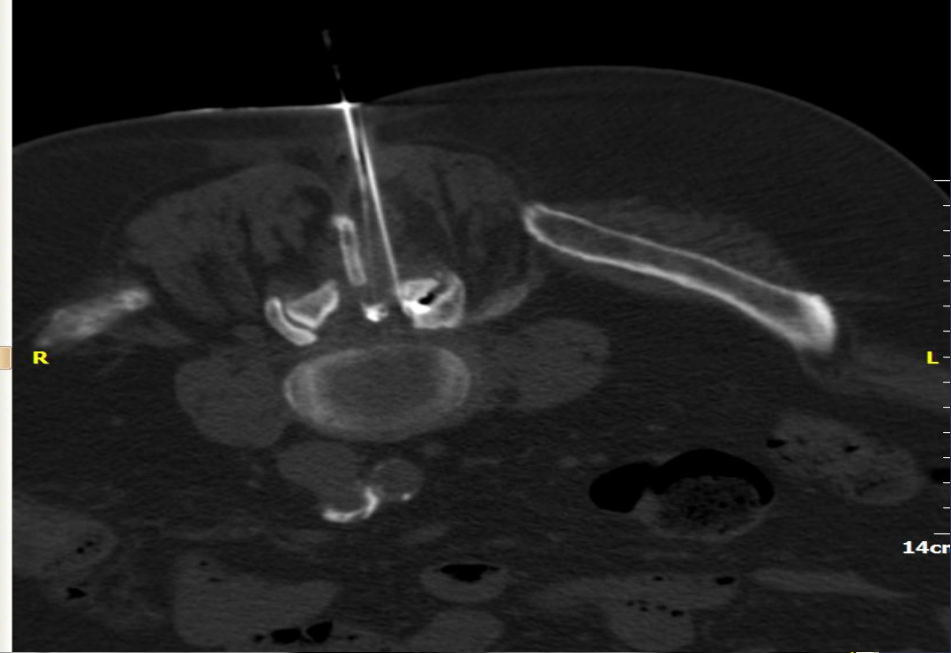
P

Axial



P

Axial



SPINE BIOPSY TARGET CONSIDERATIONS

SPINAL CORD

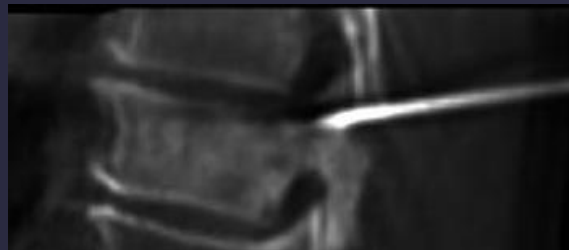
MSK BIOPSY



- Castillo et al Neuroradiol 1998 30:551-55:
“percutaneous needle biopsy of intradural
extramedullary and epidural lesions of the
lumbar spine is safe and efficacious.
Depending upon the size of the lesions,
myelography or CT can be utilized to determine
the level of aspiration.”



MSK BIOPSY



CLINICAL STUDY

CT-Guided Bone Biopsies in Metastatic Castration-Resistant Prostate Cancer: Factors Predictive of Maximum Tumor Yield

Michael G. Holmes, MD, Erik Foss, MD, Gabby Joseph, PhD, Adam Foye, BS, Brooke Beckett, MD, Daria Motamedi, MD, Jack Youngren, PhD, George V. Thomas, MD, Jiaoti Huang, MD, PhD, Rahul Aggarwal, MD, Joshi J. Alumkal, MD, Tomasz M. Beer, MD, Eric J. Small, MD, and Thomas M. Link, MD, PhD

Urology Case Reports 6 (2016) 45e46

c/o E. Eyheremendy Argentina

Growth 24 months	Accuracy
> 25%	81%
No change	42%

MSK BIOPSY

Decalcification

Hard: Freezing



- *Optimal antigen preservation*
- *Poor morphological preservation*



Cut slides



Soft: Decalcification



- *Strong acids : RDO faster*
- *Chelating agent EDTA longer but do not damage Biomarkers*

MSK BIOPSY

Cancer Metastasis Rev (2016) 35:427–437
DOI 10.1007/s10555-016-9631-3



CLINICAL

Estrogen, progesterone, and HER2/neu receptor discordance between primary and metastatic breast tumours—a review

C. Yeung¹ · J. Hilton^{2,3} · M. Clemons^{2,3} · S. Mazzarello³ · B. Hutton³ · F. Haggar³ · C. L. Addison³ · I. Kuchuk² · X. Zhu² · K. Gelmon⁴ · A. Arnaout^{1,2}

The accuracy and reliability of immunohistochemical testing is multifactorial:

- method of tissue fixation
- method of staining methods
- antigen retrieval
- subjective scoring

biopsies from different tissues require different preparation efforts leading to significant technical variations

MSK BIOPSY

Next-generation sequencing (NGS)

- Metastatic bone specimens : higher failure rate than non-bone specimens (36% vs 2.3%).
- Resection specimens, a higher failure proportion of which (6 of 10 specimens) were submitted for regular decalcification.
- FNA smear slides , alternative sources for mutational profiling of bone metastasis.

Core biopsy specimens should be grossly examined for the presence or absence of bones.

Original Article

Clinical Mutational Profiling of Bone Metastases of Lung and Colon Carcinoma and Malignant Melanoma Using Next-Generation Sequencing

Gang Zheng, MD, PhD¹; Ming-Tsai Lin, MD, PhD¹; Parvez M. Lokhandwala, MD, PhD¹; Katalin Belleri, MS¹; George J. Netto, MD^{1,2}; Christopher D. Gocke, MD^{1,2}; James R. Eshleman, MD, PhD^{2,3}; Edward McCarthy, MD¹; and Peter B. Illei, MD^{1,2}

MSK BIOPSY

- Vascular injury – Hematoma - myelopathy
- Infection
- Nerve root damage – radiculopathy
- Thecal sac puncture – headache – arachnoiditis – quadriparesis, quadriplegia
- Pneumothorax
- Vasovagal reaction
- Fracture
- Drug related allergy
- Tumor seeding

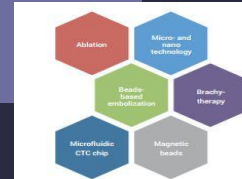
0-7.4%

*AJR 2009; 193:W407–W410.
Eur Spine J (2008) 17:975–981.
Skeletal Radiol (2002) 31:349–353*

Tehranzadeh et al Acta Radiol 2007
Le et al Semin Intervent Radiol 2010
Huang et al Radiol Clin N Am 2011

MSK BIOPSY

- Identify new targets
- Identify optimal treatment
- Predict tumor response in advanced stage
- Identify tumor recurrence
- Predict rate of recurrence
- Predicting recurrence in curative cases could help in treatment stratification, identification and validation of new targets



MSK BIOPSY

- Pathologic analysis:

- Histology
- Biomarkers (prognostic, predictive)
- Molecular profiling
- Genetic sequencing

- Pathologic assays:

- Immunohistochemistry
- Polymerase chain reaction
- Fluorescence in situ hybridization
- Direct gene sequencing

MSKBIOPSY

Tumor Type	Tumor Marker	Molecular Test	Clinical use
NSCLC	EML4-ALK EGFR mutation	FISH PCR	Targeted drug therapy
Colon Adenocarcinoma	Microsatellite instability KRAS BRAF	PCR	Prognostic, HNPCC screening Targeted drug therapy
Melanoma	BRAF	PCR	Targeted drug therapy
Pancreas	SMAD-4	IHC	Differentiate Pancreatic adenocarcinoma from Metastasis
HCC	HepPar-1 Glypican 3	IHC	Differentiate HCC from Metastasis
Renal	RCC monoclonal antibody	IHC	Differentiate Renal cyst from RCC

MSK BIOPSY

- Use the largest possible needle biopsy that can safely maximize the diagnostic yield - Perform all the necessary tests for the obtained sample
- Effective communication with pathologist, molecular diagnostic laboratory and oncologist treating the patient

MSK BIOPSY

- Increasingly important as recent advances in molecular profiling and tissue biomarkers require adequate tumor sample
- Must be aware of the expanded indications, tissue yield and expectations related to biopsy: adapt to the new changes and alleviate possible challenges

MSK BIOPSY

📍 SIO2022

ANNUAL SCIENTIFIC MEETING

3-7 FEBRUARY 2022 || SAN FRANCISCO, CALIFORNIA, USA

MSK Mets

Bone and soft tissue biopsies of metastatic disease: Tips and tricks for the challenging cases

Treatment of pathologic fractures of the spine: Vertebral augmentation from cement to implants

The role of bone ablation for local tumor control

Treatment of extra-spinal pathologic fractures: Percutaneous osteoplasty from cement to screws and implants

Complications of percutaneous ablation: How to minimize and avoid

Pain Palliation

Pharmacological management of cancer pain in 2022

Nerve blocks and steroid injections for cancer pain

Percutaneous neurolysis in 2022: Facing the challenges

Multidisciplinary approach to cancer pain with combination treatment

The role of percutaneous ablation in the palliation of cancer pain

MSK Sarcoma

Combining systemic and local therapy for sarcoma MSK metastases

Ablation and other palliative techniques for painful sarcoma lesions

Percutaneous ablation in oligometastatic MSK sarcoma for local tumor control

Percutaneous ablation for desmoids: What is the evidence?

What is the role of HIFU for the treatment of sarcomas and desmoids?

MSK BIOPSY



THANK YOU FOR
YOUR ATTENTION

The



End