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Hip Cooled-RF Training Presentation

Imagine where life could take your patients

AGENDA

- Patient Selection
- Anatomy Overview
  - Neuroanatomy
  - Lesion targets
- Technique
  - Diagnostic Block
  - Procedure Overview
  - Procedure Technique
- Precautions
- Appendix

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Treatment Options for Hip/Knee Pain

- Structural repair/regenerative technologies
  - Structural replacement with cells grown on scaffolds
  - Chondrocyte injections, mesenchymal stem cells
- Analgesic augmentive or suppressive injections
  - Hyaluronic acid, steroids – Not supported by AAOS.
  - PRP per Nguyen "…evidenced-based research regarding treatment with PRP is scant; the scientific literature on PRP is in its infancy, and PRP cannot be considered a standard of care until further research establishes such standards."
- Neuromodification technologies

Nguyen RT, Borg-Stein J, McInnis K. Applications of platelet-rich-plasma in musculoskeletal and sports medicine: an evidence-based approach. *PM R*. 2011;3:226-250.

Vora A, Borg-Stein J, Nguyen RT. Regenerative injection therapy for osteoarthritis: fundamental concepts and evidence-based review. *PM R*. 2012;4(5 Suppl):S104-109.

Neuromodification technologies

- Dorsal column/DRG/nerve root stimulation
  - Superior for neurogenic pain
  - No evidence supports use in nociceptive pain
- Peripheral nerve stimulation – not supported by literature
- Neuroablative technologies
  - RF – available now

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Let’s dive in deeper…

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How does one safely eliminate painful sensation from a joint?

- Interrupt purely sensory distal afferent nerves, typically articular nerves
- Consider interruption of mixed sensory-motor nerve where the loss of motor function is clinically unimportant
- Avoid lesioning mixed nerve where the loss of motor function has significant adverse clinical consequences. Consideration can be given to surgical neuroplasty of such nerves.
- Use anatomically reliable landmarks determinable by fluoroscopy, ultrasound or electrical stimulation of the nerves
- Surgical approach must minimize risk of injury to overlying or adjacent visceral and neurovascular structures.

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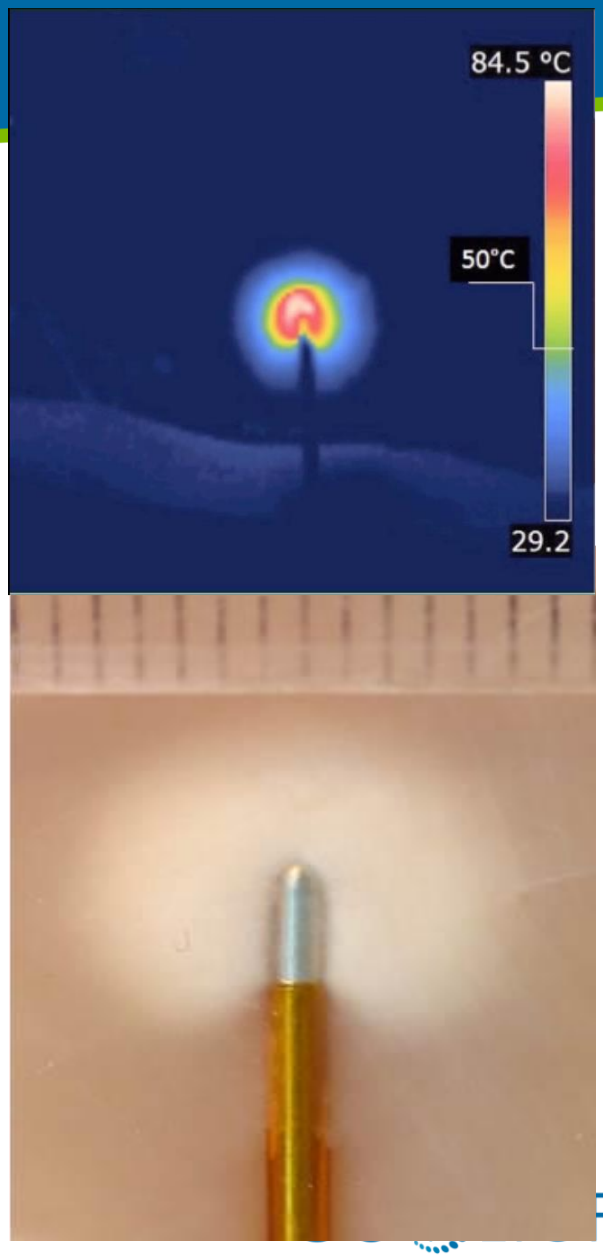
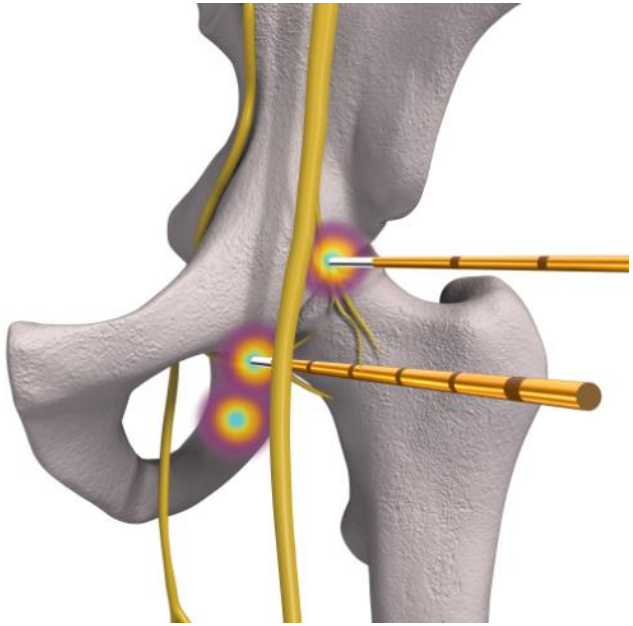
Why cooled RF?

- Anatomy is very variable based on cadaveric dissections
- Near spherical 10-12 mm diameter tissue lesion is produced using 4 mm active RF probe tip.
- Large lesion volume compensates for variable course of the articular branches. More efficient in OR and more predictable than multiple passes with smaller gauge RF probes.
- Anatomic technique under fluoroscopy relies upon easily visualized landmarks.
- MRI validated anatomic technique uses oblique entry 50-70^{o} from sagittal plane to minimize risk of vascular injury
- 2 Hz electrical stimulation verifies absence of proximity to motor nerve.



Hip Patient Selection



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Chronic Hip Pain

- Prevalence:
  - Hip joint pain is a common condition with an estimated prevalence of 7% in men and 10% in women, in a population sample aged over 45
    - *Birrell F, et al. Association between pain in the hip region and radiographic changes of osteoarthritis: Results from a population-based study. Rheumatology, 2005;44:337-41.*
  - Rates of chronic pain @ 1 yr, THR 38%
    - *Spencer S. Liu, MD. et al. A Cross-Sectional Survey on Prevalence and Risk Factors for Persistent Postsurgical Pain 1 Year After Total Hip and Knee Replacement. Reg Anesth Pain Med 2012;37: 415-422*
  - Symptomatic osteoarthritis of the hip affects 4.4% of adults ≥55 years of age (3.6% female; 5.5% male)
    - *Lawrence RC, Felson DT, Helmick CG, et al. Estimates of the prevalence of arthritis and other rheumatic conditions in the United States. Part II. Arthritis Rheum 2008;58(1):26–35.*

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Anatomy Overview

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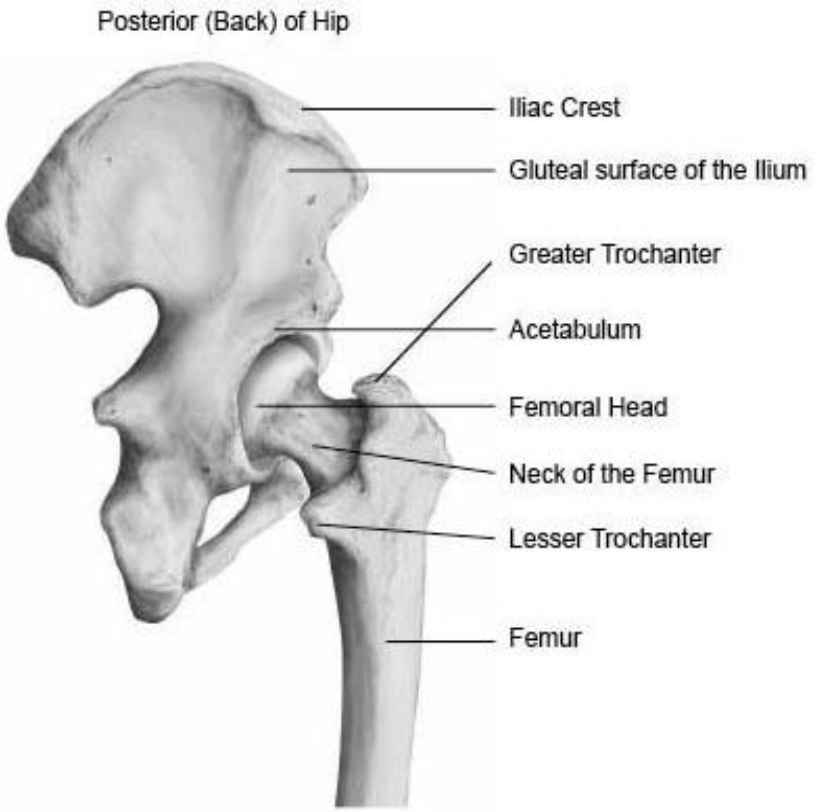
Application to Hip Pain

Frequent causes of hip pain:

- Degenerated Joint Disease (DJD)
- Avascular Necrosis (AVN)
- Labral tears
- Femoroacetabular Impingement (FAI)
- Tumor



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Innervation of the hip joint is regionally specific:

- Anteromedial innervation supplied by the articular branches of the obturator nerve or accessory obturator nerve
- Anterior hip joint capsule innervated by sensory articular branches of the femoral nerve
- Posterior innervation supplied by articular branches derived from the sciatic nerve
    - Posteromedial hip joint capsule innervated by articular branches from the nerves to the quadratus femoris muscle
    - Posterolateral hip joint capsule innervated by articular branches from the superior gluteal nerve.

Birnbaum K, Prescher A, Hessler S, Heller KD. The sensory innervation of the hip joint – An anatomical study. Surg Radiol Anat (1997)19; 371-375.

Neuroanatomy of the anterior hip joint

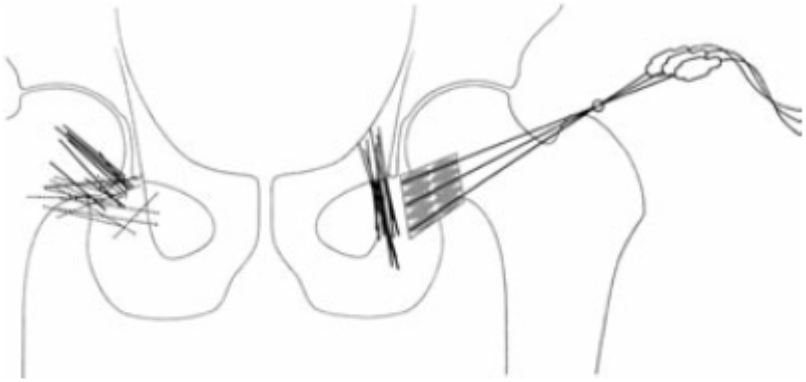
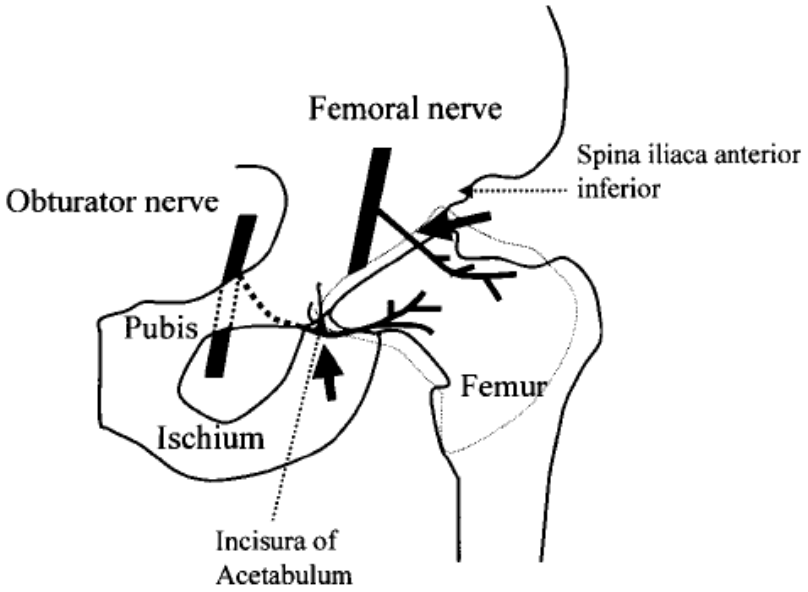


Figure 1 Articular branches of the obturator nerve and target region for radiofrequency denervation. Covering the right hip are tracings of the anteroposterior projections of the metal wires used to mark the location of the articular branches in cadavers. In each cadaver, articular branches were spread across band-like areas. The bold lines represent the upper boundary of each area, and the dotted lines represent the lower boundary. The stem of each band was located below the teardrop shape of the inferior end of the acetabulum. Over the left hip, the matrix of lesions required to coagulate the articular branches is illustrated. Its medial margin lies opposite and below the teardrop silhouette of the acetabulum. For reference, tracings of wires covering the obturator nerve have been depicted.



Locher, S et. Al. Radiologic anatomy of the obturator nerve and its articular branches: Basis to develop a method of radiofrequency denervation for hip joint pain. Pain Med 9(3) 2008;291-298.

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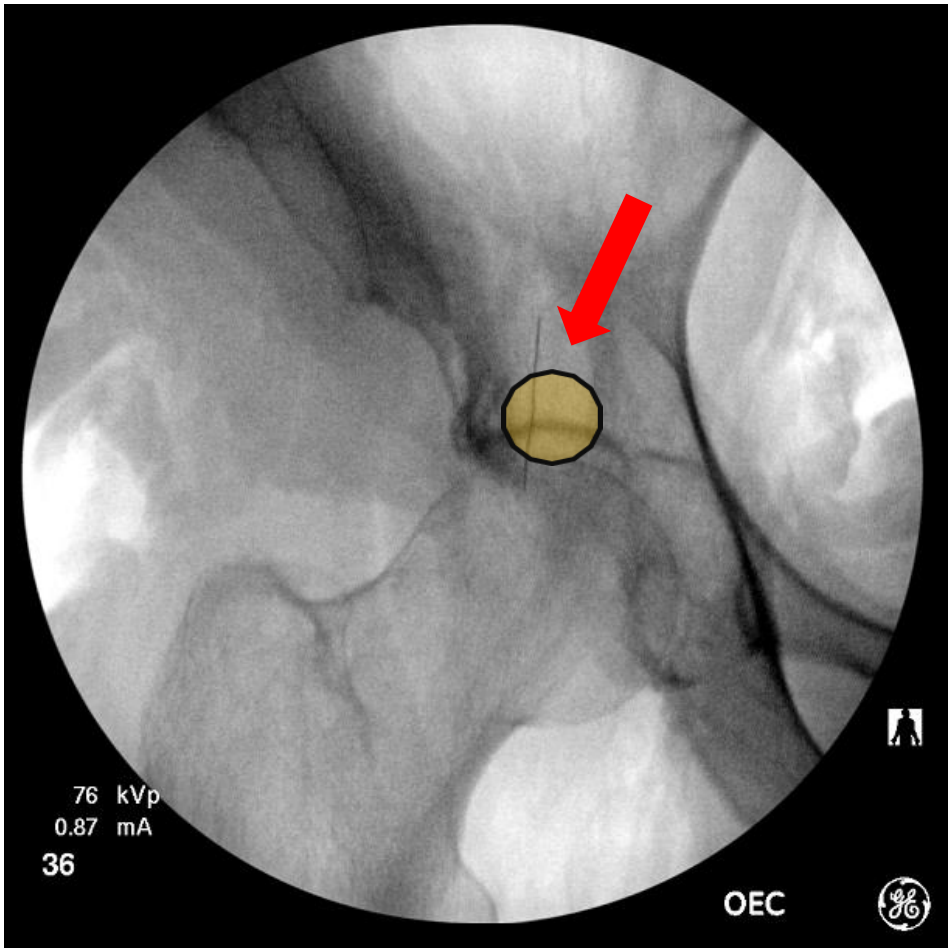
Femoral articular branch innervation

- Innervation to the anterosuperior aspect of the hip is relatively constant across the 11:30-12:30 clock position.
- Two femoral articular branches shown derived from nerve to iliacus mm.
- Hypothetical RF lesions made with Coolief™ RF probe at 12 o'clock position shown in gold.



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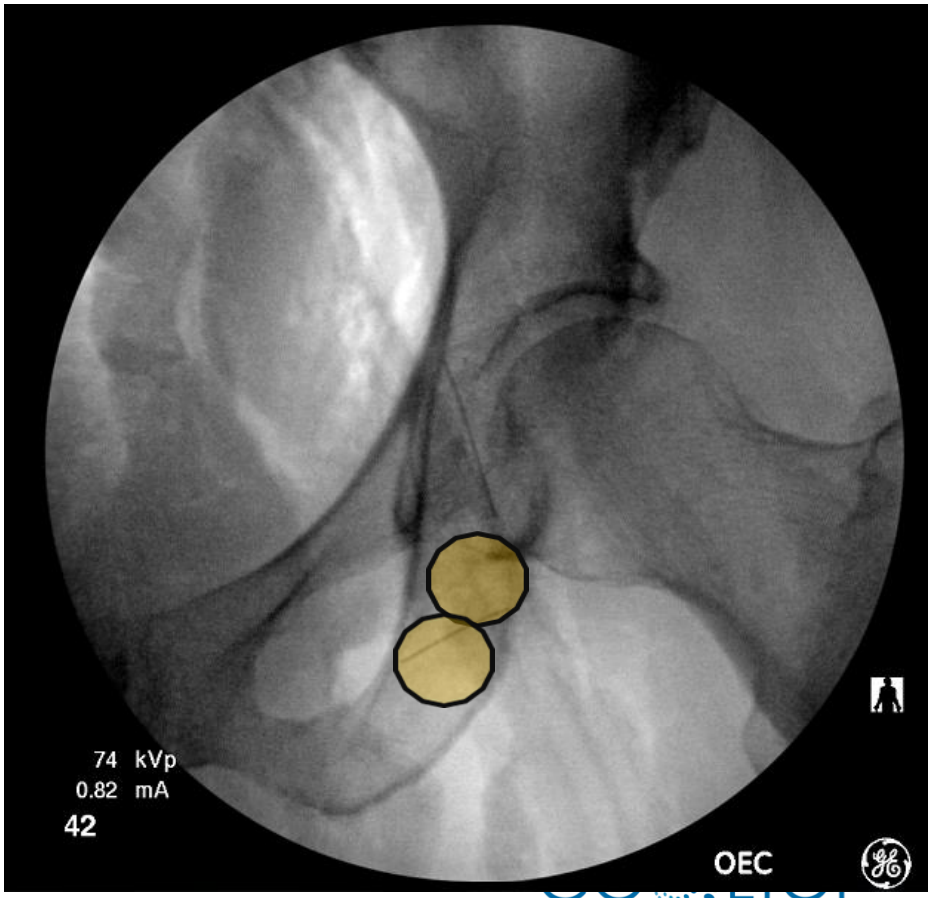
Variation of obturator nerve innervation pattern

- The paths of the obturator articular branch(es) vary across the ischium – Two vertically adjacent lesions are made with Coolief™ RF probe over the ischium for reliable denervation.



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Precautions

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Precautions

- Major anatomic targets for therapeutic RF anterior hip neurolysis lie deep to important neurovascular structures including the femoral nerve, artery and vein!!
- Entry made lateral to a vertical line drawn 2 cm lateral to the lateral border of a palpable femoral pulse will generally avoid the neurovascular bundle in a 55-75 kg patient (This line will be much further lateral in obese patients).
- Never make an RF lesion with a “finder” needle in place.
- Use of diagnostic ultrasound to locate the femoral neurovascular structures is optional.

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Technique

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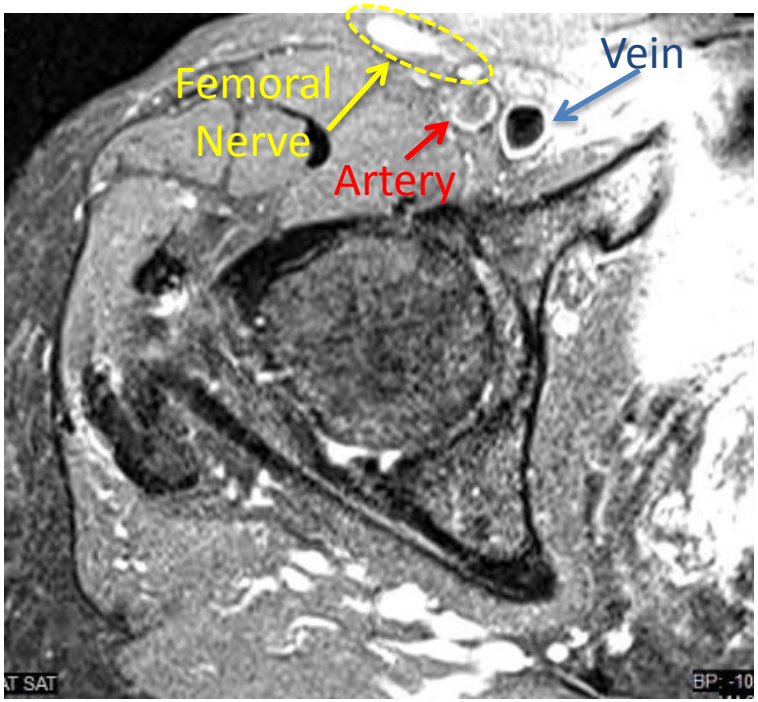
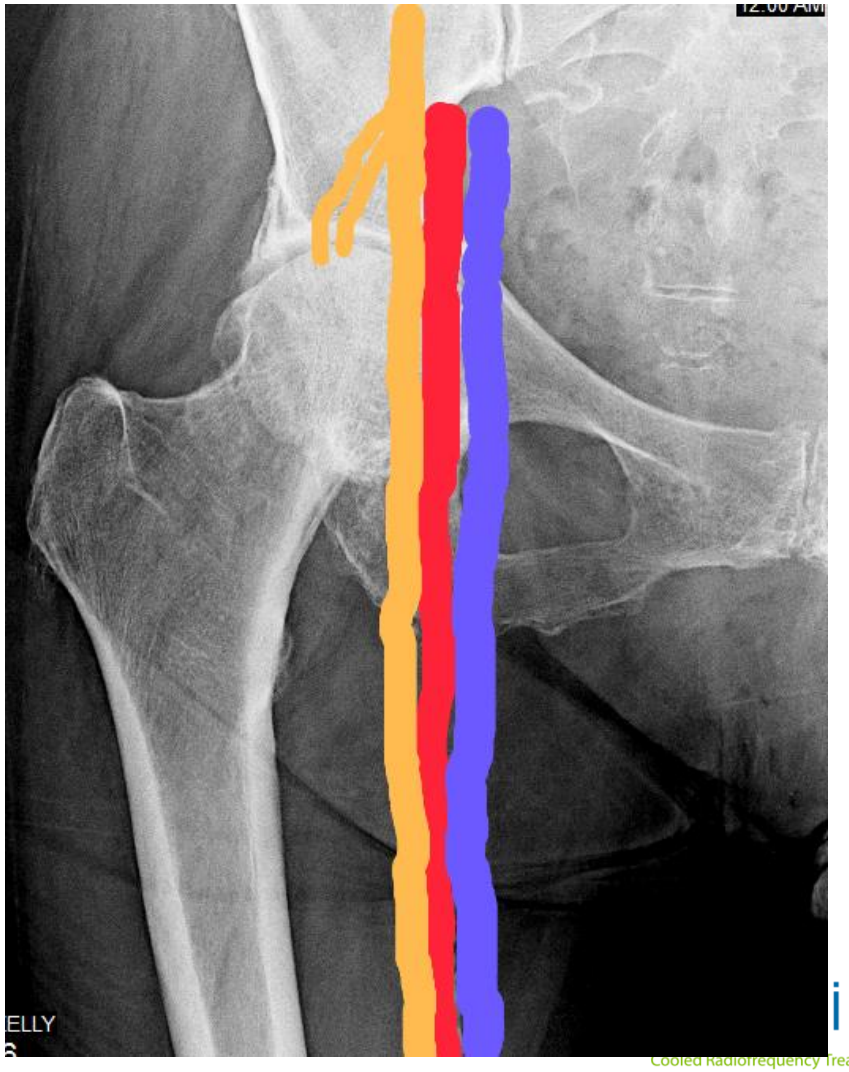
Developing a safe procedural technique

- Major targets for therapeutic partial RF denervation of hip innervation lie deep to important neurovascular structures!!





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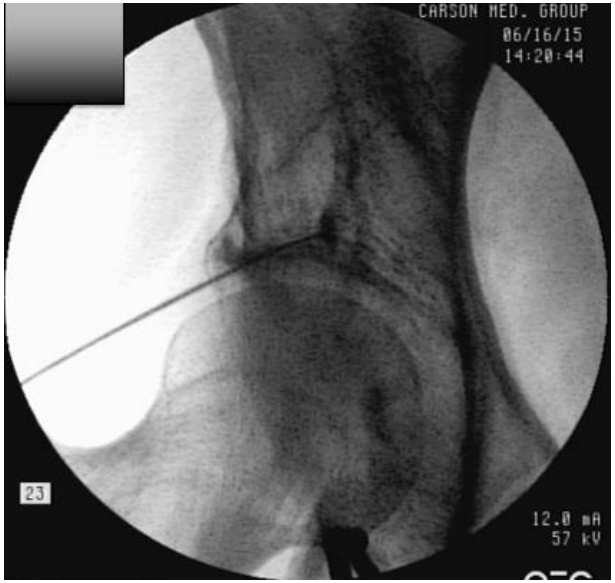
Femoral Articular Branch Diagnostic Blocks

Femoral articular branches:

- Using AP fluoroscopy, advance your needle to the target site at 12 o'clock on the superior acetabulum.
- Use 0.5-1 ml volume of contrast to verify appropriate anatomical coverage
- Then inject 0.5 - 1 ml volume of your local anesthetic for the block
  - (0.9cc = 12mm COOLIEF lesion)



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#1 - Place patient into supine position on table

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#2 - Prep and drape in standard sterile fashion

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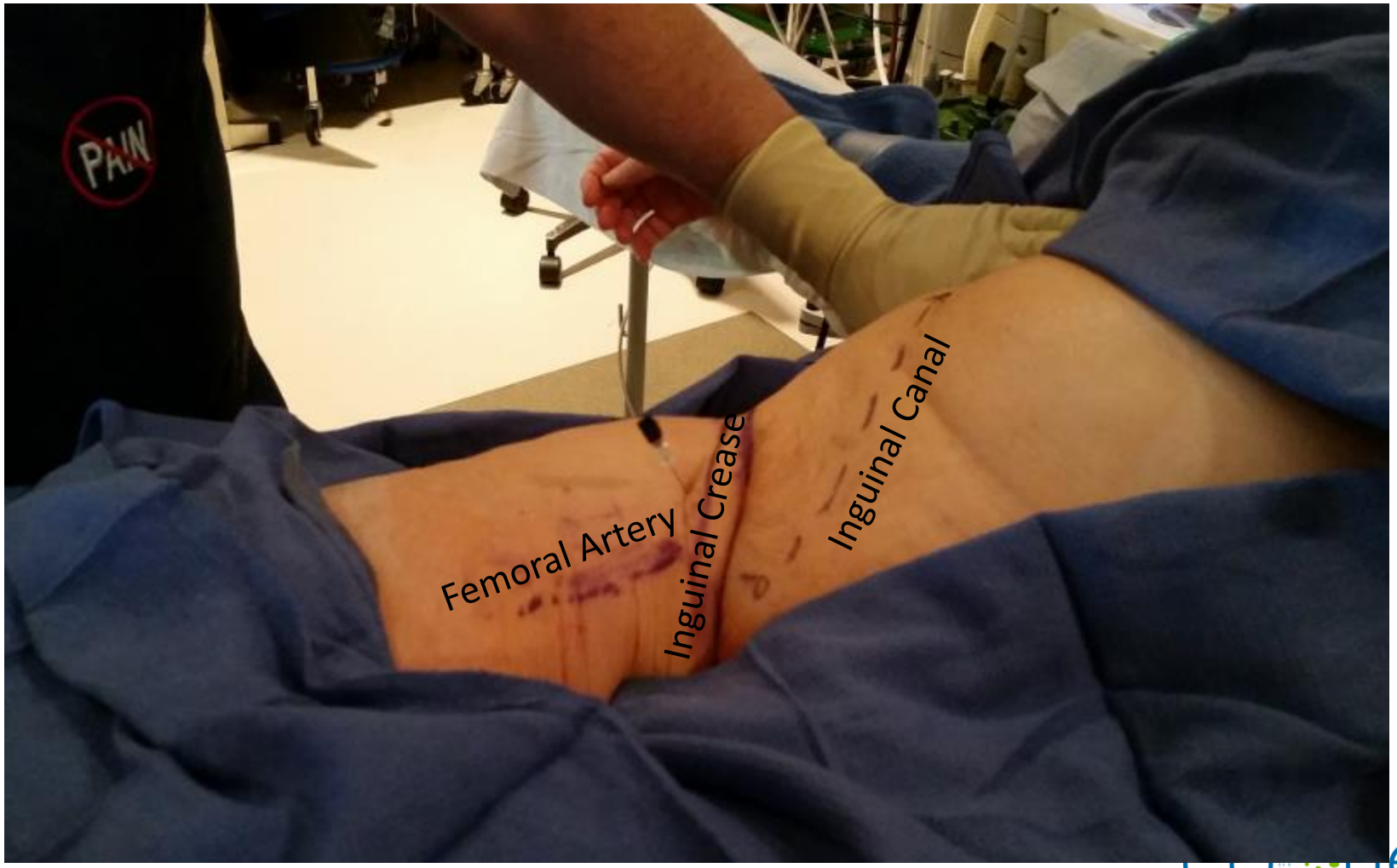
#3 - Appropriately mark patient including inguinal canal, inguinal crease and femoral artery to the mid-thigh



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#4 – Scout AP Pelvis

- Ensure symmetry of obturator foramen

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#5 – Optimize hip joint visualization (push/pull of fluro unit, DO NOT adjust angles)

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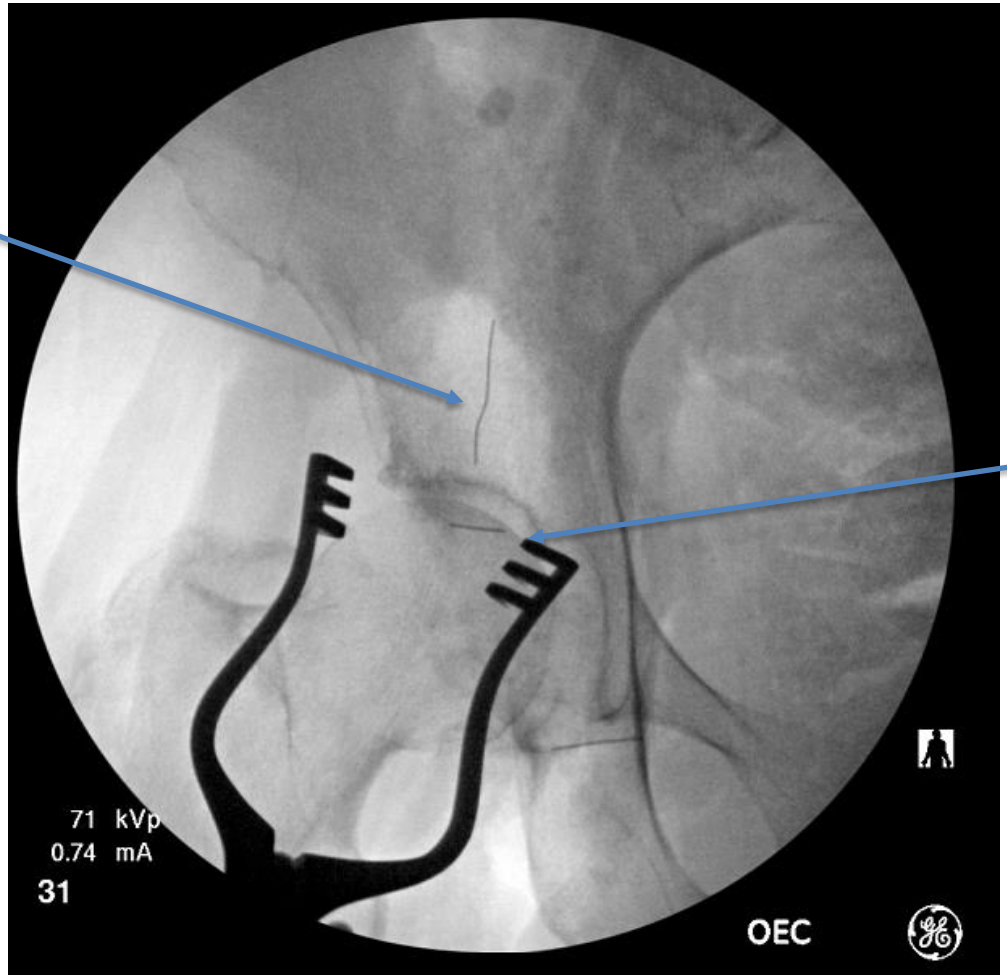
Optimal target lession location

Wire diagram of femoral nerve articular branch



1cm reference

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#6 – Determine needle entry site

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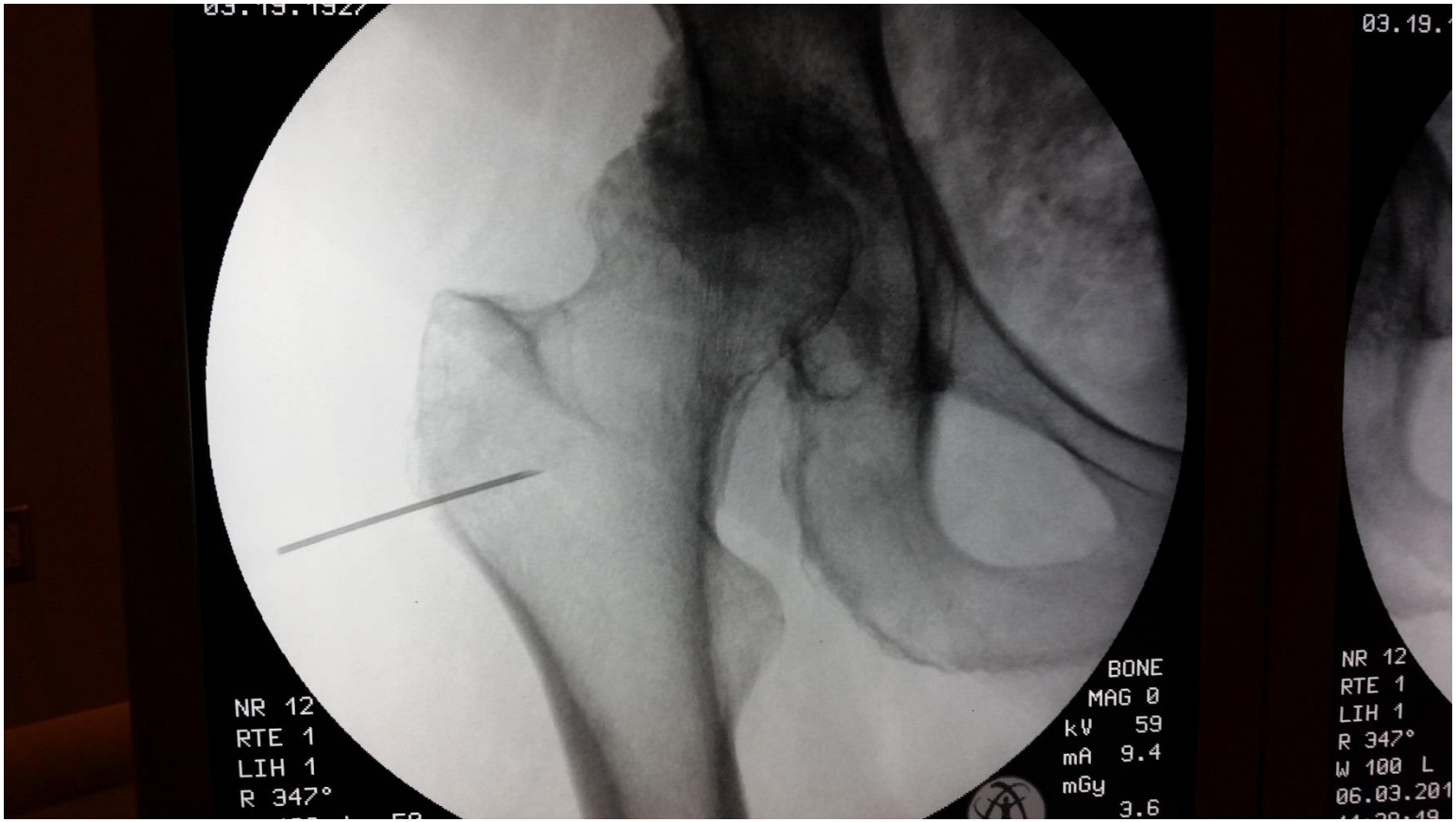
#7 – Confirm with fluoroscopic imaging



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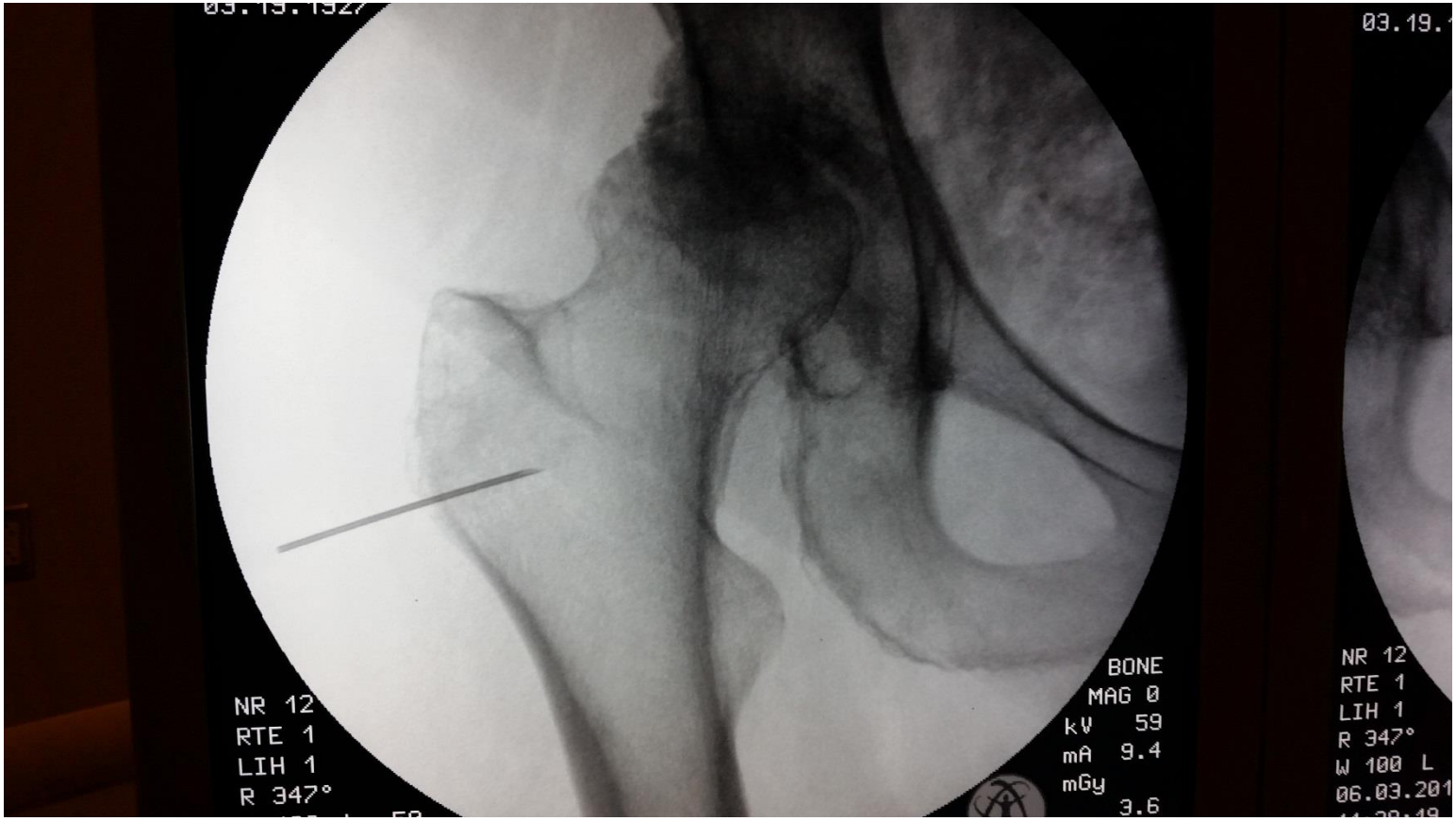
WARNING – if needle entry site is below the superior aspect of the greater trocanar, we recommend repositioning. Adjustment of caudad tilt will raise the needle tip more superiorly. Adjust until needle tip is above greater trocantor.



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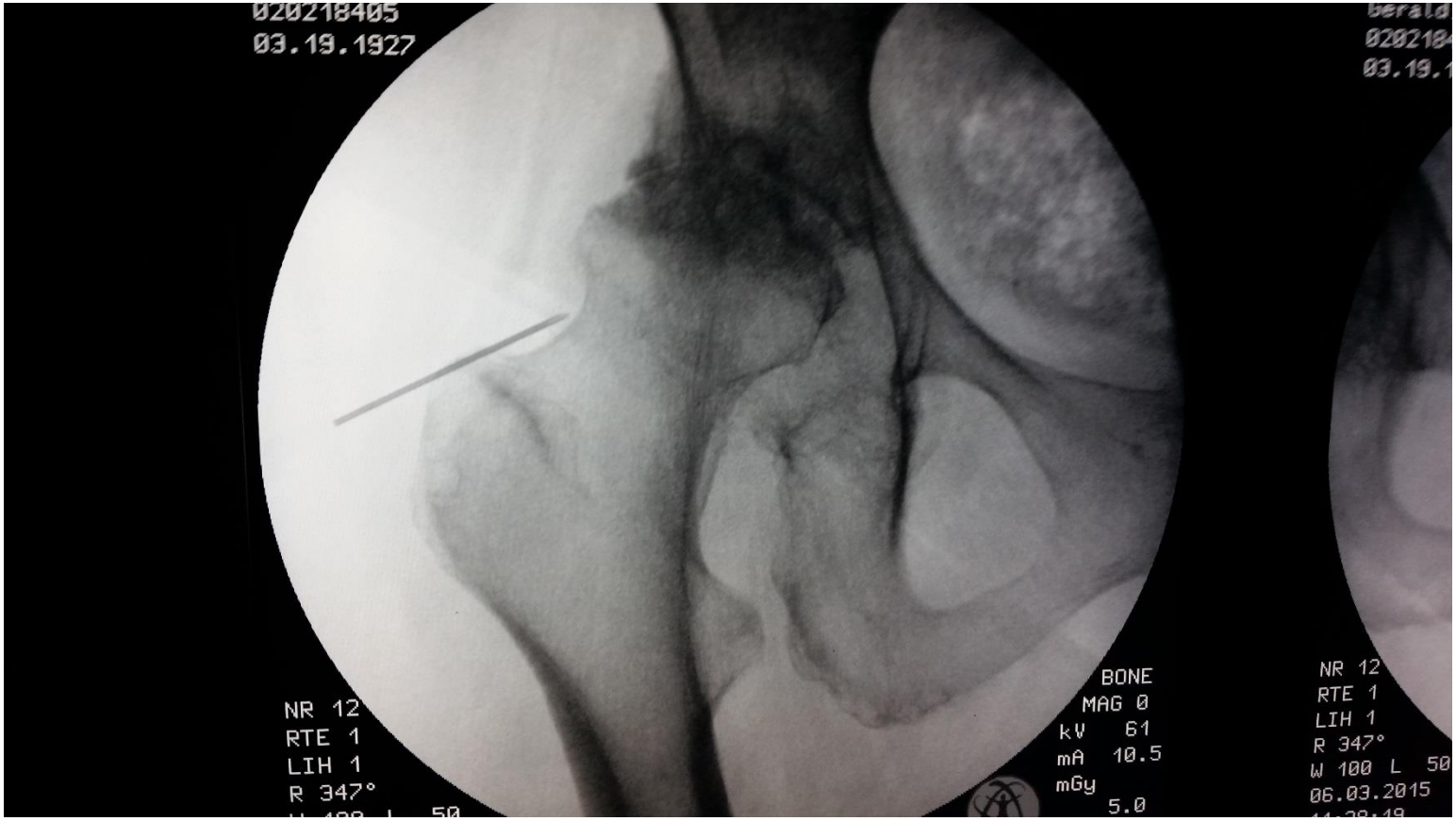
With caudad repositioning, note new position of local needle for cephlad



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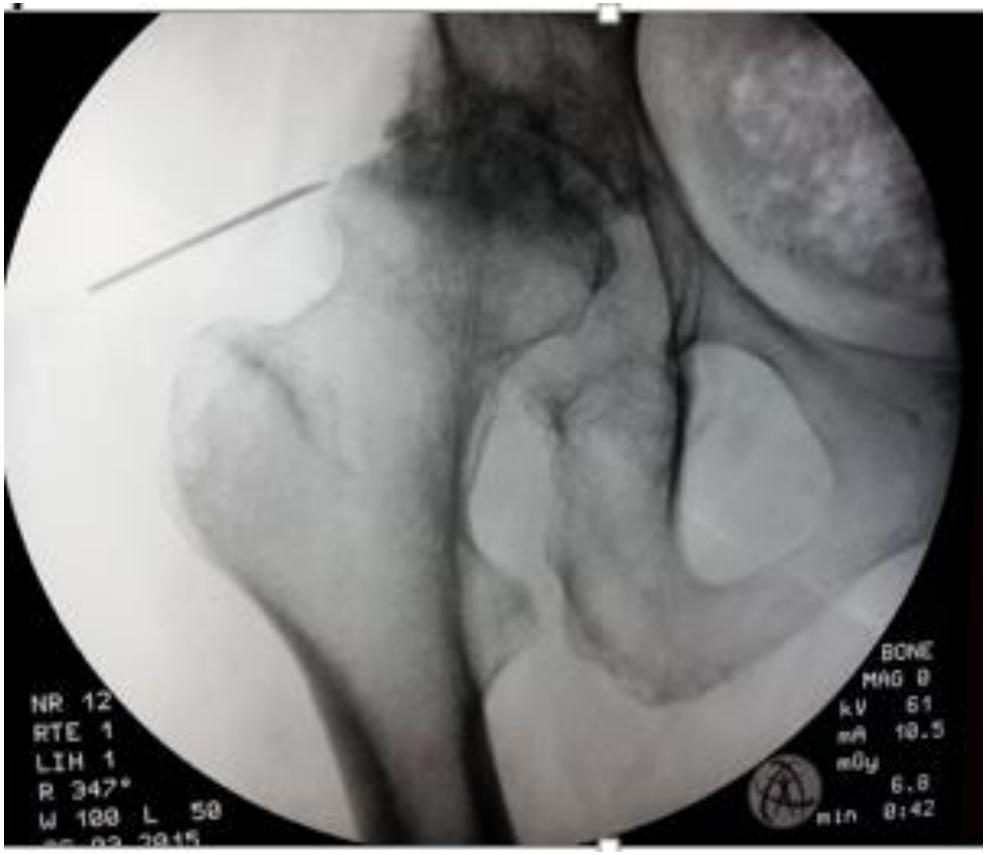
Note actual entry point in this case – we are below the inguinal crease. The more lateral along the inguinal crease, the more superior you are in relation to the acetabulum. Goal is to be horizontal to lesion site.

#8 – Anesthetize deep track towards target



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#9 – Insert COOLIEF introducer through deep anesthetized track toward lesion site. Advance Coolief introducer under fluoroscopy to the 12 o'clock acetabular target site where osseous acetabulum is contacted.

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#10 - Initiate 2 Hz motor stimulation up to 1-2V affirming lack of muscle contractions to avoid lesioning motor branches near the RF probe tip.

Note: Local anesthetic should not be injected prior to motor stim testing

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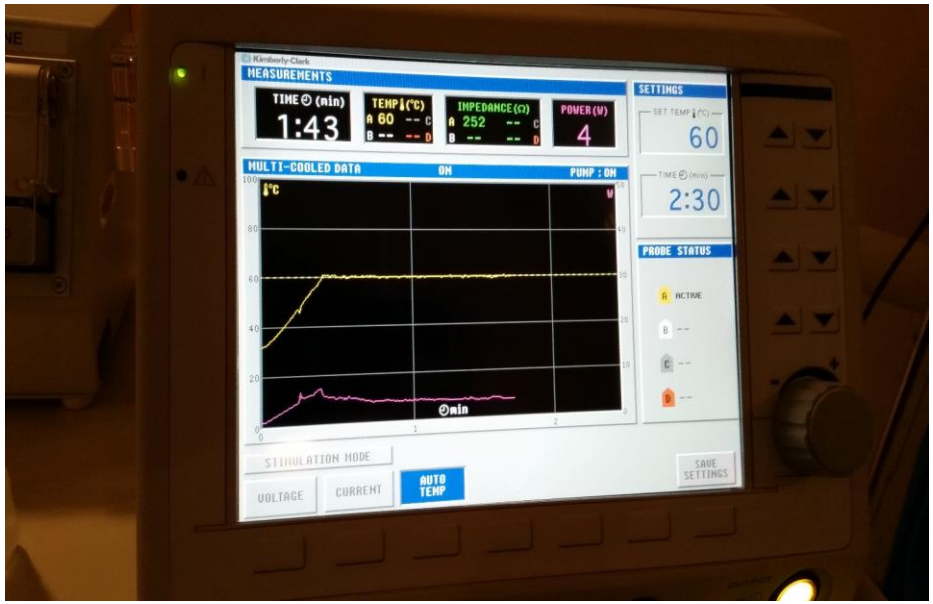
#11 - Inject 1-2 ml of local anesthetic through the Coolief introducer prior to lesioning at 60° C for 2:30 minutes.



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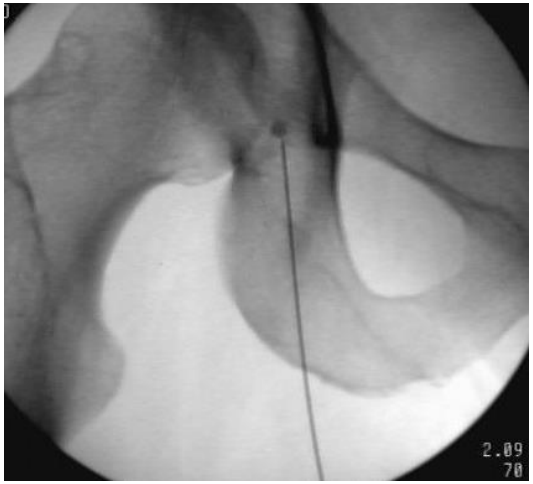
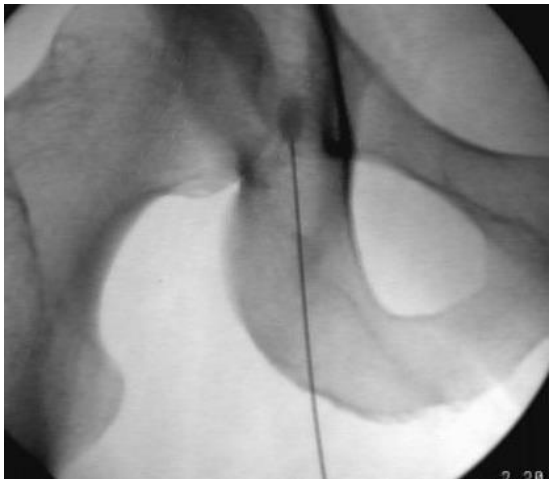
Obturator Articular Branch Diagnostic Blocks

Obturator articular branches :

- Place patient in supine position with sterile prep and drape of groin and hip.
- Using AP fluoroscopy, identify the incisura target site below the inferior junction of the pubis and the ischium which appears as a teardrop shape in the anteroposterior view.
- Palpate femoral arterial pulse. Draw a vertical line on the femoral pulse. View AP fluoroscopy and anesthetize skin site.
- Advance your needle under fluoroscopic guidance to meet a bony endpoint just below the teardrop. Aspirate to ensure no blood return.
- Use 0.5-1 ml volume of contrast to verify appropriate anatomical coverage
- Then inject 0.5 - 1 ml volume of your local anesthetic for the block
  - (0.9cc = 12mm COOLIEF lesion)





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#1 – Obtain AP of relevant hip joint

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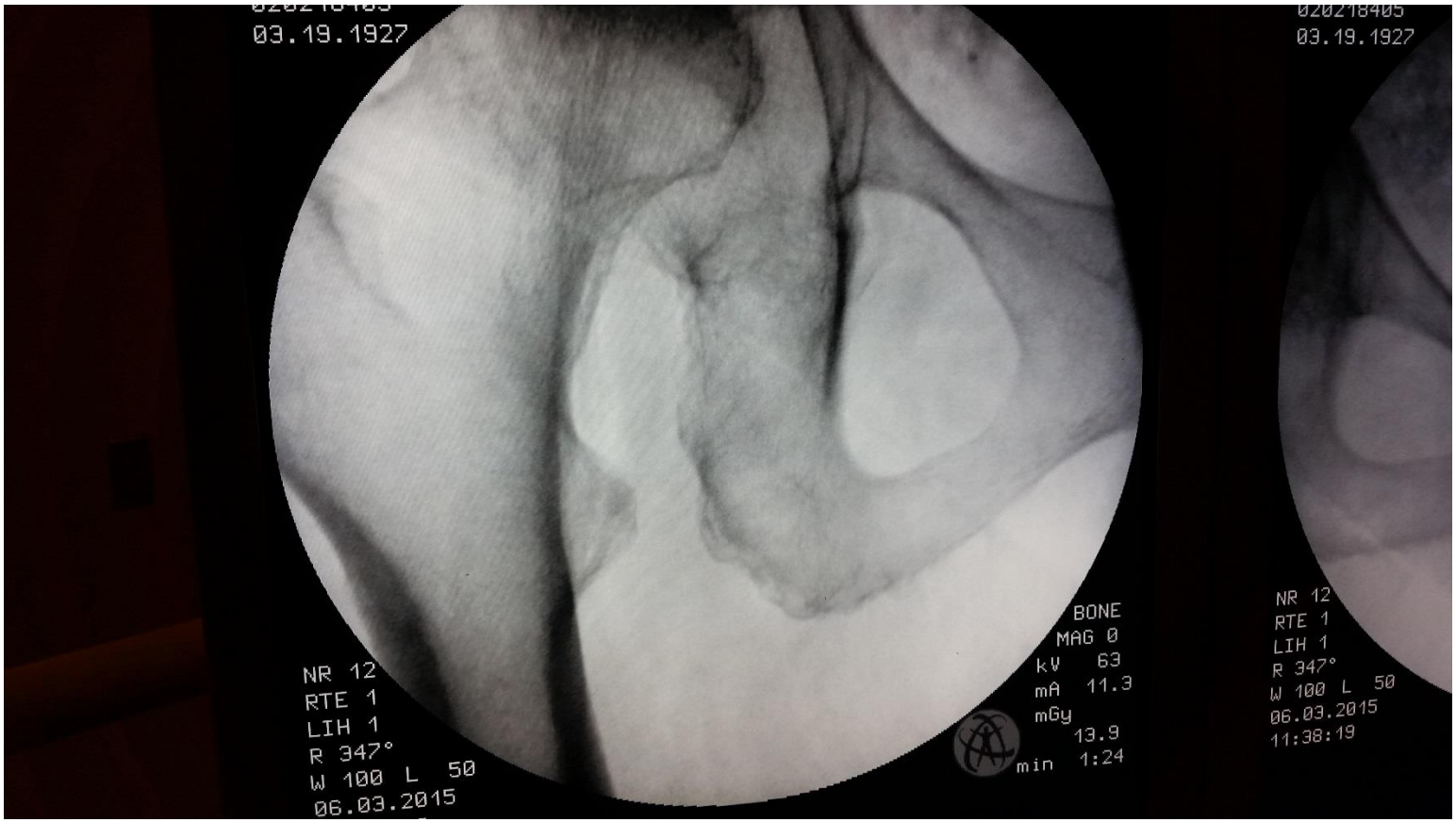
#2 – Adjust fluor unit towards feet to place pubic ramus in middle of screen



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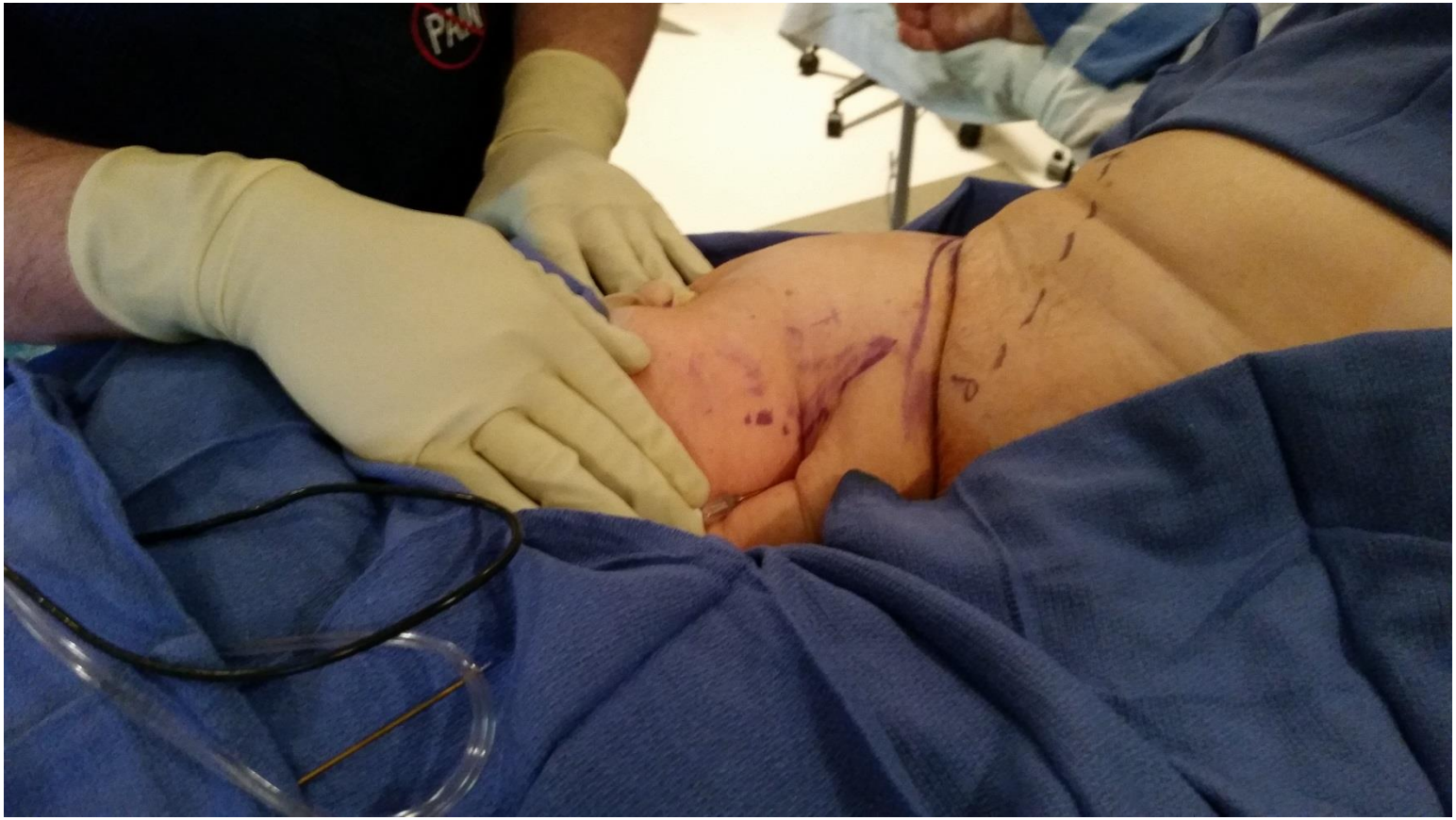
#3 - Anesthetize deep track towards target



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#4 – Insert COOLIEF introducer through deep anesthetized track toward lesion site.

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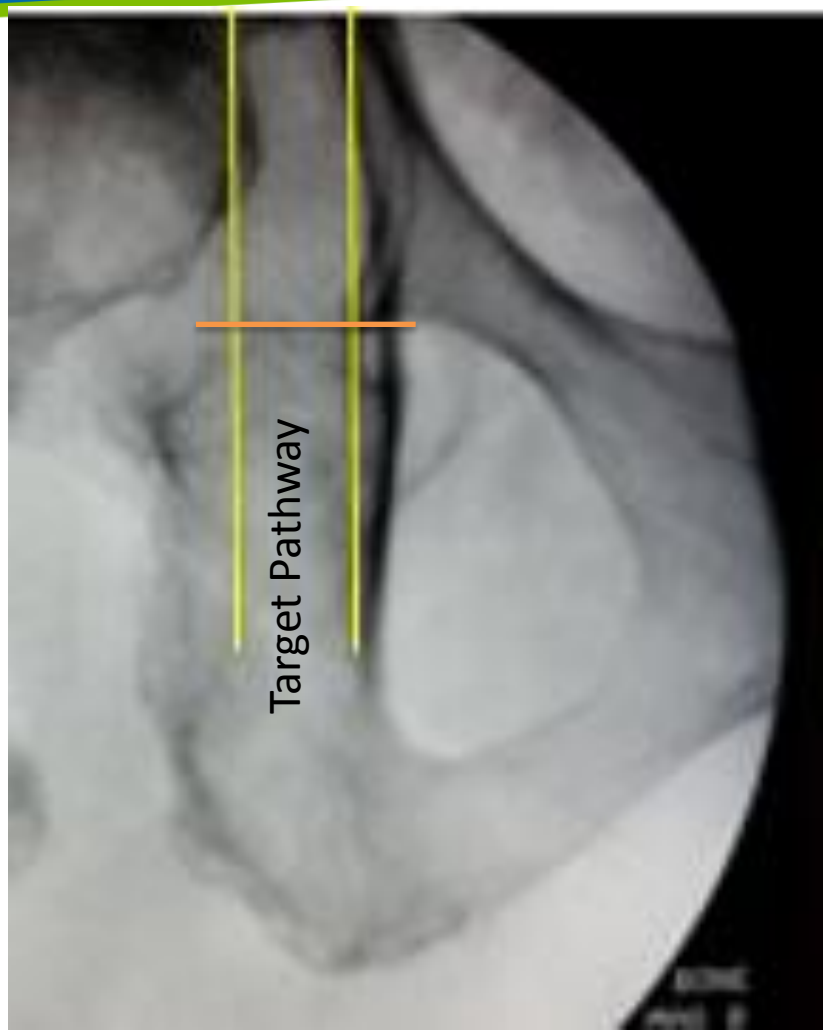
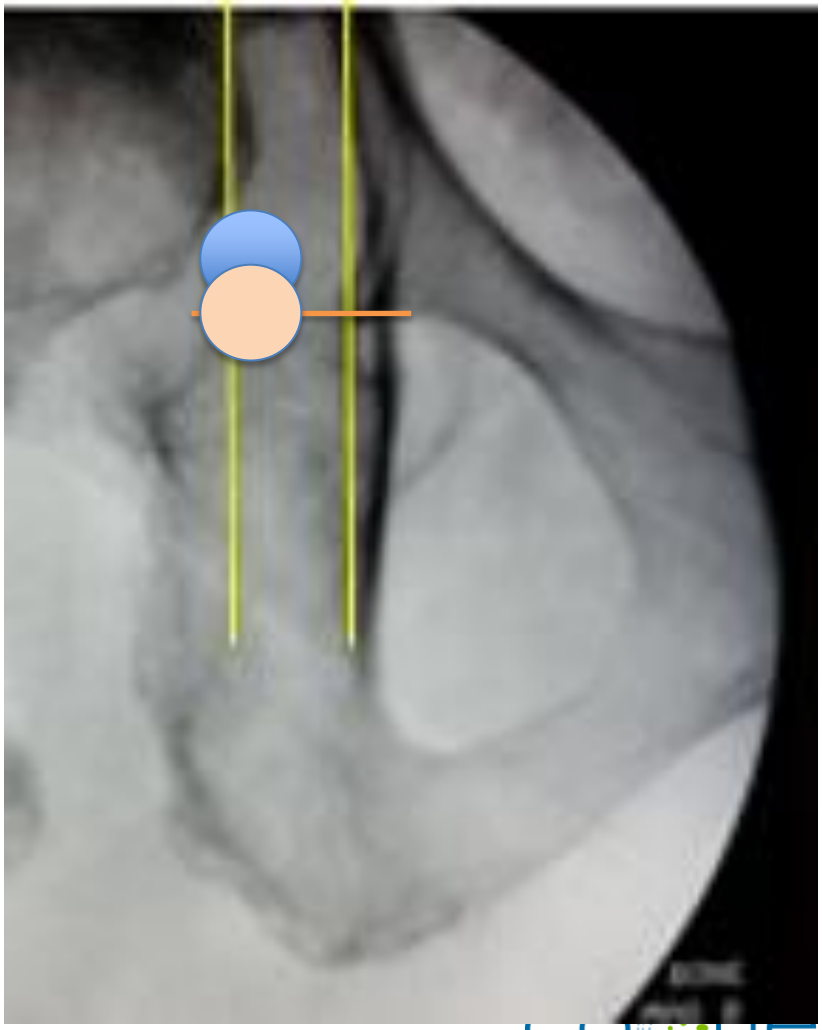
Optimal lesion positions





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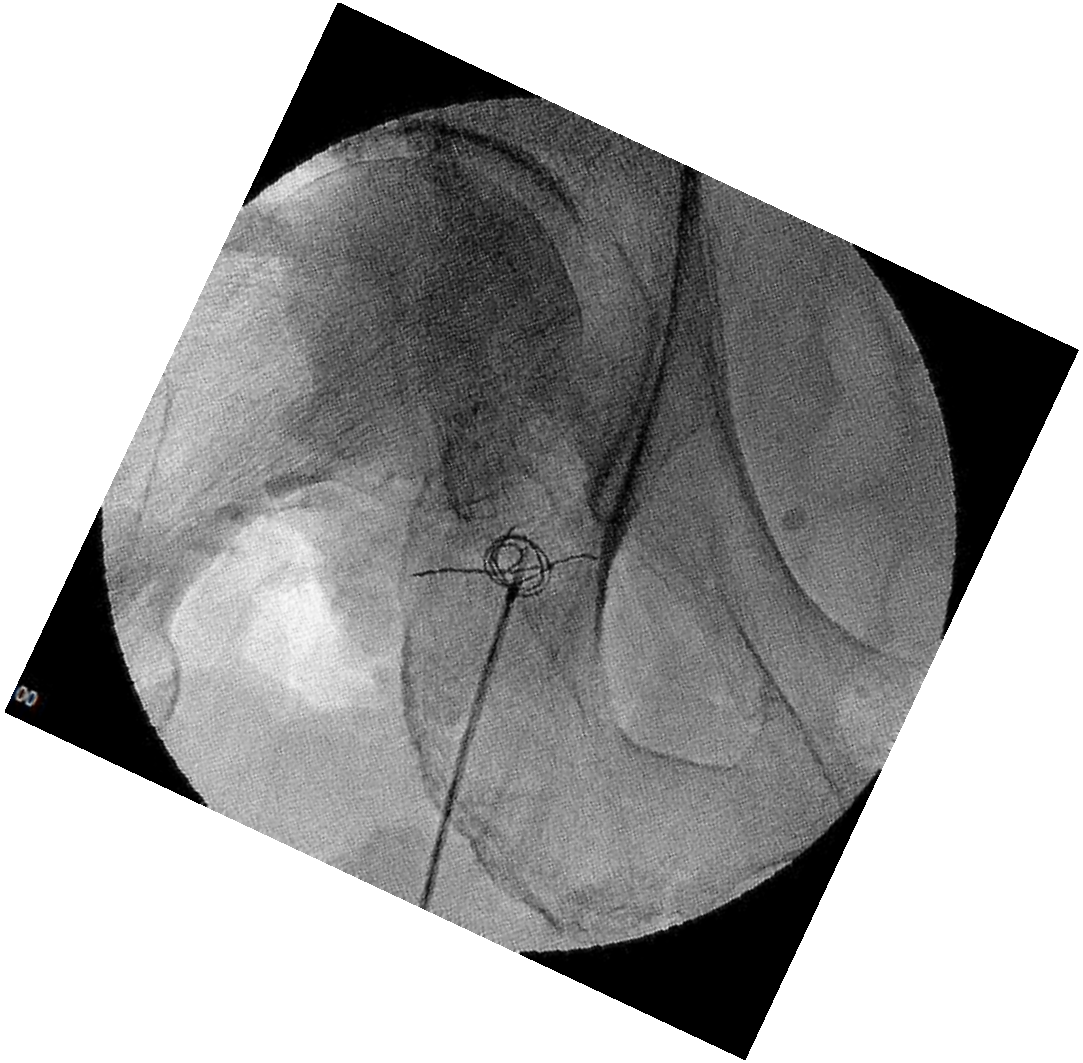
Optimal lesion positions – Wire Diagram



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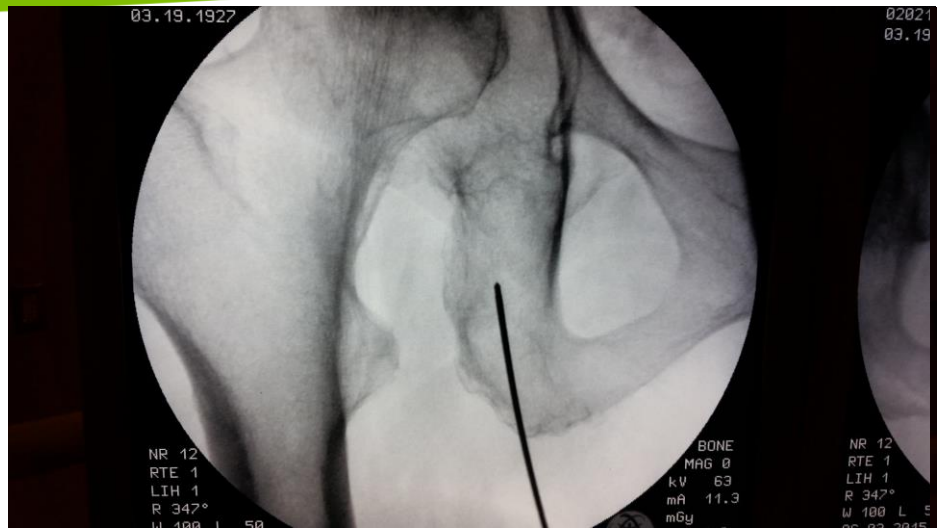
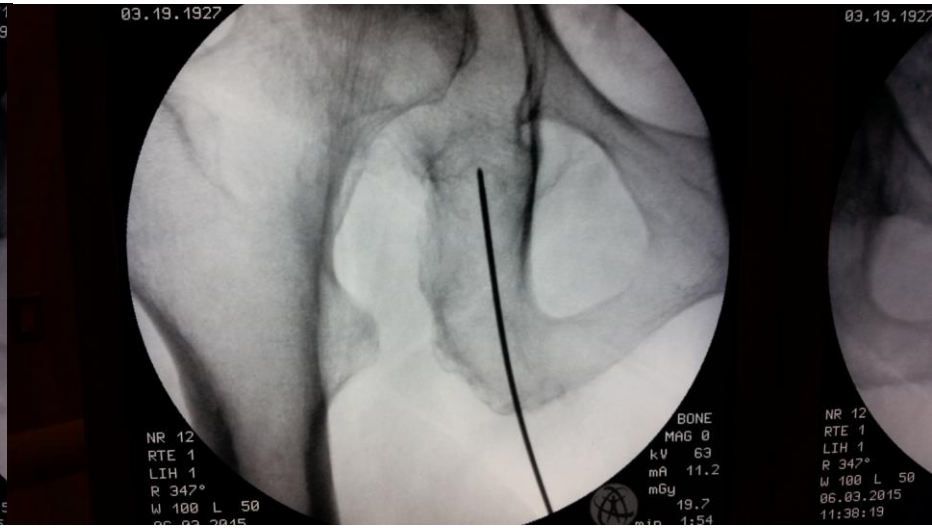
#5 – Advance COOLIEF introducer towards lesion site





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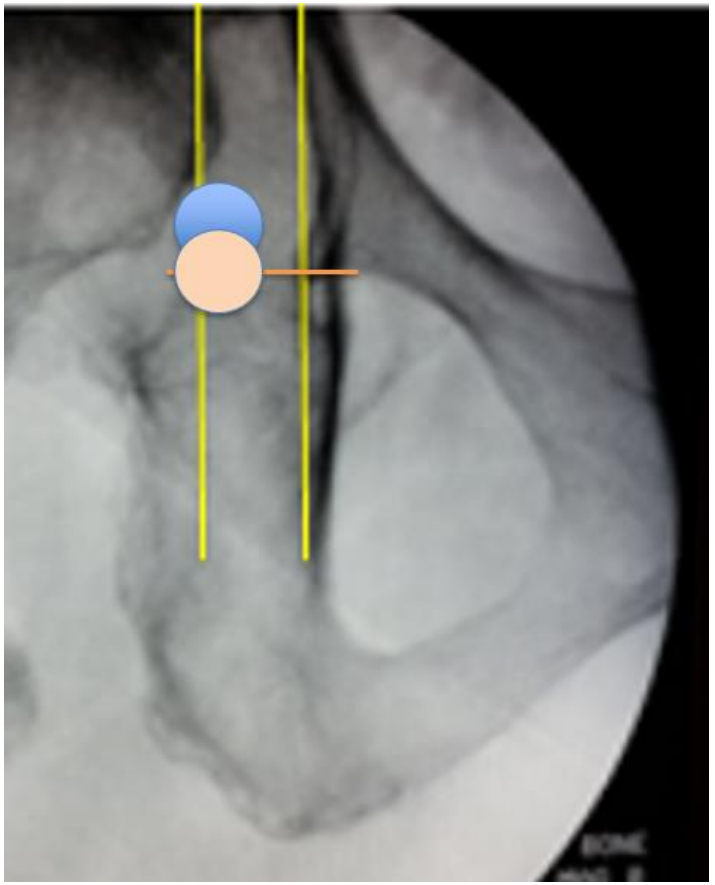
#6 – Insert COOLIEF probe at initial lesion site



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#7 - Initiate 2 Hz motor stimulation up to 1-2V affirming lack of muscle contractions to avoid lesioning motor branches near the RF probe tip.

Note: Local anesthetic should not be injected prior to motor stim testing

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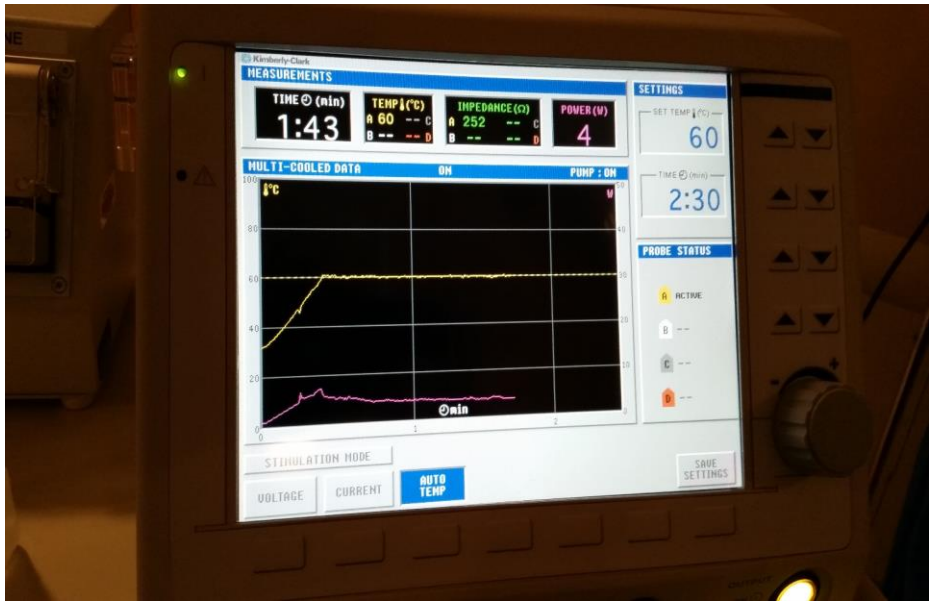
#8 – DO NOT Inject local anesthetic for the first lesion (this will compromise motor stim for the 2nd lesion). Lesion at 60° C for 2:30 minutes.



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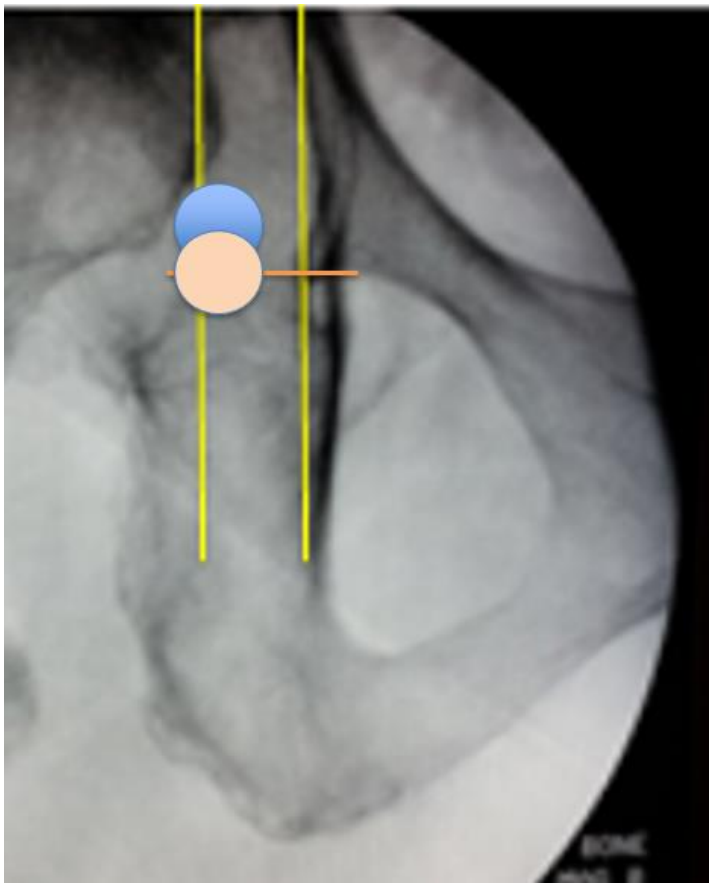
#9 – Withdraw COOLIEF probe 2-4mm to arrive at 2nd lesion site



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#10 - Initiate 2 Hz motor stimulation up to 1-2V affirming lack of muscle contractions to avoid lesioning motor branches near the RF probe tip.

Note: Local anesthetic should not be injected prior to motor stim testing

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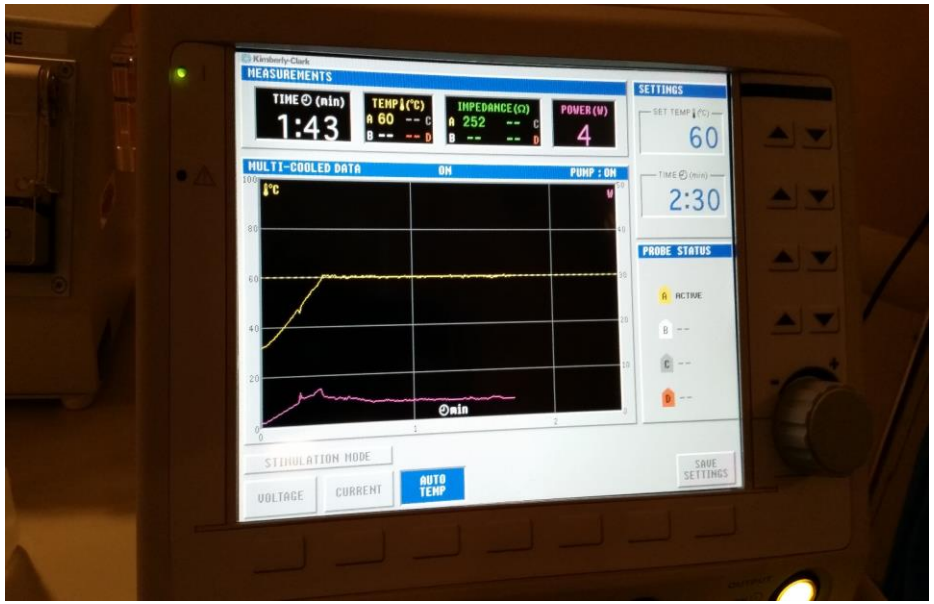
#11 – Injection of optional local anesthetic if desired through the Coolief introducer prior to this 2nd lesion. Lesion at 60° C for 2:30 minutes.



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Clinical Pearls

- Intravenous/oral antibiotics prophylaxis
- Intraarticular antibiotic prophylaxis
- Hip Joint Arthrogram – concern over capsule violation

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Inadvertent Femoral Artery Puncture

- Addressing a femoral artery puncture:
  - Hold pressure for 15 minutes using 2 hands to compress the artery above and at the puncture site
  - Make sure distal pulse in the ankle is preserved
  - Observe patient in PACU for at least 2 hours in supine position
  - Minimize hip flexion and ambulation until the AM
  - Notify patient to call if pain in hip or anywhere in the lower extremity, difficulty moving ankle/toes, severe pain or discoloration

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Summary

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Summary: RFL for peripheral joint pain

- The anatomic basis for therapeutic partial sensory denervation of the hip and knee joints by Cooled RF lesioning techniques has been demonstrated.
- Adjacent neurovascular structures and variations in anatomic innervation must be considered in order to plan safe and effective RF denervation procedures.
- Strong evidence exists for knee RF denervation, but duration of outcomes studied is limited.
- Pilot studies support careful use of these techniques and ongoing study, including clinical trials.

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Thank You

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Appendix

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Hip Outcomes

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Clinical Literature

Rivera F, Mariconda C, Annartone G. *Percutaneous radiofrequency denervation in patients with contraindications for total hip arthroplasty*. Orthopedics (2012)7;35(3)e202-205.

- Prospective pilot study of 17 consecutive patients
- Outcome measures: Harris Hip Score, VAS, WOMAC
- Results:

	Mean Scores		
	VAS	**Harris**	**WOMAC**
pre-procedure	9.52	28.64	75.7
6 month follow up	6.35	43.88	63.7

- 1 Complication- 3 hematomas due to vessel puncture-approach technique altered to prevent reoccurrence
- Conclusion-Percutaneous RF lesioning of the sensory branches of the nerves innervation the hip joint can be an option for patients with intractable hip joint pain and an alternative treatment of hip arthritis with contraindications for THA.

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Clinical Literature

Percutaneous Radiofrequency Lesioning of Sensory Branches of the Obturator and Femoral Nerves for the Treatment of Non-Operable Hip Pain

Pain Physician. 2003;6:499-502,

Atif Malik, MD, Thomas Simopolous, MD, Mohamed Elkersh, MD, Musa Aner, MD, and Zahid H. Bajwa, MD

- Small case series with n=4
- Outcomes measures- VAS, decrease use of pain meds, improvement in function
- Results- 4 of 4 experienced reduced pain, 2 of 4 decreased pain meds, 3 of 4 improved function
- Complications- 1 report of lateral hip surface numbness
- Conclusion- Percutaneous RF lesioning of the sensory branches of the obturator and femoral nerves appears to be a safe alternative to hip replacement, especially where surgery is not an option

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Clinical Literature

Percutaneous Radiofrequency Lesioning of Sensory Branches of the Obturator and Femoral Nerves for the Treatment of Hip Joint Pain

Masahiko Kawaguchi, M.D., Keiji Hashizume, M.D., Toshio Iwata, M.D., and Hitoshi Furuya, M.D.

Reg Anesth Pain Med 2001;26:576-581.

- Retrospective study of 14 patients with differing techniques
- Outcome Measures- VAS
- Results -mean VAS went from 6.2 to 2.7. 86% of pts saw at least 50% relief of pain for up to 11 months
- No side effects or motor weakness observed

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Summary of the literature

- Small sample sizes
- Tedious technique requiring multiple lesions using conventional RF probes to ensure capture of variable nerve courses
- Risk of vascular injury especially involving the femoral artery/vein

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Obturator nerve oblique RF technique minimizes risk of neurovascular injury

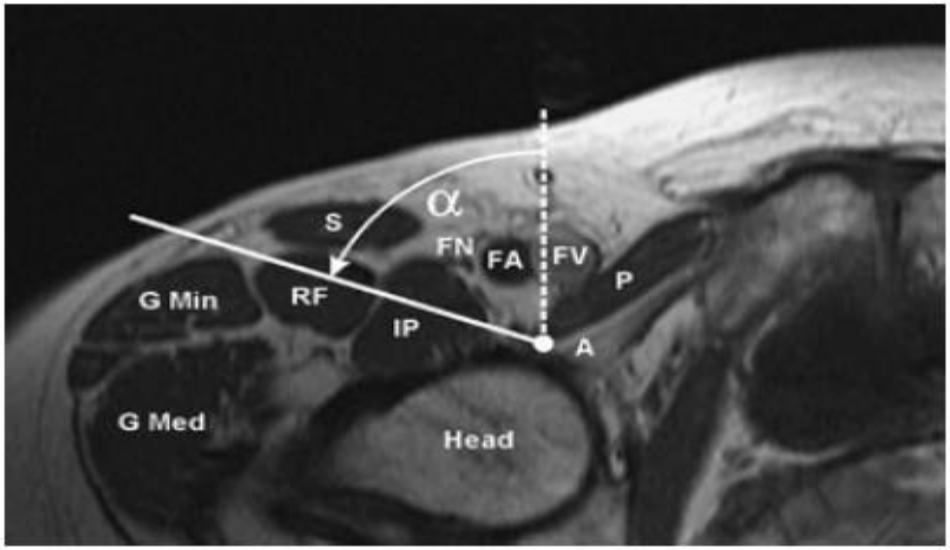

Figure 2 Magnetic resonance imaging (MRI) of the right pelvic area. The primary target for electrode positioning is the bony structure corresponding to the teardrop on an anteroposterior fluoroscopic view. To reach this target and avoid the femoral nerve-vessel bundle, the electrode should be introduced using an oblique pass. Based on our 20 MRI analyses, we recommend that the electrode be introduced at an angle of 70° with the sagittal plane and 20° with the transversal plane in order to always avoid the vessels and minimize the angle between the electrode and the target nerves. A = acetabulum; FA = femoral artery; FN = femoral nerve; FV = femoral vein; G Min = gluteal minor muscle; G Medical = gluteal medial muscle; Head = head of femur; IP = iliopsoas muscle; P = pectineal muscle; RF = rectus femoris muscle of the quadriceps muscle; S = sartorius muscle; α = recommended angle of 70° with the sagittal plane to introduce the electrode.

Locher, S et. Al. Radiologic anatomy of the obturator nerve and its articular branches: Basis to develop a method of radiofrequency denervation for hip joint pain. Pain Med 9(3) 2008;291-298.

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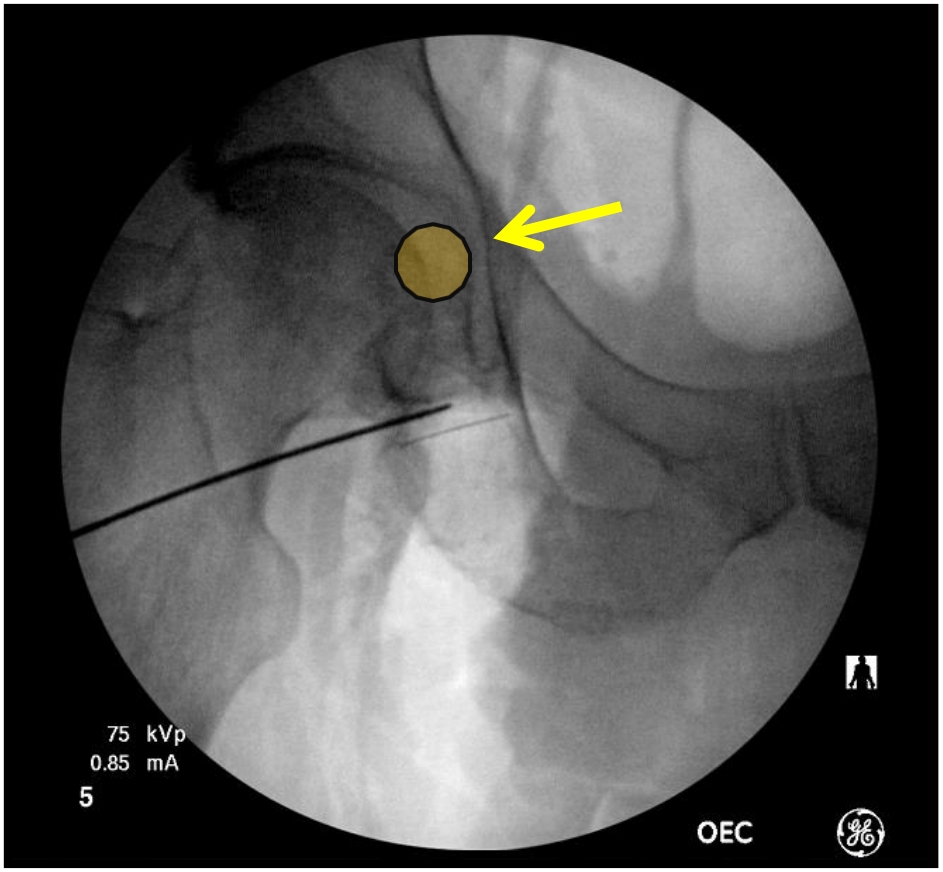
Accessory Obturator Nerve



- At this point, we believe that the accessory obturator will end up supplying the same part of the capsule as the main obturator nerve; therefore no separate lesion is required.

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THE INNERVATION OF THE KNEE JOINT[1]

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