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Αρχές και αναγκαιότητα της κλειστής κατευθυνόμενης βιοψίας

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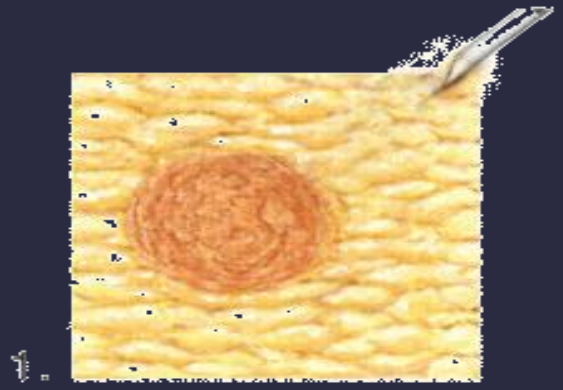
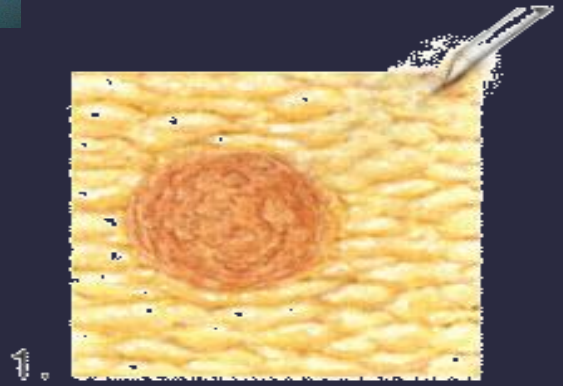
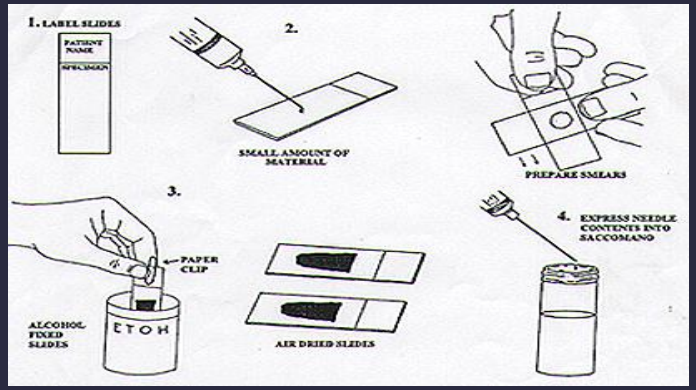


ΔΙΑΔΕΡΜΙΚΕΣ ΒΙΟΨΙΕΣ

- 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

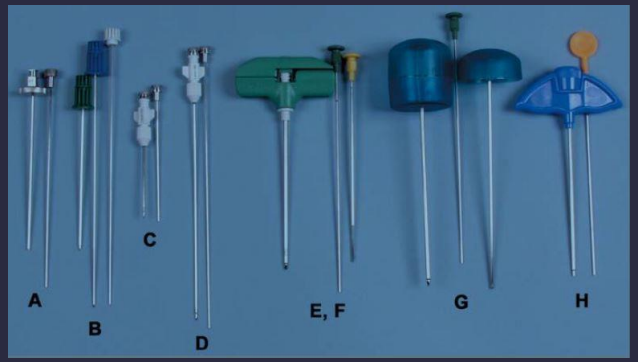
20-22 G NEEDLES



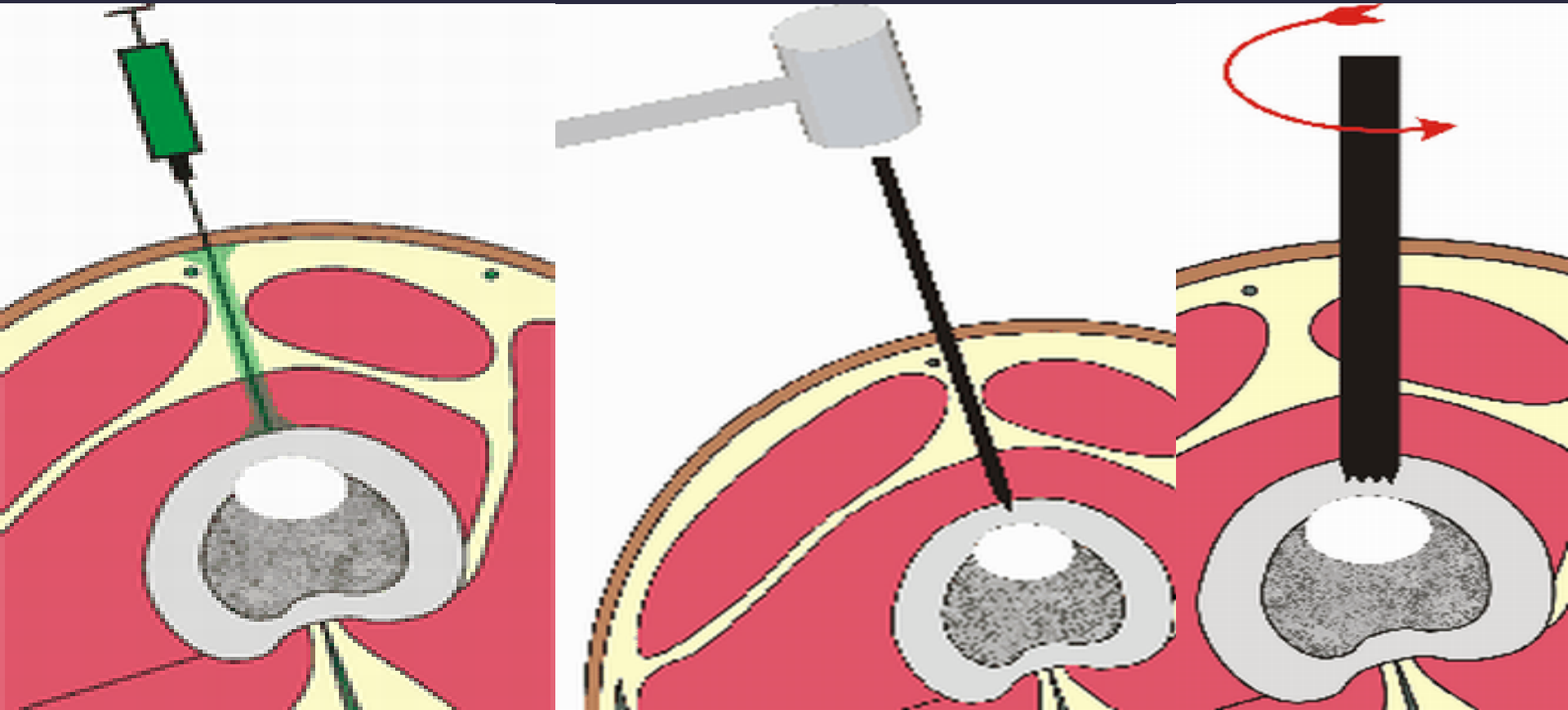

1. LABEL SLIDES
PATIENT NAME
2.
SMALL AMOUNT OF MATERIAL
PREPARE SMEARS
3.
PAPER CLIP
ALCOHOL FIXED SLIDES
ETOH
AIR DRIED SLIDES
4. EXPRESS NEEDLE CONTENTS INTO SACCOMANO

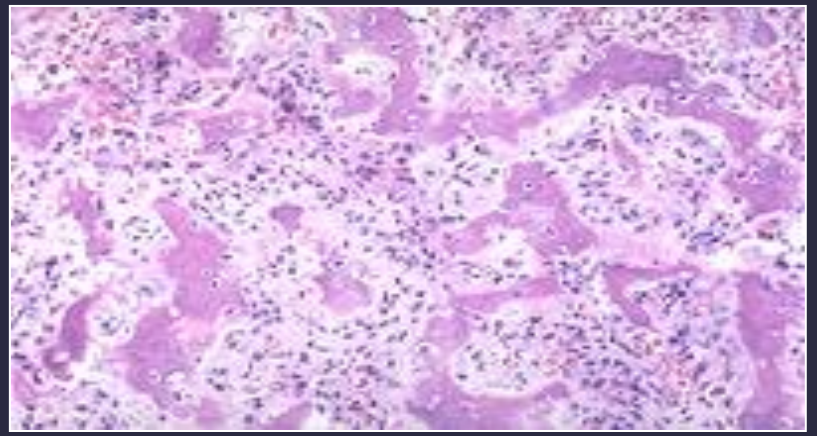
ΒΙΟΨΙΑ ΜΕ ΒΕΛΟΝΑ ΜΕ ΤΕΜΝΟΝ ΑΚΡΟ (CORE NEEDLE BIOPSY)

Βελόνες cut 10-18 G



Techniques for sampling bone





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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

A.N. Walace et al. The Oncologist 2015;20:1205–1215
Ratasvuori M et al. Surg Oncol 2013;22:132-138

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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

A.N. Walace et al. The Oncologist 2015;20:1205–1215
Ratasvuori M et al. Surg Oncol 2013;22:132-138

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-

LF Czervionke, DS Fenton. Percutaneous Spine biopsy. In: Image guided spine intervention. Eds LF Czervionke, DS Fenton. Saunders 2003; 141-187

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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

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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

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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

A.N. Walace et al. The Oncologist 2015;20:1205–1215
Ratasvuori M et al. Surg Oncol 2013;22:132-138

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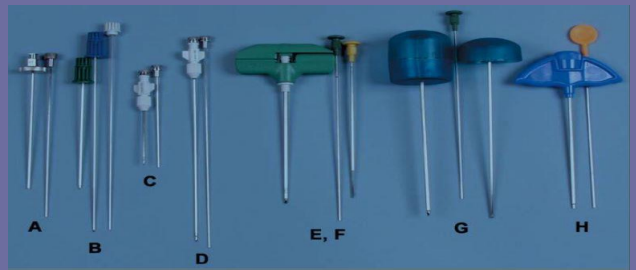
- Select the image guidance method optimal for the biopsy
- Assess the appropriate needle trajectory that would likely give the greatest diagnostic yield
- Choose the most appropriate biopsy system and type of anesthesia



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

Kambadakone A et al CT-guided Celiac Plexus Neurolysis: A Review of Anatomy, Indications, Technique, and Tips for Successful Treatment Radiographics 2011

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)

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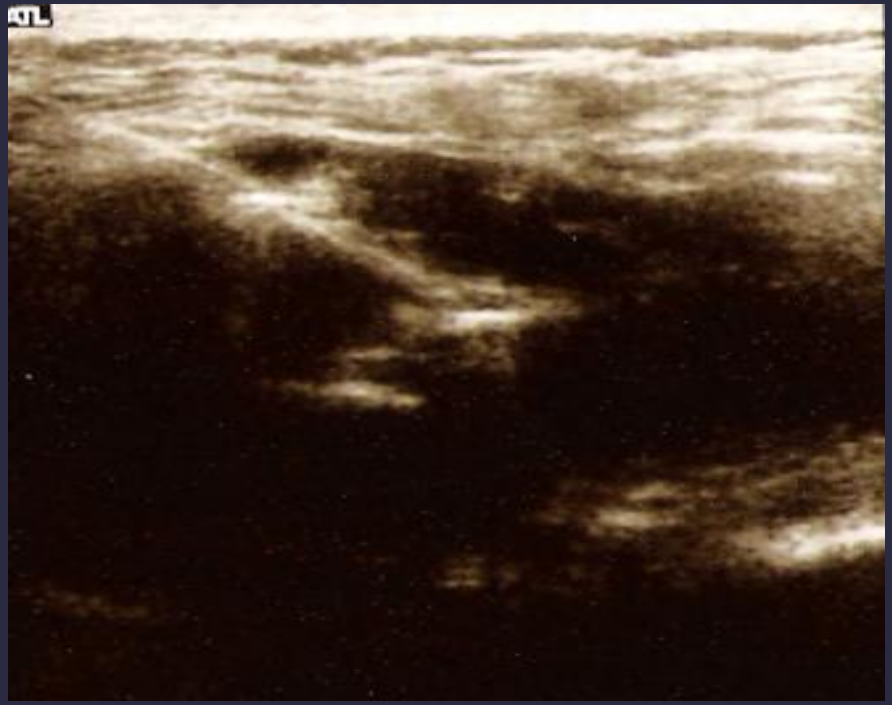

IMAGING GUIDANCE

Advantages

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

Disadvantages

- Radiation exposure

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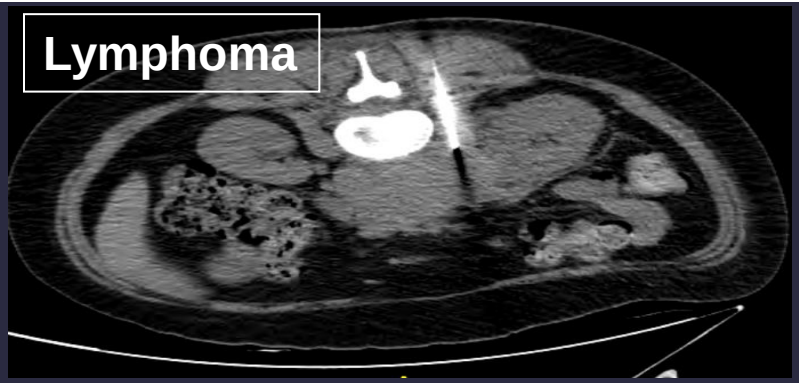
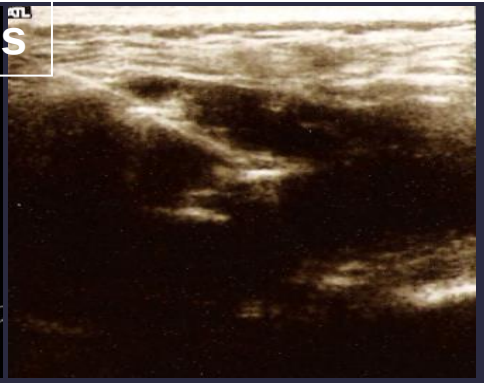
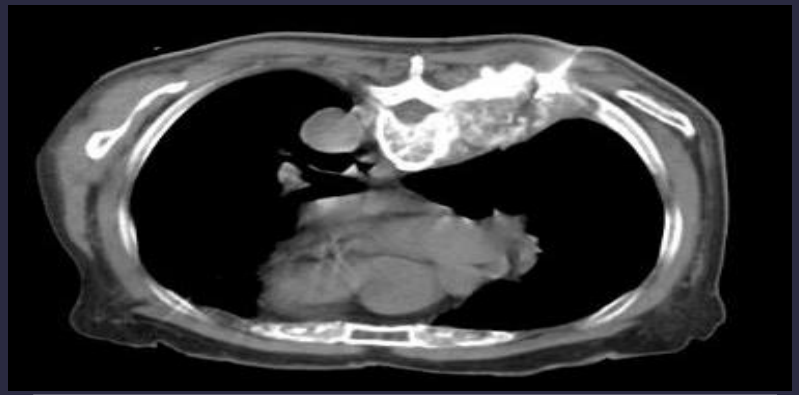
MSK BIOPSY

Lymphoma



Gastric Ca metastasis





Urinary Bladder Ca metastasis

Multiple Myeloma

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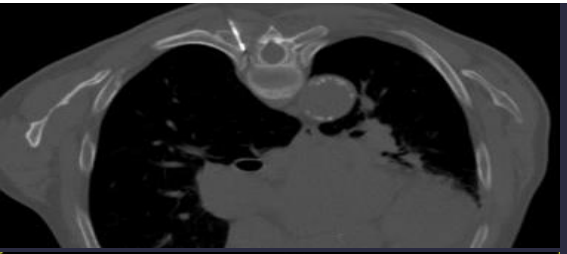
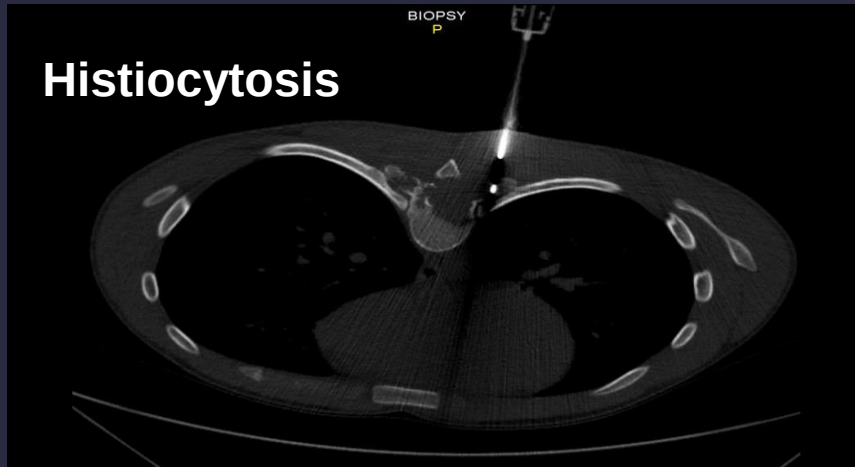


Bronchogenic Ca meta



Histiocytosis

IMAGING GUIDANCE

MR

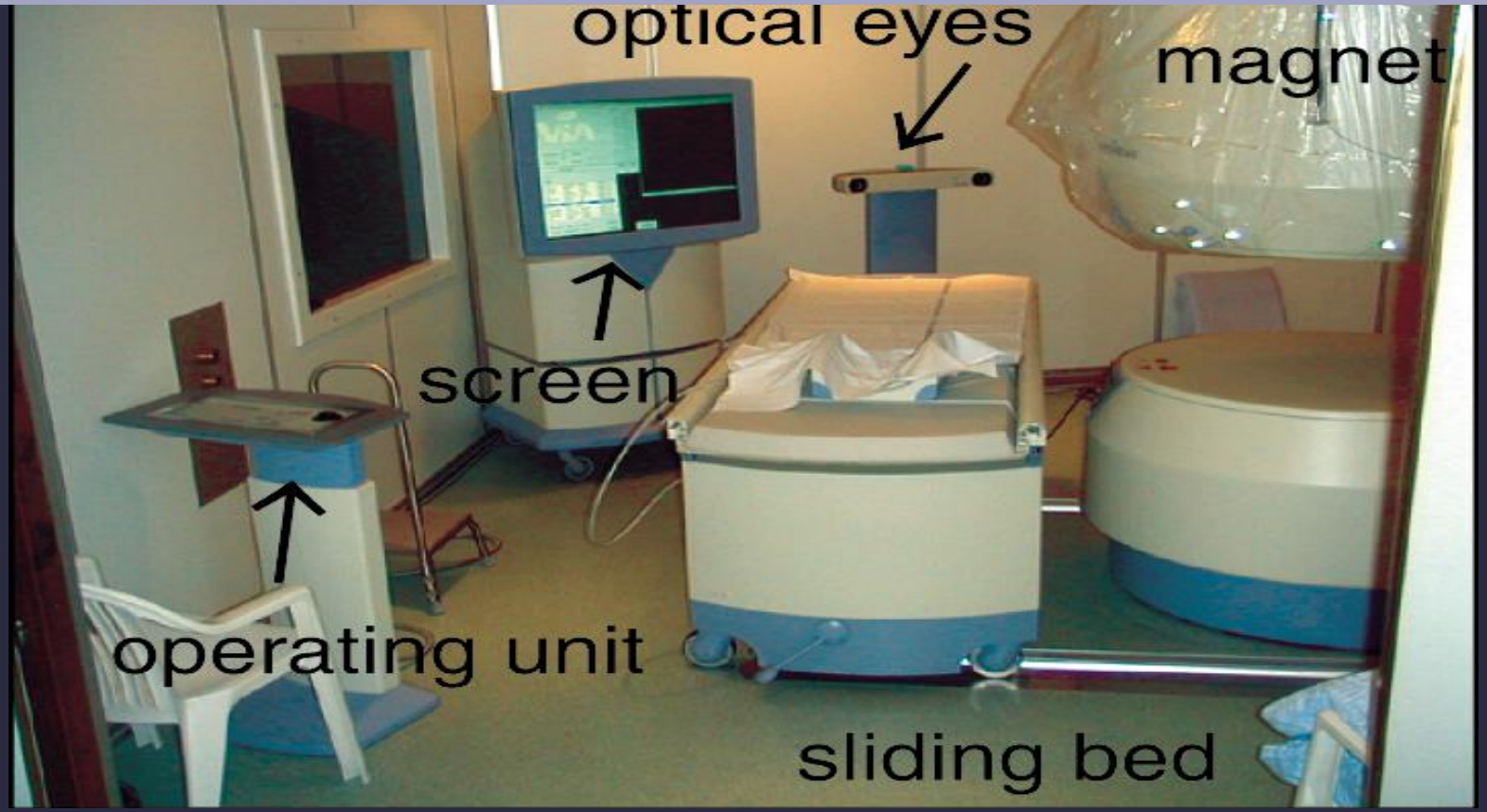
Advantages

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

Disadvantages

- Small working area
- Limited availability
- Longer duration

IMAGING GUIDANCE



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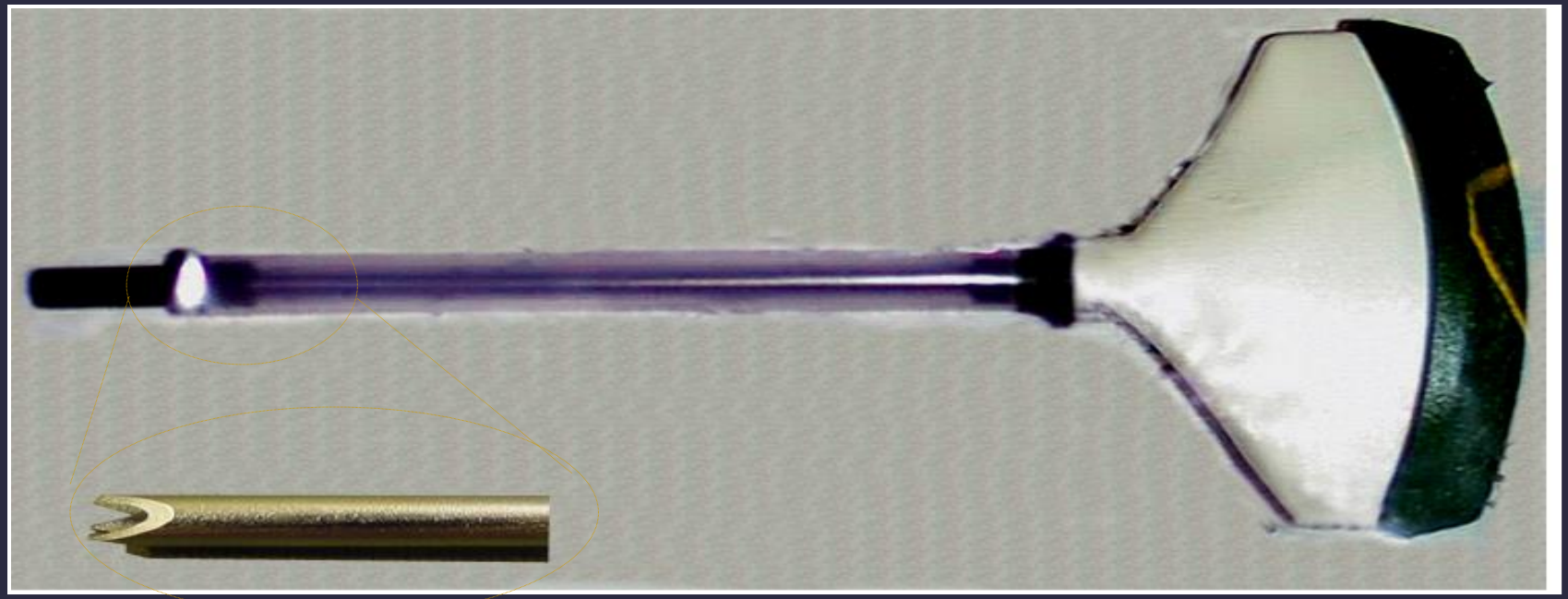

Titanium Biopsy Systems

IMAGING GUIDANCE

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MSK BIOPSY

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

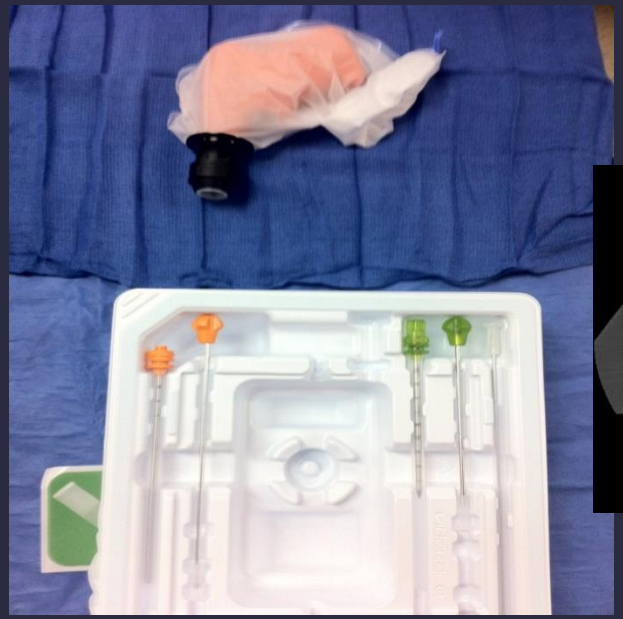
CIRSE CrossMark

TECHNICAL NOTE

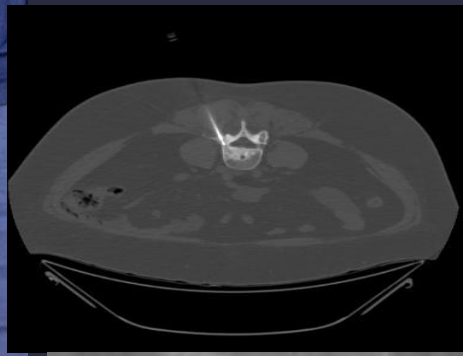
Fluoroscopy-Guided Percutaneous Vertebral Body Biopsy Using a Novel Drill-Powered Device: Technical Case Series

Adam N. Wallace[1] · Rafael A. Pacheco[1] · Anderanik Tomasian[1] · Andy C. Hsi[2] · Jeremiah Long[1] · Randy O. Chang[3] · Jack W. Jennings[1]

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



Breast Ca metastasis



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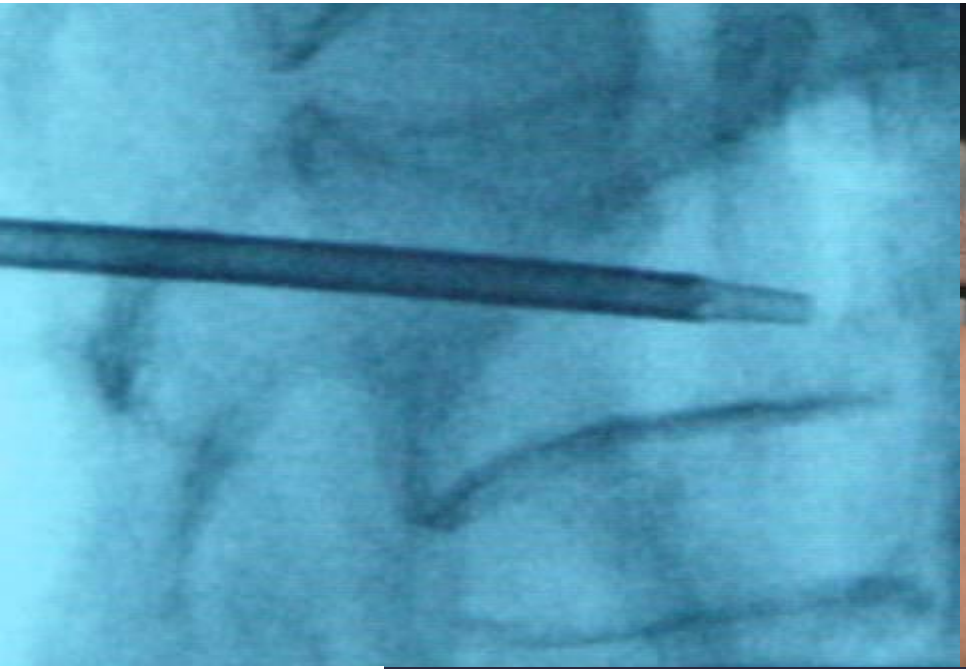

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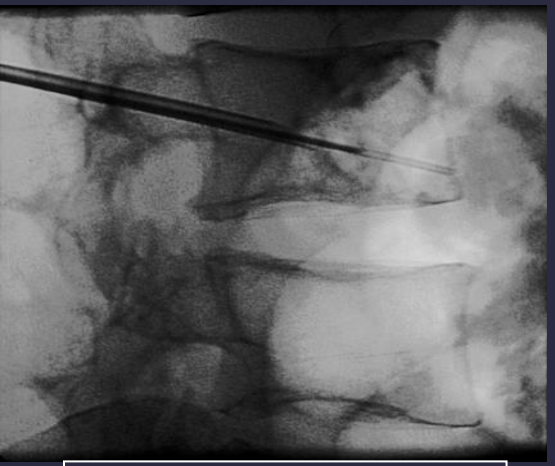
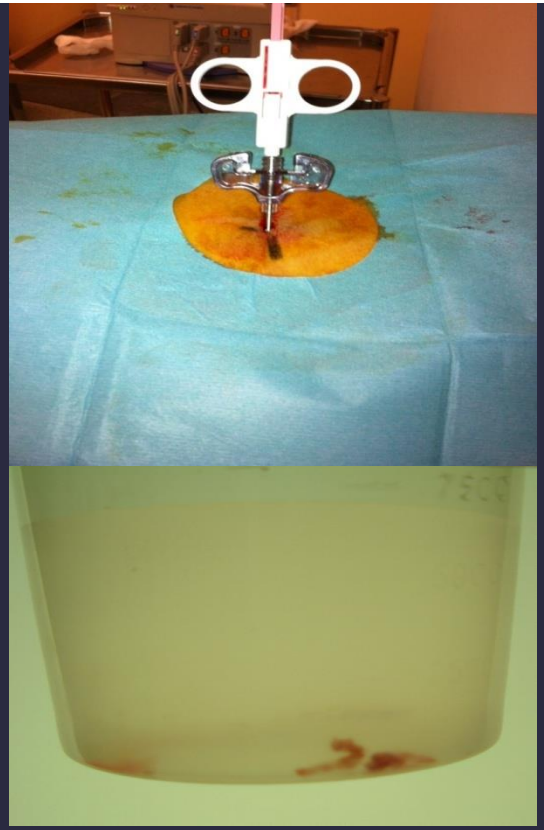


Multiple Myeloma



Neurinoma

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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**

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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%**

Harish S, Hughes RJ, Saifuddin A, Flanagan AM. Image-guided percutaneous biopsy of intramedullary lytic bone lesions: utility of aspirated blood clots. Eur Radiol. 2006

MSK BIOPSY

- Coagulopathy (INR>1.5, PT>1.5 times control, platelets<50.000/mm^3)
- 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)

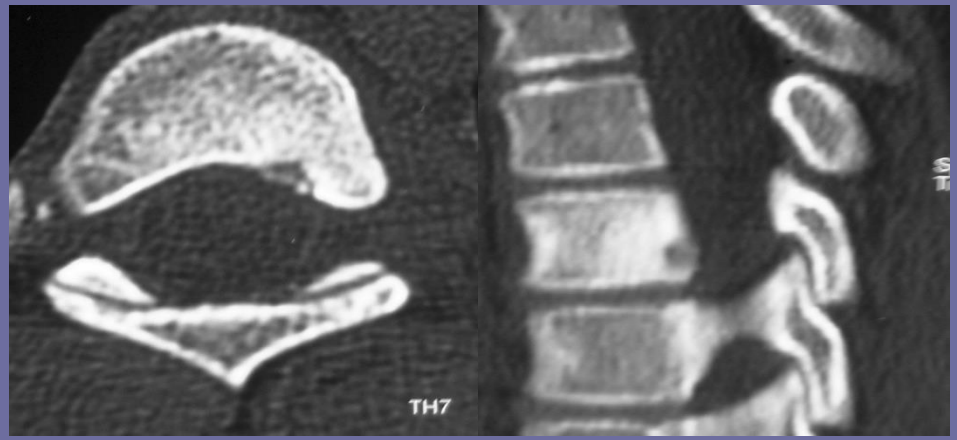
Rosenthal et al. Radiology 2012
Gangi et al CVIR 2010

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



Mukherjee S et al J Neurosurg Spine 2014; 21(5): 687-97

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

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

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 (n = 151)	65	71	75	77	77	77	4
General lesion subtype							
Soft tissue (n = 63)	67	71	73	76	76	76	4
Bone (n = 88)	64	70	77	77	77	77	3
Bone lesion subtype							
Sclerotic (n = 28)	39	46	57	57	57	57	3
Lytic (n = 60)	75	82	87	87	87	87	3
Lesion size (cm)							
≤2 (n = 24)	42	50	54	54	54	54	3
>2 To 5 (n = 57)	67	72	74	75	75	75	4
>5 (n = 70)	71	77	84	86	86	86	4
Biopsy needle gauge							
14 (n = 6)	67	67	67	83	83	. . .	4
15 (n = 68)	54	63	72	72	72	72	3
16 (n = 30)	67	73	73	77	77	77	4
18 (n = 47)	79	81	83	83	83	83	3
Imaging guidance modality							
CT (n = 133)	65	71	76	77	77	77	4
US (n = 18)	67	72	72	78	78	78	4

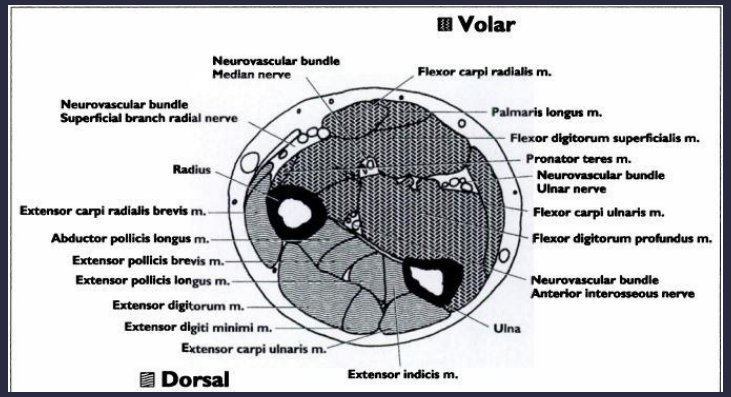
Wu JS et al. Bone and soft tissue lesions: What factors affect diagnostic yield of image guided core needle biopsy. Radiology. 2008; 248: 962-970.

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]



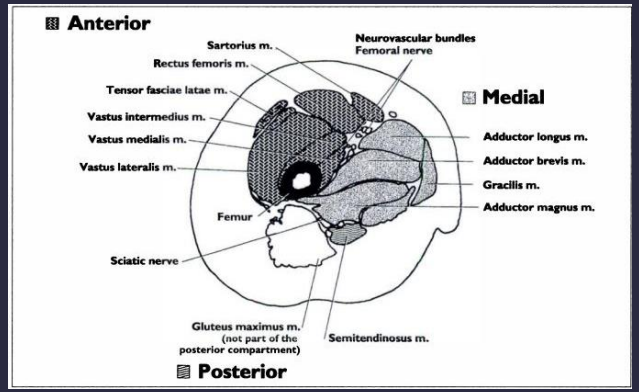
APPENDIX 2: Anatomic Compartments

General
- Skin and subcutaneous fat
- Bone
- Parosseous space
- Joint

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

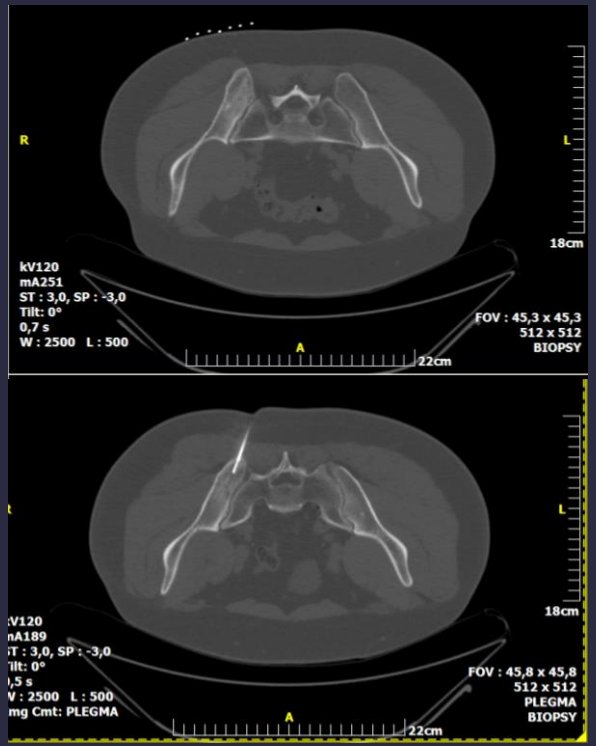
Pelvis
- Individual bone or muscle

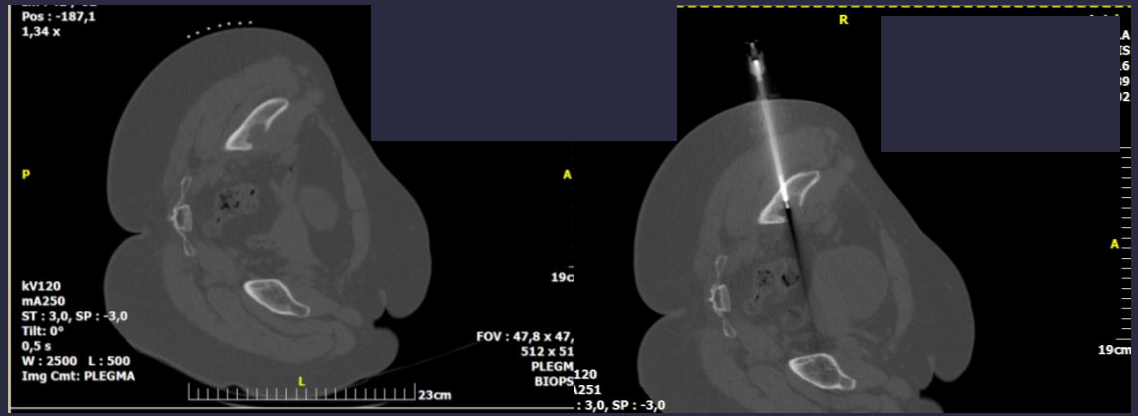
Lower Extremity
- Thigh: anterior, posterior, and medial
- Lower leg: anterior, deep posterior, posterior, and lateral
- Foot: plantar tissues (medial, central, and lateral)



Anderson MW et al. Compartmental Anatomy: Relevance to Staging and Biopsy of Musculoskeletal Tumors. AJR 1999; 173: 1663

BONE BIOPSY: respect compartmental anatomy





BONE BIOPSY: respect compartmental anatomy

STEPS TO A SOLUTION:

Talk to your surgeon to determine the ideal approach route

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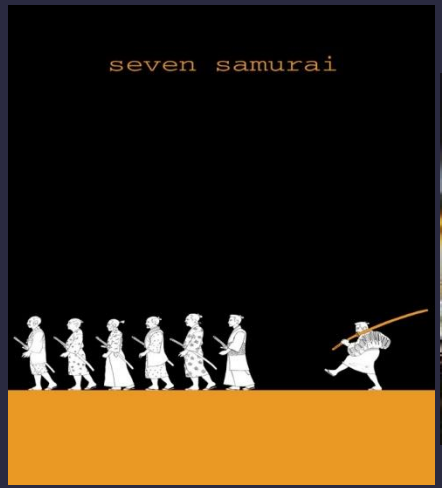
SPINE BIOPSY

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

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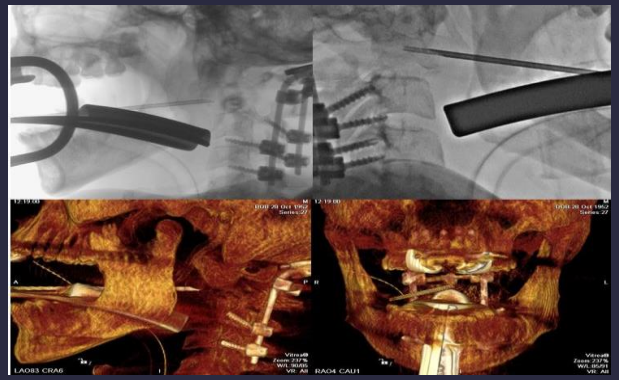
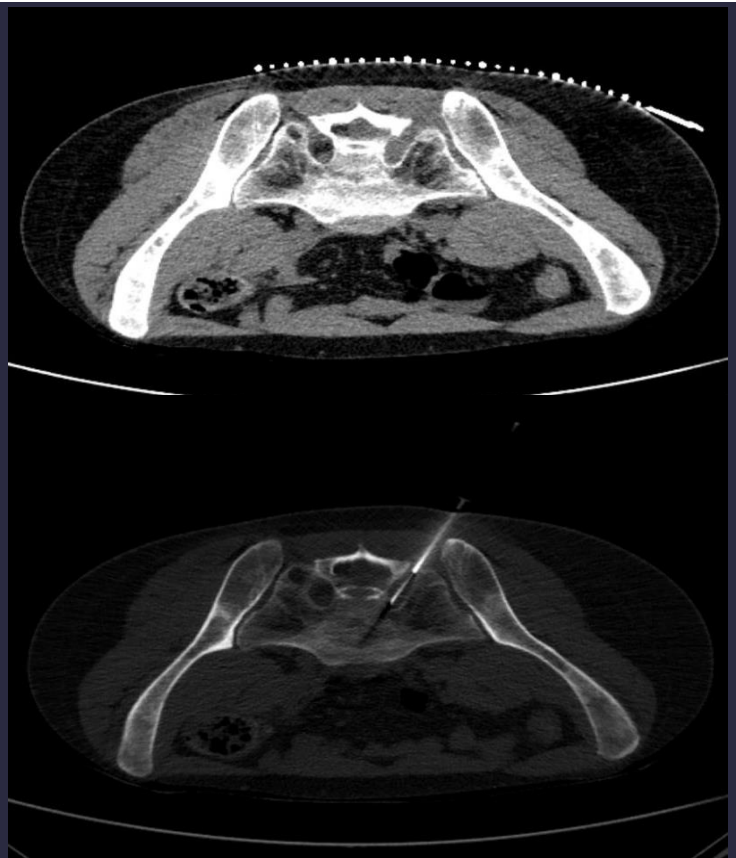
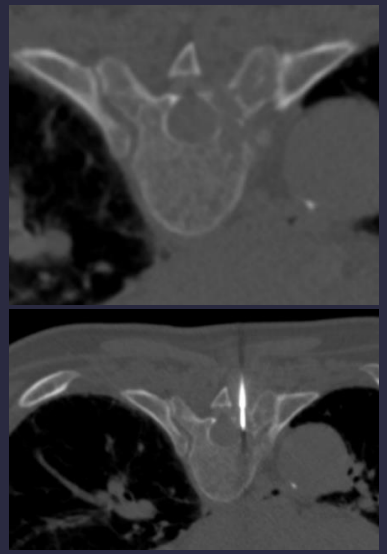
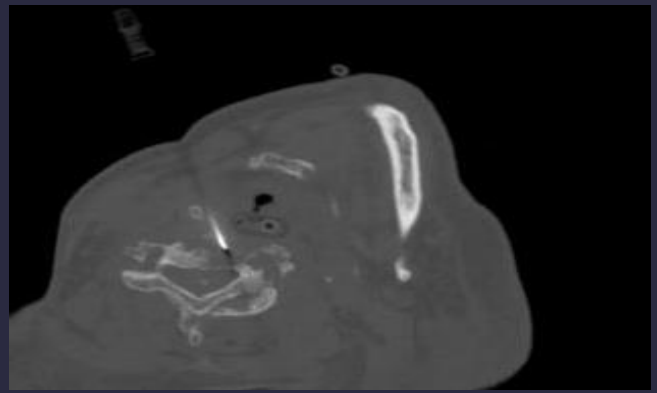
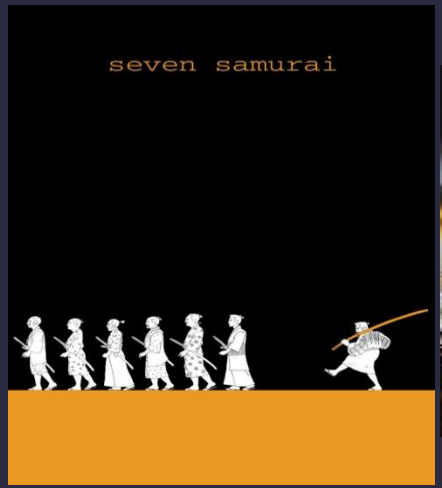








SPINE BIOPSY TARGET

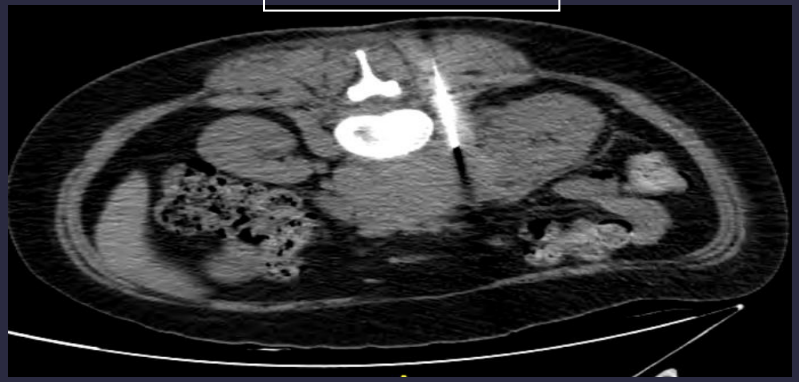


1. Vertebral body
2. Posterior vertebral arch
3. Intervertebral disc
4. Facet joint
5. Paraspinal mass
6. Epidural space – neural foramen
7. Spinal cord

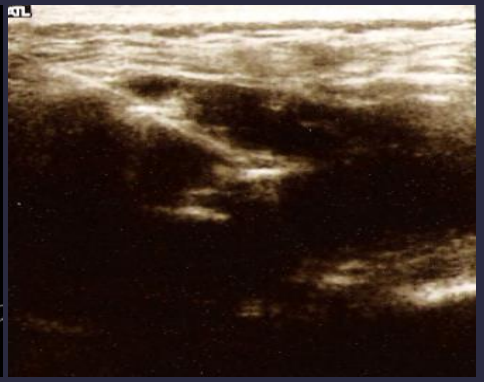
SPINE BIOPSY TARGET CONSIDERATIONS

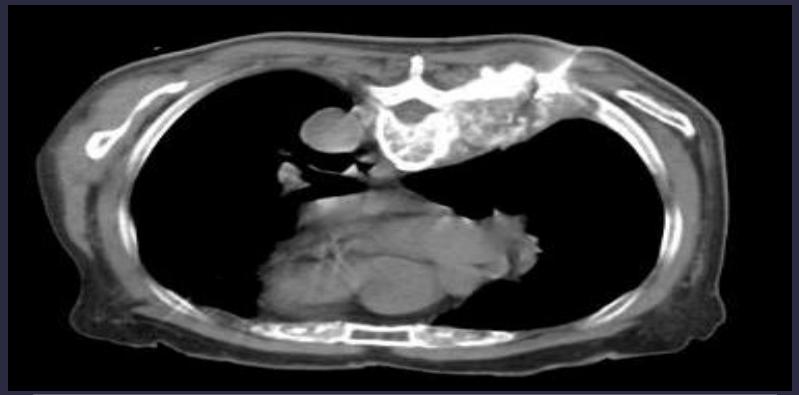
PARASPINAL MASS

Lymphoma



Gastric Ca metastasis





Urinary Bladder Ca metastasis

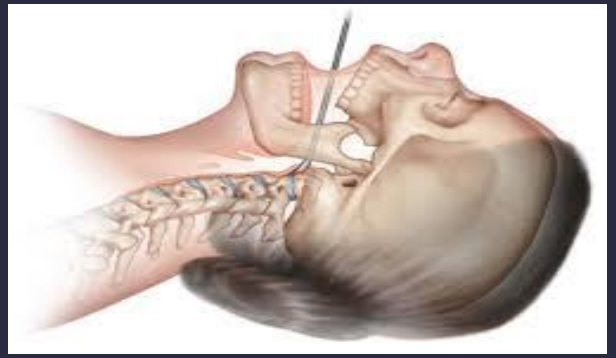
Multiple Myeloma

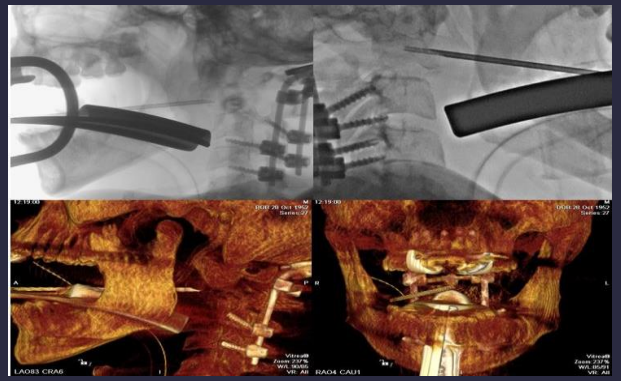
SPINE BIOPSY TARGET CONSIDERATIONS

VERTEBRAL BODY

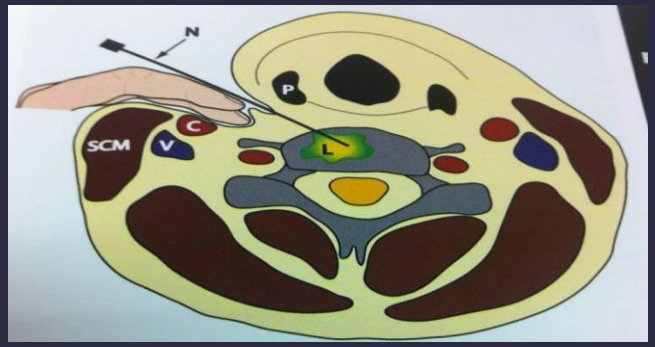
CERVICAL SPINE APPROACH

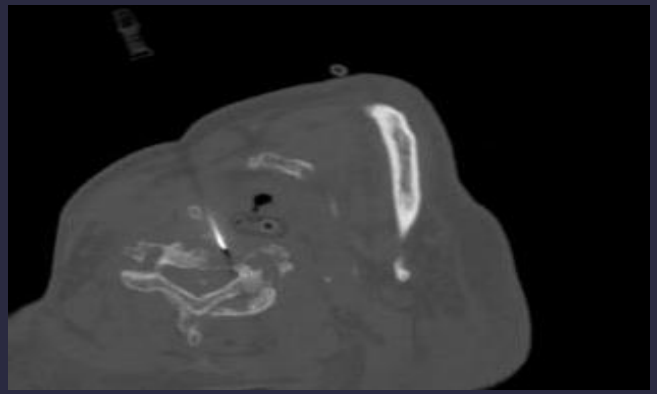
TRANS-ORAL





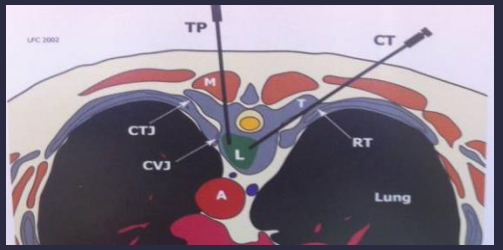
ANTERO-LATERAL

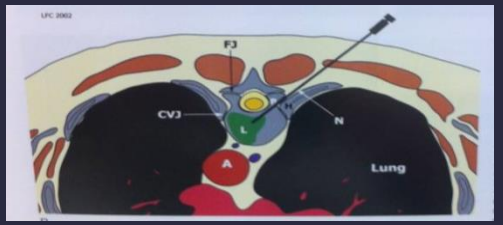


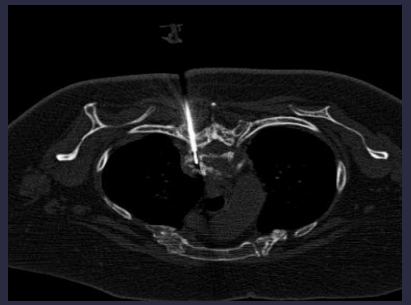


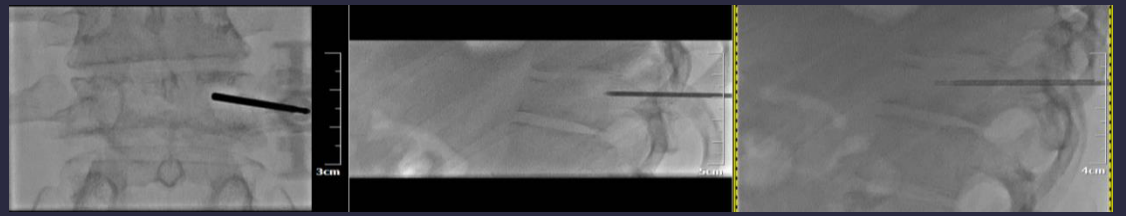
THORACIC SPINE APPROACH

COSTOVERTEBRAL
COSTOTRANVERSE JOINT
INTERCOSTAL
TRANS-PEDICULAR





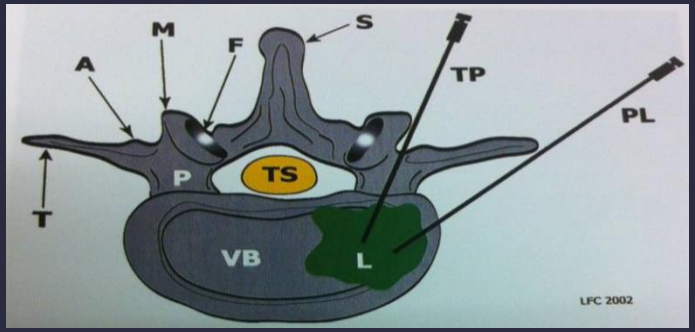


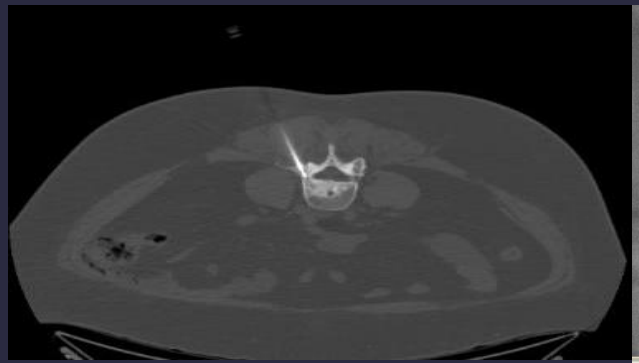


LUMBAR SPINE APPROACH

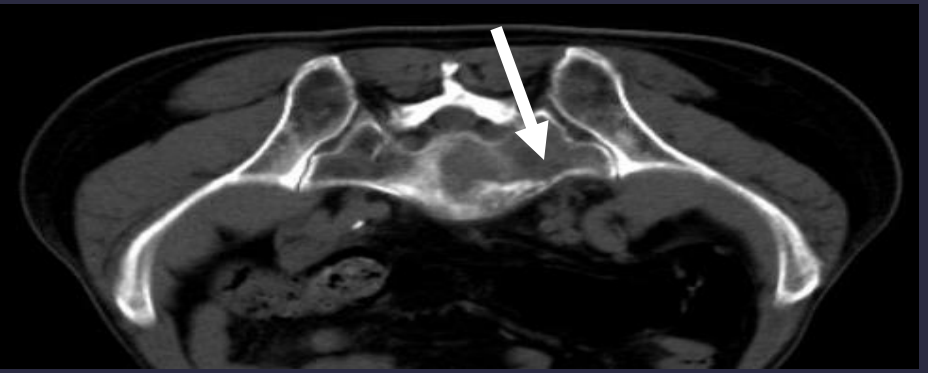
POSTEROLATERAL

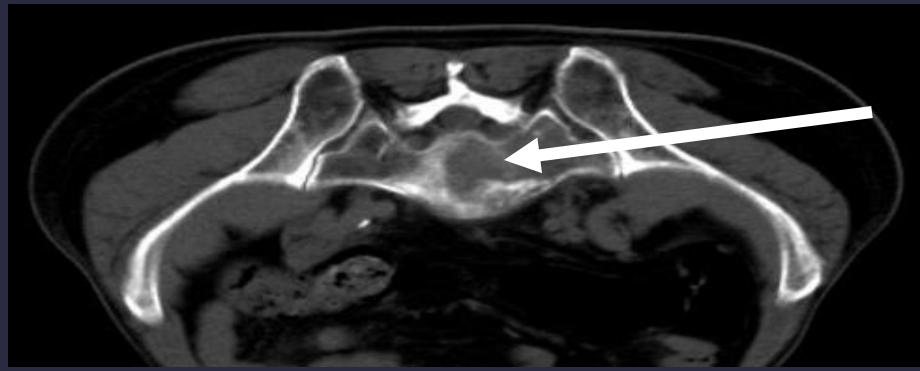
TRANS-PEDICULAR

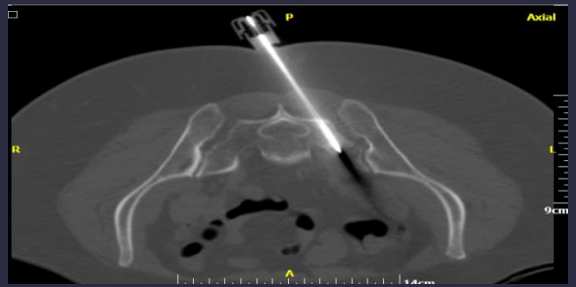




SACRAL SPINE APPROACH







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%.**

Harish S, Hughes RJ, Saifuddin A, Flanagan AM. Image-guided percutaneous biopsy of intramedullary lytic bone lesions: utility of aspirated blood clots. Eur Radiol. 2006

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%

De Lucas et al. Clin Rheumatol 2009
Pupaibool et al Spine Journal 2015

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%.

L. M. White et al Study of Osteomyelitis: Utility of Combined Histologic and Microbiologic Evaluation of Percutaneous Biopsy Samples Radiology. 1995 Dec;197(3):840-2.

BIOPSY AND SPONDYLODISCITIS

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

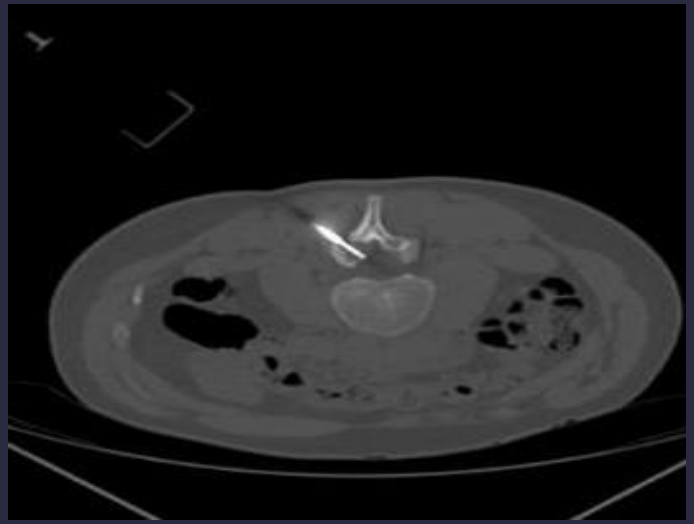
Correspondence to: Dr James J Rankine, Department of Clinical Radiology, St James's University Hospital, Beckett Street, Leeds LS9 7TF, UK; james.rankine@leedsth.nhs.uk

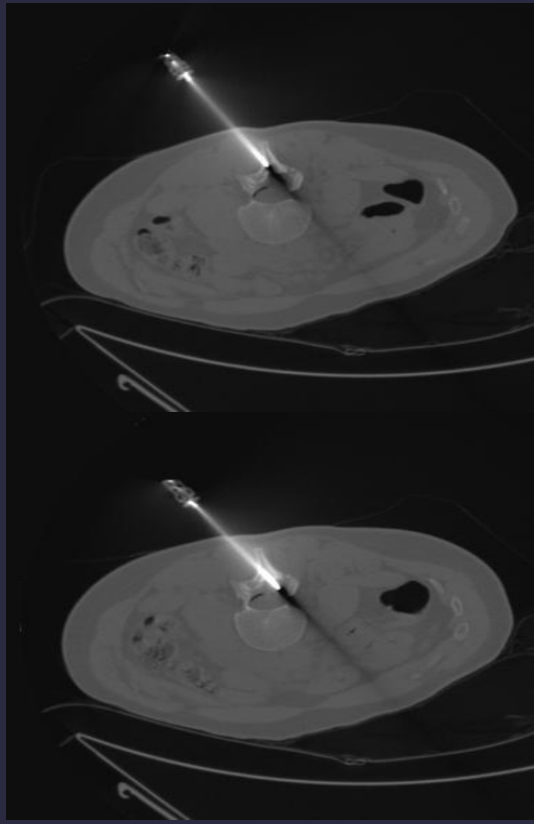
Submitted 8 December 2003
Accepted 16 January 2004

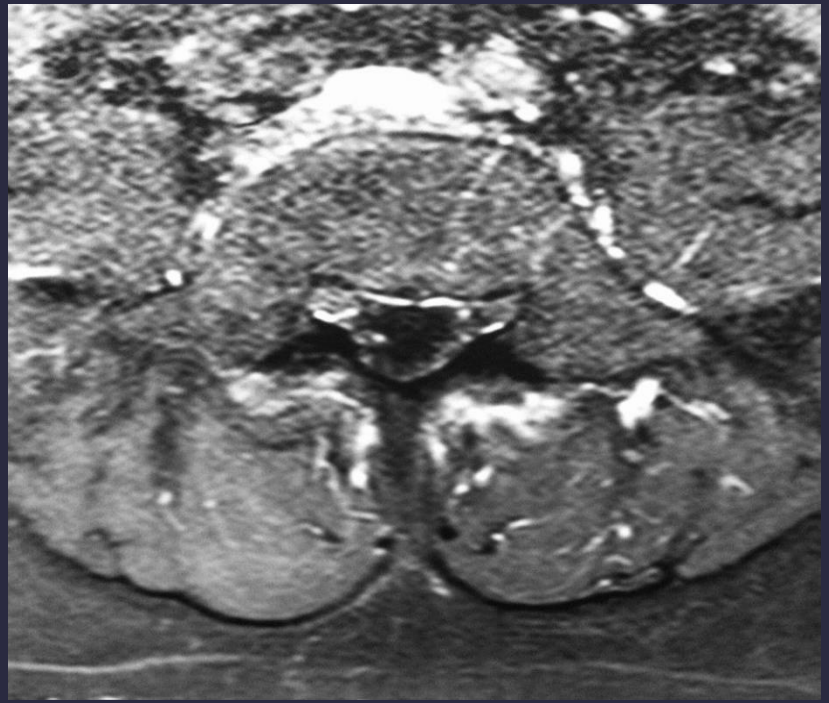
Objective: To investigate the therapeutic impact of percutaneous spinal biopsy in patients with suspected spinal infection.
Design and patients: A review of the case notes and imaging features of 36 patients who underwent percutaneous spinal biopsy was performed. From this group 20 patients with a prebiopsy 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.

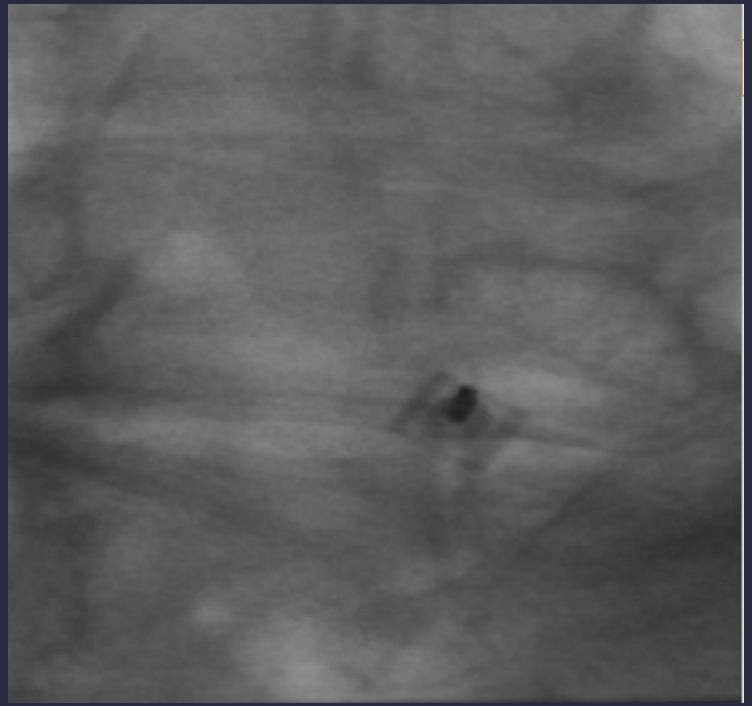
SPINE BIOPSY TARGET CONSIDERATIONS

FACET JOINT









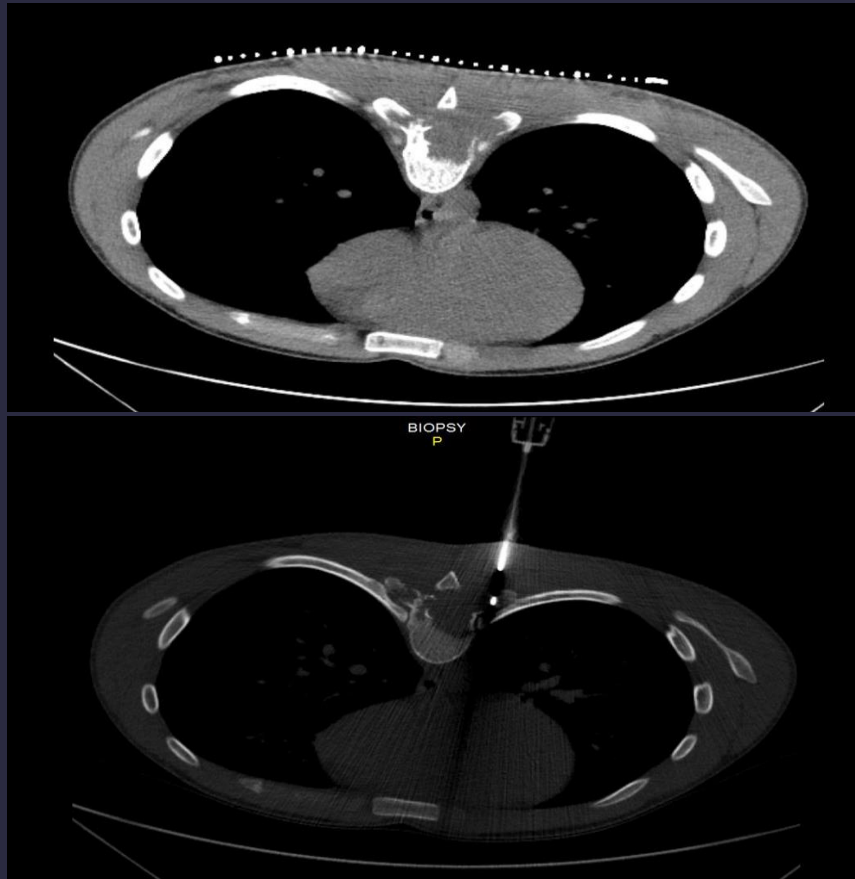
Septic arthritis of the facet joint

SPINE BIOPSY TARGET CONSIDERATIONS

POSTERIOR VERTEBRAL ARCH

Bronchogenic Ca meta

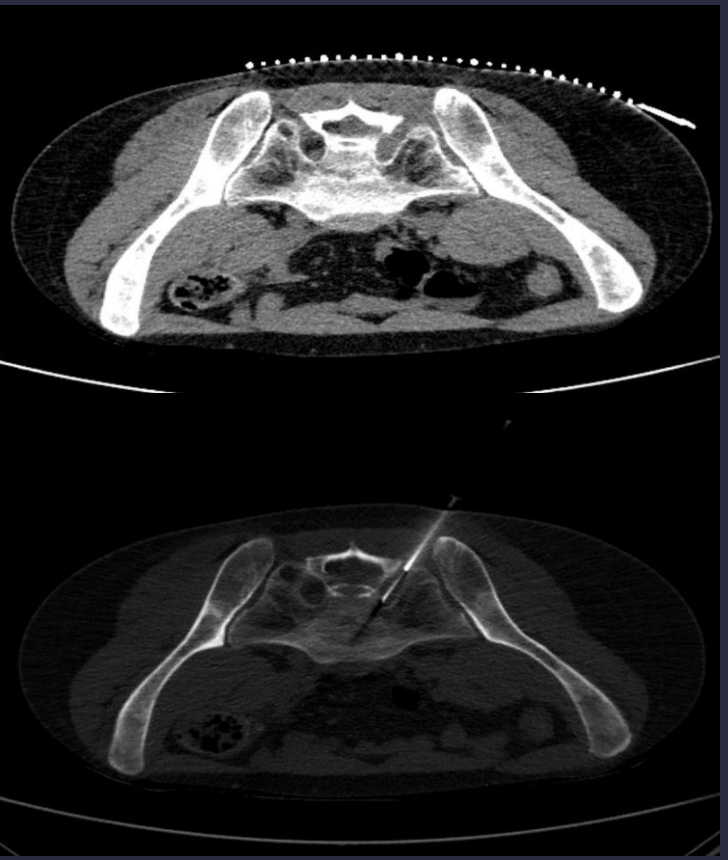
Histiocytosis

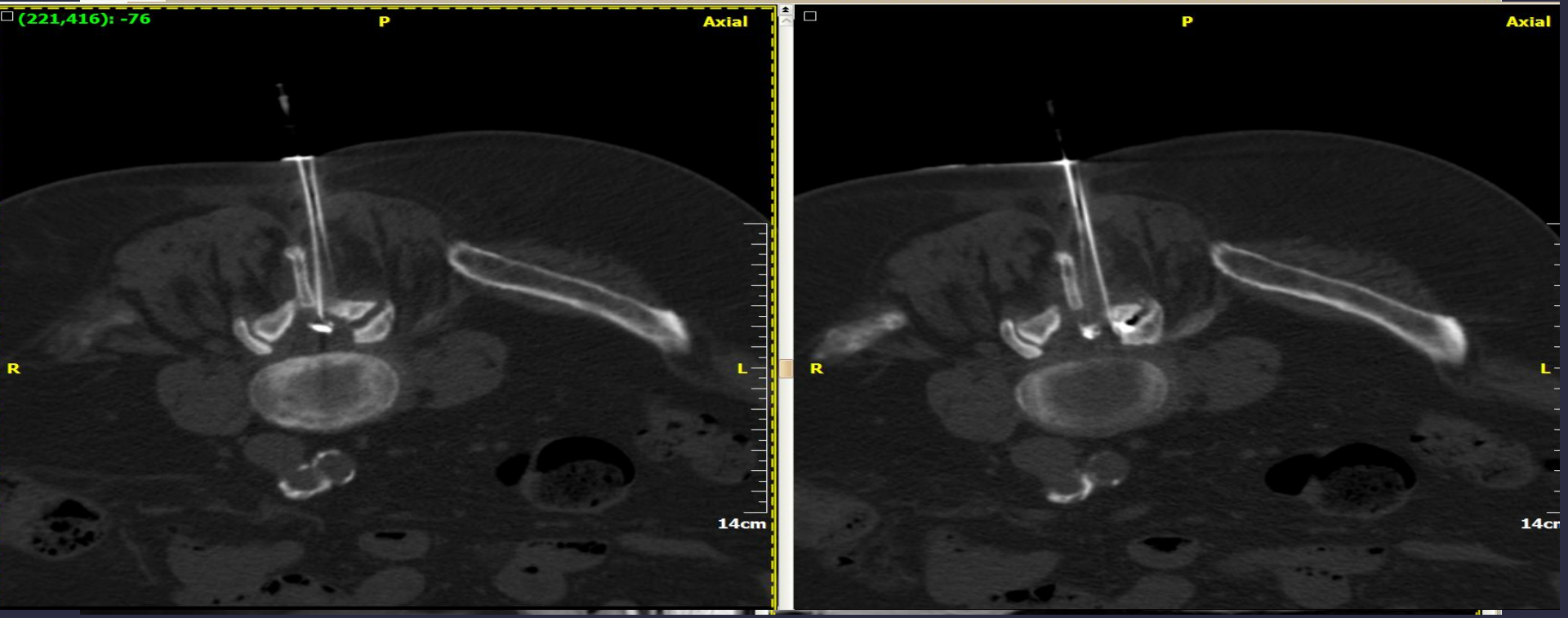


SPINE BIOPSY TARGET CONSIDERATIONS

NEURAL FORAMEN

EPIDURAL SPACE



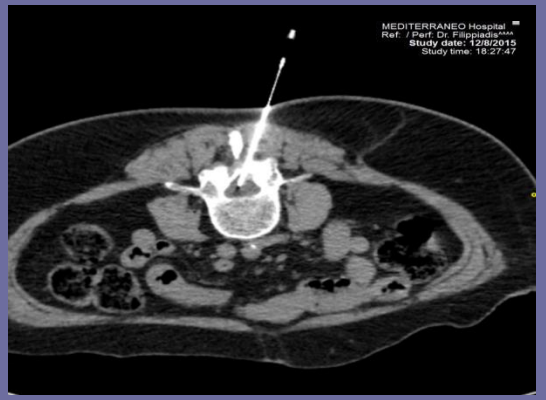

(221,416): -76
P
Axial
R
L
14cm
P
Axial
R
L
14cr

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.”



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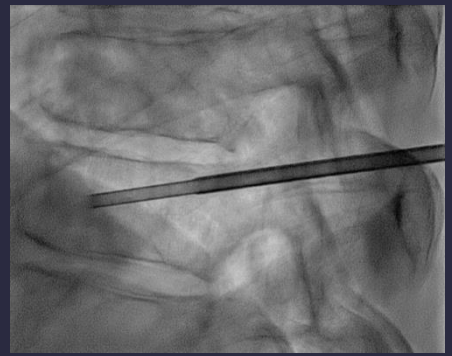
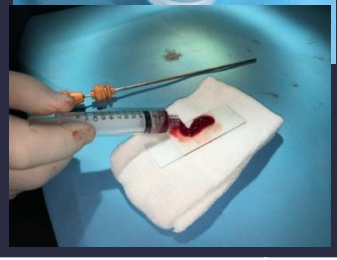
MSK BIOPSY





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*

c/o E. Eyheremendy Argentina

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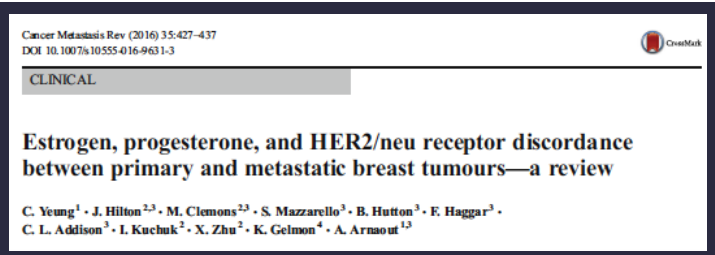
MSK BIOPSY



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. Yeung[1] · J. Hilton[2,3] · M. Clemons[2,3] · S. Mazzarello[3] · B. Hutton[3] · F. Haggar[3] · C. L. Addison[3] · I. Kuchuk[2] · X. Zhu[2] · K. Gelmon[4] · A. Arnaout[1,3]

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

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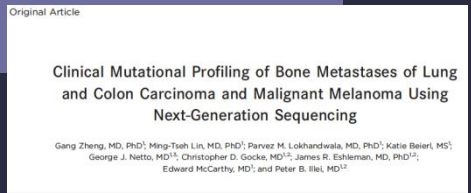
MSK BIOPSY

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, PhD[1]; Ming-Tseh Lin, MD, PhD[1]; Parvez M. Lokhandwala, MD, PhD[1]; Katie Beierl, MS[1]; George J. Netto, MD[1,3]; Christopher D. Gocke, MD[1,2]; James R. Eshleman, MD, PhD[1,2]; Edward McCarthy, MD[1]; 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

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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

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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

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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

J Vasc Interv Radiol 2013; 24:1094 -1103

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

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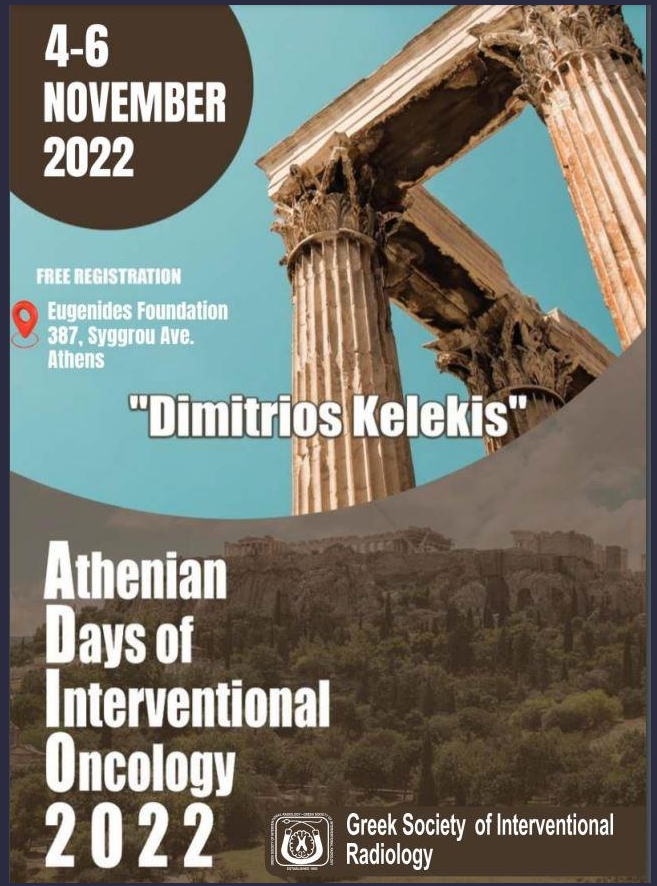
ATTIKON



16:30 - 18:00

MSK - *A. KELEKIS & A. GANGI*

Surgical approaches for MSK mets - *P. Papaggelopoulos*

Ablation in the spine and peripheral skeleton: which technique, which target - *J. Jennings*

Percutaneous augmentation in the spine: is there room for improvement? - *S. Marcia*

Percutaneous augmentation in peripheral skeleton: is there room for improvement? - *D. Filippiadis*

Trans-arterial embolization for MSK lesions: indications, technique, results - *A. Ryan*

Radiation therapies in the spine and peripheral skeleton - *M. Trichas*

Combined approaches - *M. Callstrom*

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MSK BIOPSY

The