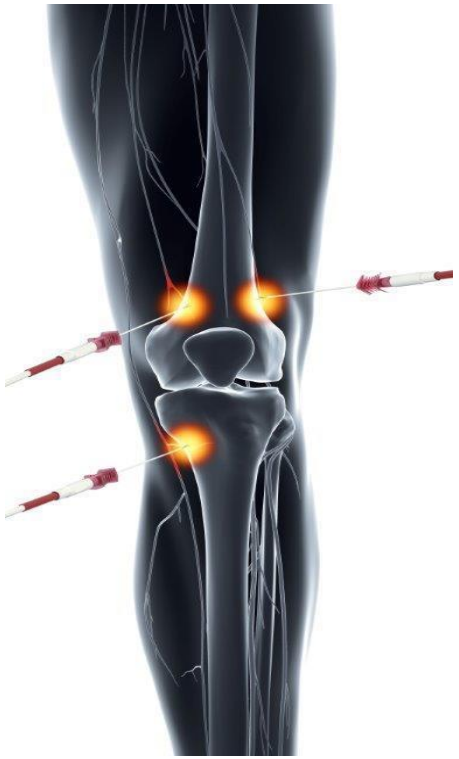
Genicular RFA



Katherine Travnicek MD

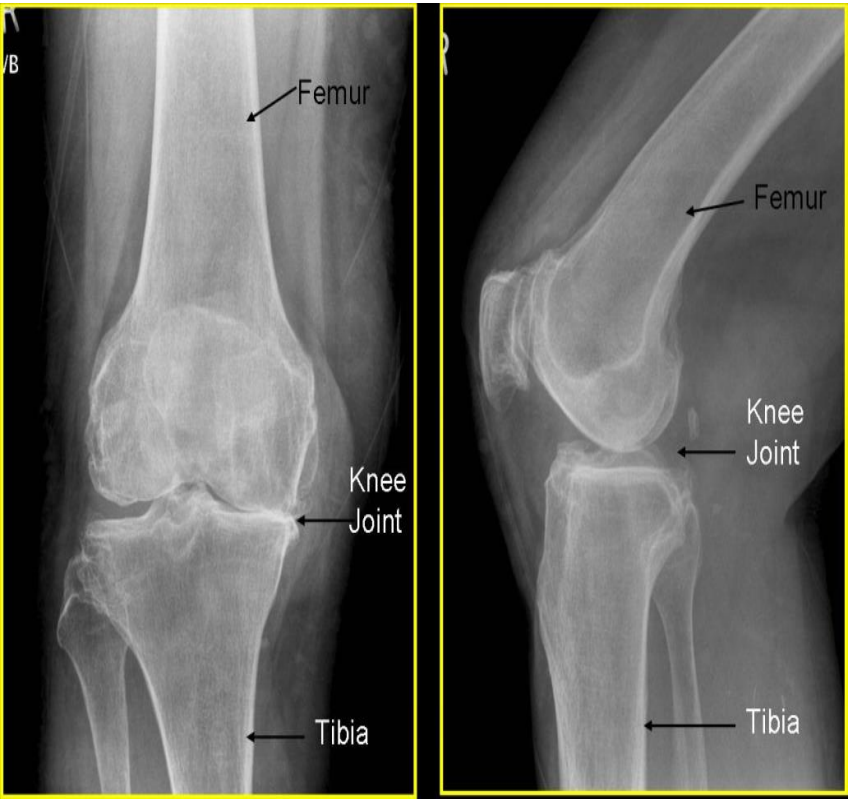
AAPMR Meeting

New Orleans, LA

October 21, 2016

Specifically…..

- Osteoarthritis
- S/p TKA pain



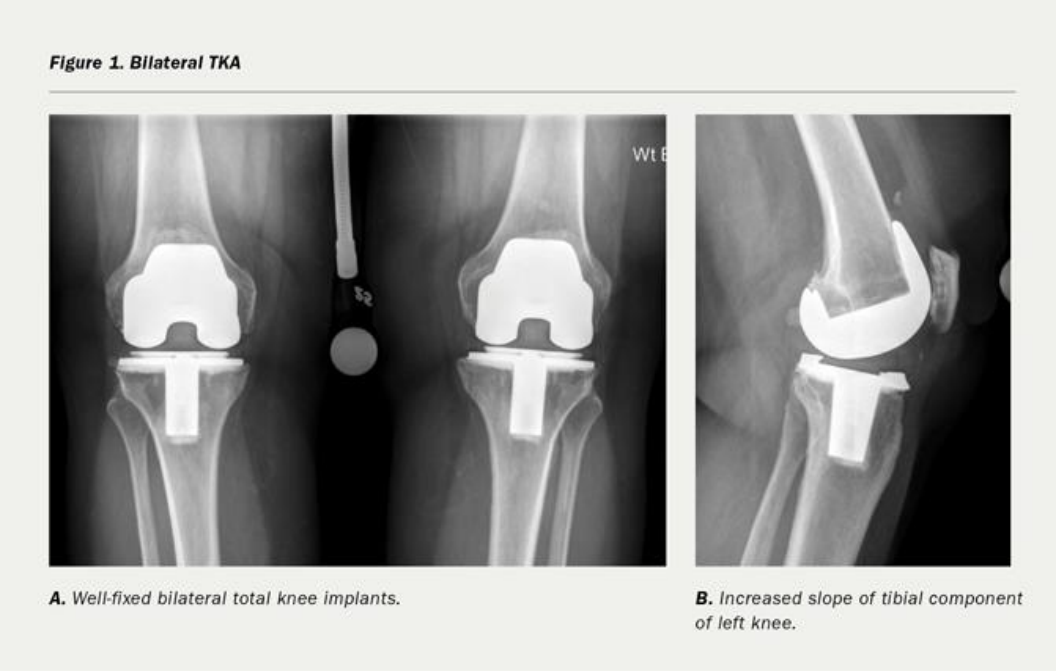


Figure 1. Bilateral TKA

A. Well-fixed bilateral total knee implants.

B. Increased slope of tibial component of left knee.

Disclosures

- I have no disclosures

- All images have been approved

Knee pain

- Very common health problem affecting **~20-25% adults**
- **Osteoarthritis** → most common cause of knee pain in patients age > 50 yrs
- Limits mobility, function, QOL
- Between direct costs & indirect costs → **~$28.5 billion**
- Major economic & public health concern

Current OA treatment options

- **Exercise**
- **Weight loss**
- **Physical Therapy**
- **Modalities**
- **Knee braces, sleeves**
- **Assistive devices**
- **Acupuncture**
- **Medications**
  - NSAIDS, Acetaminophen, Topical creams, Neuropathic, Tramadol, Opioids
- **Injections**
  - Corticosteroid or Viscosupplementation
- **Orthopedic Surgery**
  - Arthroscopic debridement, Osteotomy, partial or full TKA

New ideas

- **Structural repair/regenerative technologies**
  - Structural replacement with cells grown on scaffolds
  - Chondrocyte injections, mesenchymal stem cells
  - Platelet rich plasma
    - PRP per Nguyen "…evidenced-based research regarding treatment with PRP is scant; the scientific literature on PRP is in its infancy, PRP cannot be considered a standard of care until further research establishes such standards."
- **Neuromodulatory technologies**
  - **RFA**

Surgery

- ~ 719,000 total knee replacements yearly
- ~ 984,000 knee arthroscopies yearly
- Others: high tibial osteotomy, partial knee replacement
- Each has demonstrated efficacy in some patients
- TKA satisfaction rates vary ~ 75 - 89 %

Anterior Knee Pain after TKA

- One of the most common causes of persistent problems after TKA
- Occurs with or without patellar resurfacing
- Rule out infection, loosening, malalignment
- After joint infection, patella-femoral problems are one of the most common reasons for re-operation/revision
- Patellar re-surfacing success rates 50-60%

Anterior Knee Pain after TKA

- **Multi-factorial causes**
  - Lumbar spine pathology
  - Mechanical
    - New problem such at tib-fib joint
    - Patello-femoral problems
    - Hip pathology
  - Functional
    - Muscle imbalance
  - Neuropathic
    - Infrapatellar branch neuroma
    - Cutaneous nerve injury
    - Chronic neuropathic pain

Chronic Pain s/p TKA

- **Up to 1/3rd of patients experience long term pain after TKA**

- **Up to 7% have more severe pain after TKA than pre-op**

How can we help?

- Genicular nerves are increasingly being targeted for radiofrequency ablation to alleviate the pain of patients not adequately addressed by other measures

Candidates for RFA

- Chronic knee pain greater than 3 months
- Functionally impaired
- Failed conservative therapies
- Pathology unable to be corrected by surgery
- Surgical patients who either
  - Can NOT have surgery due to medical co-morbidities
  - Do NOT want surgery
  - Too young for surgery
  - Failed TKA?
- Diagnosis
  - Osteoarthritis – ICD 10 M17 codes
  - Neuralgia – ICD 10 M79.2 code

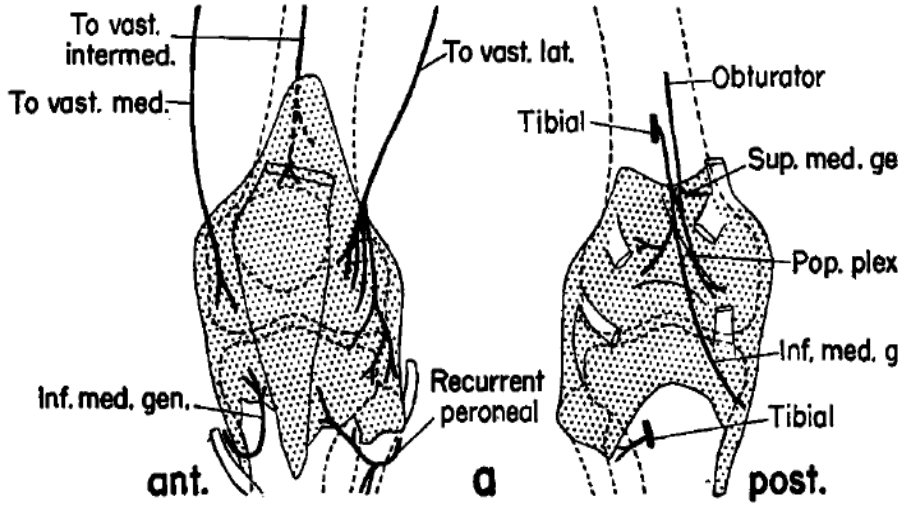
Therapeutic goals

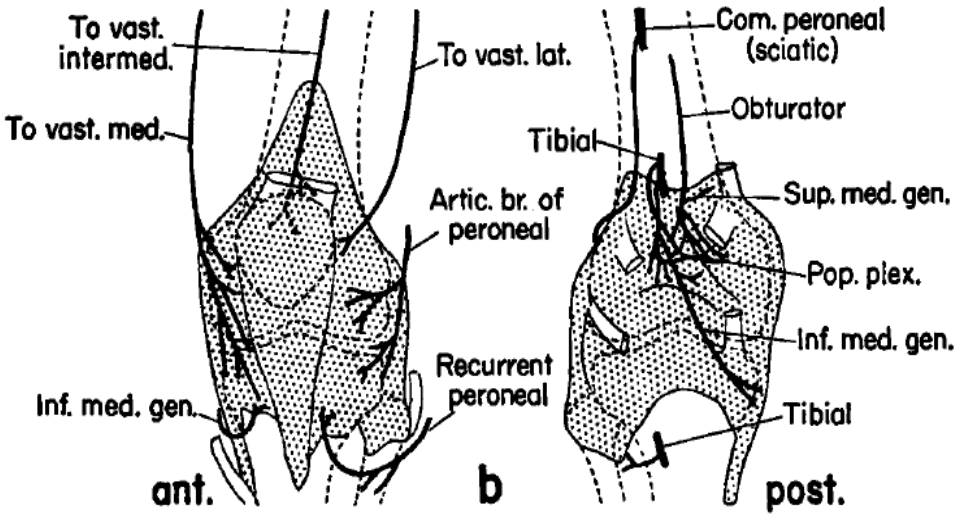
- Improve function/mobility
- Decrease pain
- Improve quality of life
- Reduce or eliminate opioids & other meds

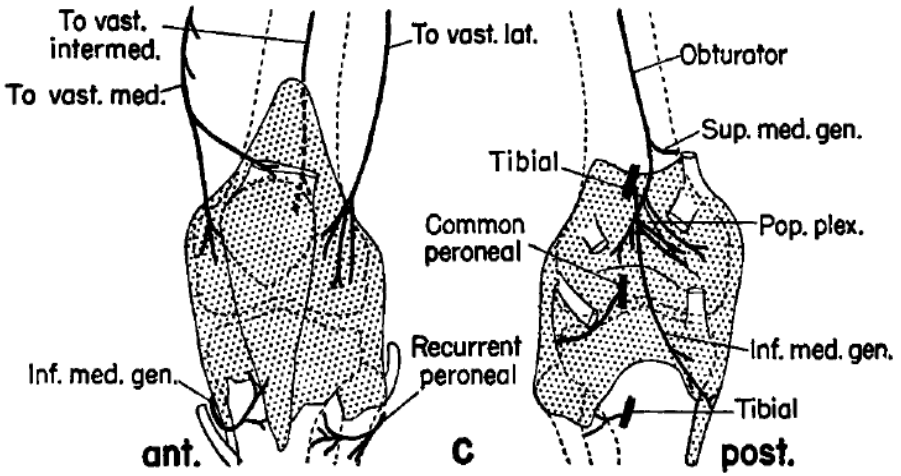
Anatomical studies

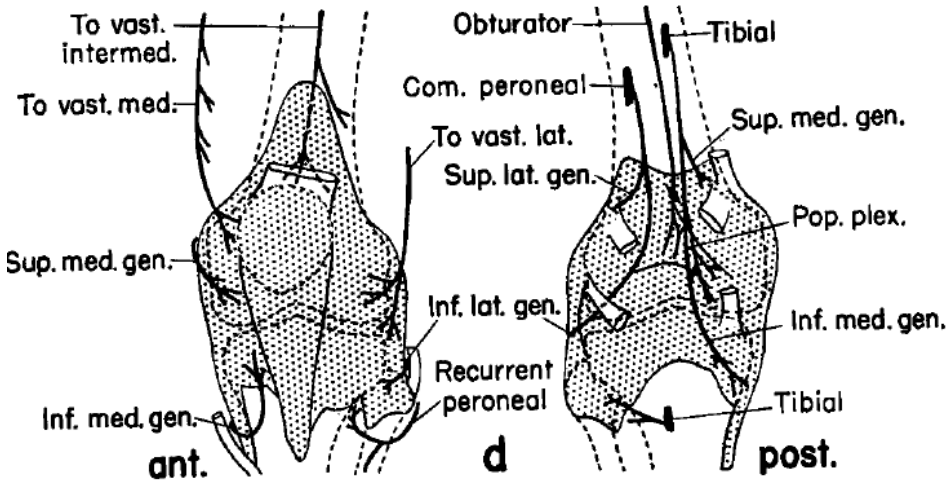
- **Since 1800s**
  - ~15 studies with ?? total knees
  - Femoral → Saphenous, Obturator, & Sciatic → Tibial & Common Peroneal
- **Well done studies that generally agree**
  - Jeletsky 1931 (30 knees)**
  - Gardener 1948 (11 knees)
    - These 2 have no 3D or soft tissue plane description
  - Kennedy et al. 1982 (15 knees)
    - No superior lateral genicular nerve or landmarks
  - Horner & Dellon. 1994 (45 knees)
    - Surface landmarks noted
    - No femoral branches noted to superior lateral joint
  - Franco et al. 2015 (8 knees)
    - Middle br incorrectly named; no sciatic branches found to lateral knee
  - Burckett-St. Laurant et al. 2016 (20 knees)
- **Variations**
  - Superior lateral genicular nerve is from femoral OR from sciatic
  - Obturator nerve and obturator accessory branch rarely innervates anterior knee joint
  - Two Common Peroneal branches have significant contribution to lateral knee

Gardener 1948









Gardener 1948

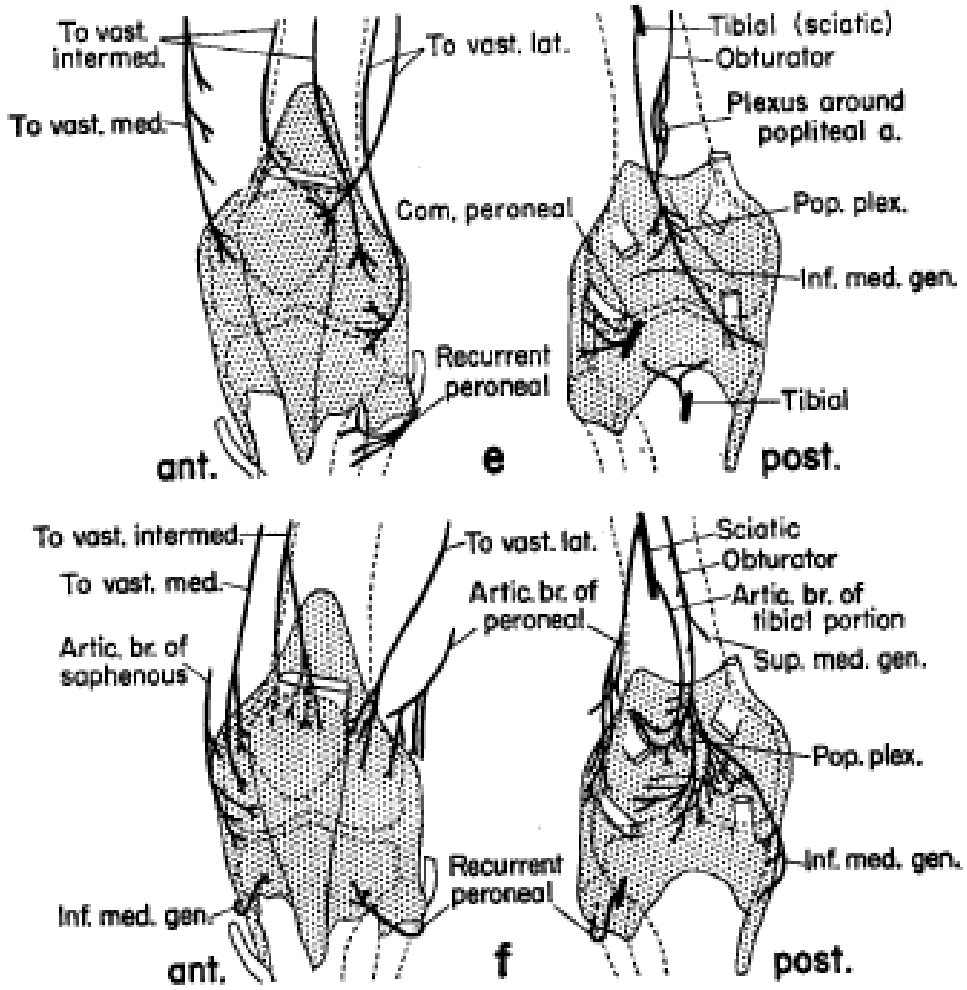
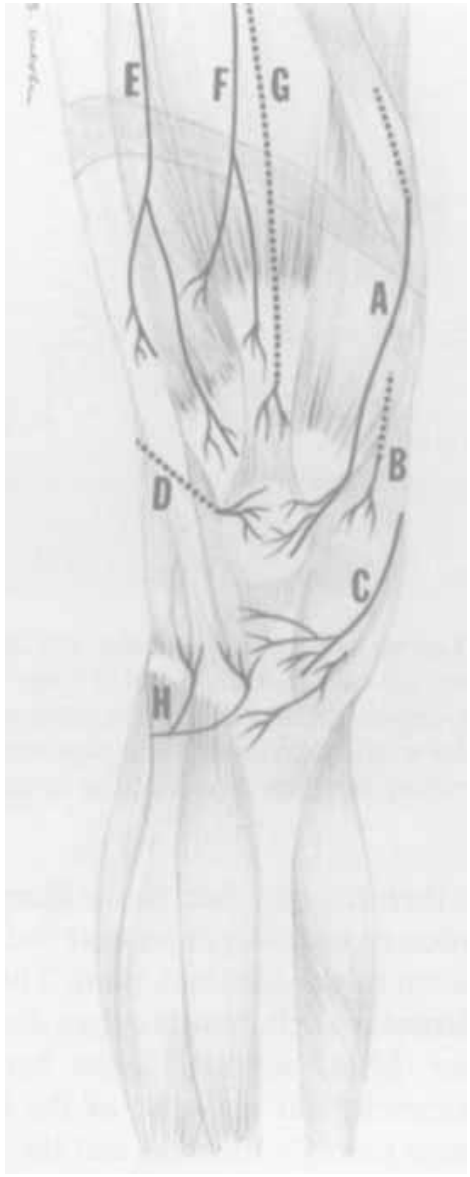


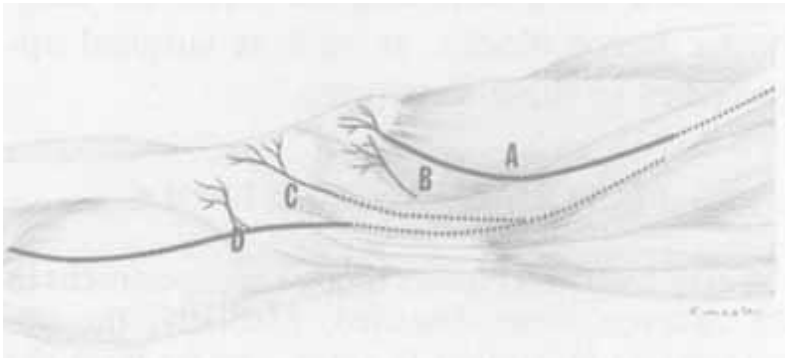
Fig. 2 Further patterns of distribution. f, ant. shows the articular branch of the saphenous nerve.

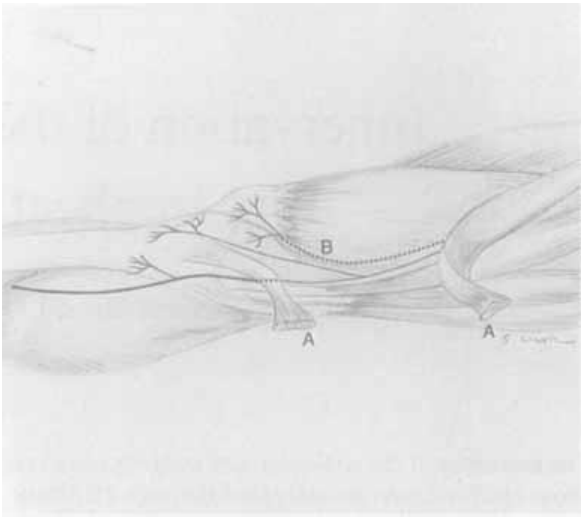
Horner & Dellon 1994

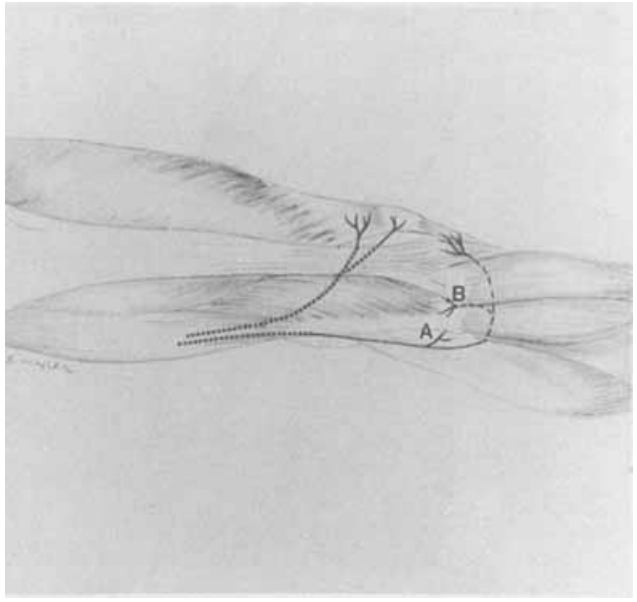
- **Tibiofemoral**
  - **Cutaneous: (From anterolateral to medial then posterior)**
    1. Lateral femoral cutaneous
    2. Anterior femoral cutaneous
    3. Medial cutaneous nerve of the thigh (saphenous)
    4. Infrapatellar branch (saphenous)
    5. Posterior femoral cutaneous nerve
  - **Joint: (From anterolateral to medial then posterior)**
    1. Lateral retinacular nerve / superior lateral genicular nerve (sciatic)
    2. Terminal branch of innervation of vastus intermedius (femoral; NVI)
    3. Medial retinacular nerve (femoral; NVM)
    4. Infrapatellar branch (saphenous)
    5. Sciatic nerve —> common peroneal 2 branches laterally
- **Proximal Tibiofibular**
  1. Recurrent Genicular branch of common peroneal nerve

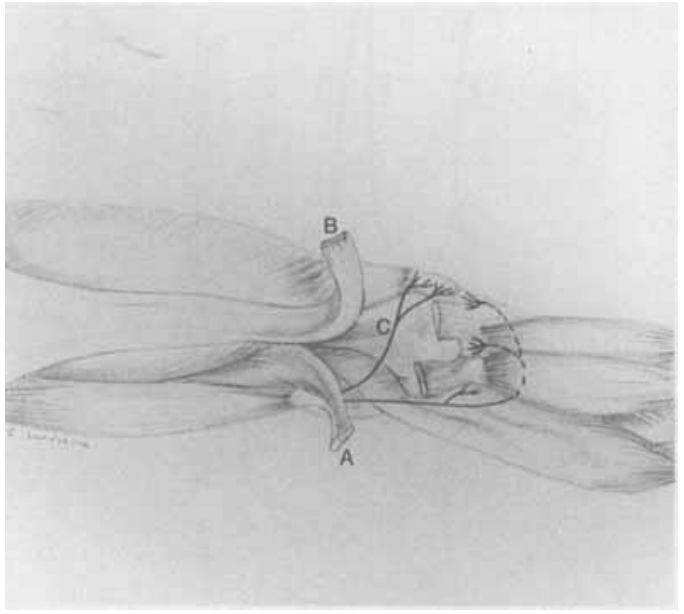
Horner & Dellon 1994







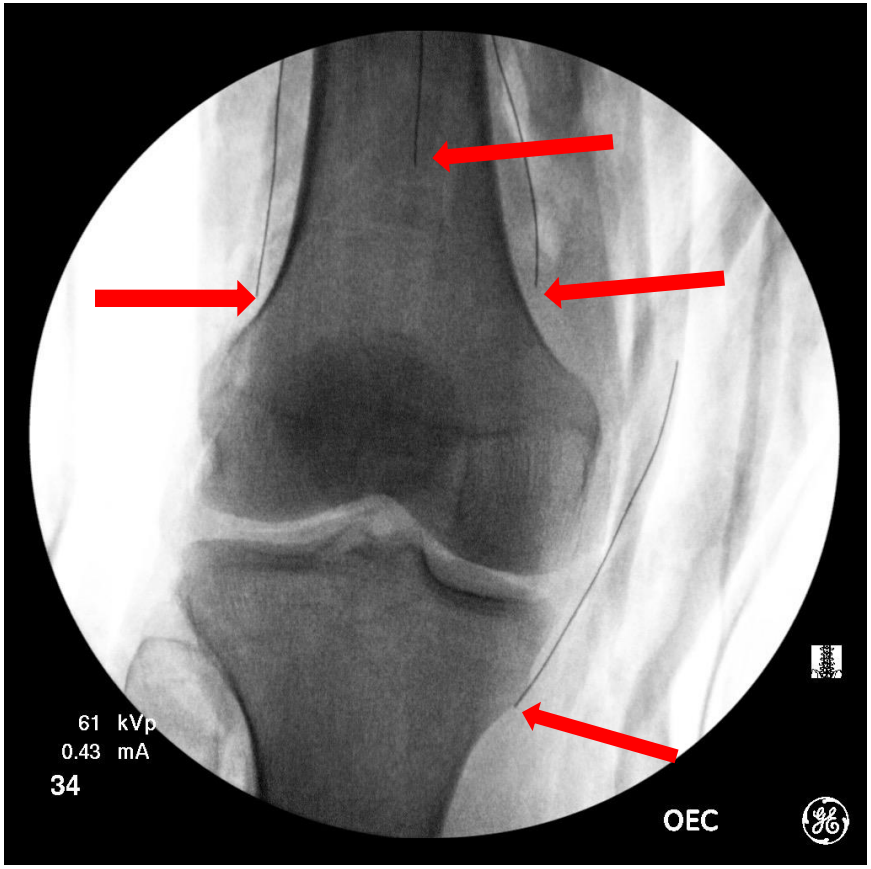


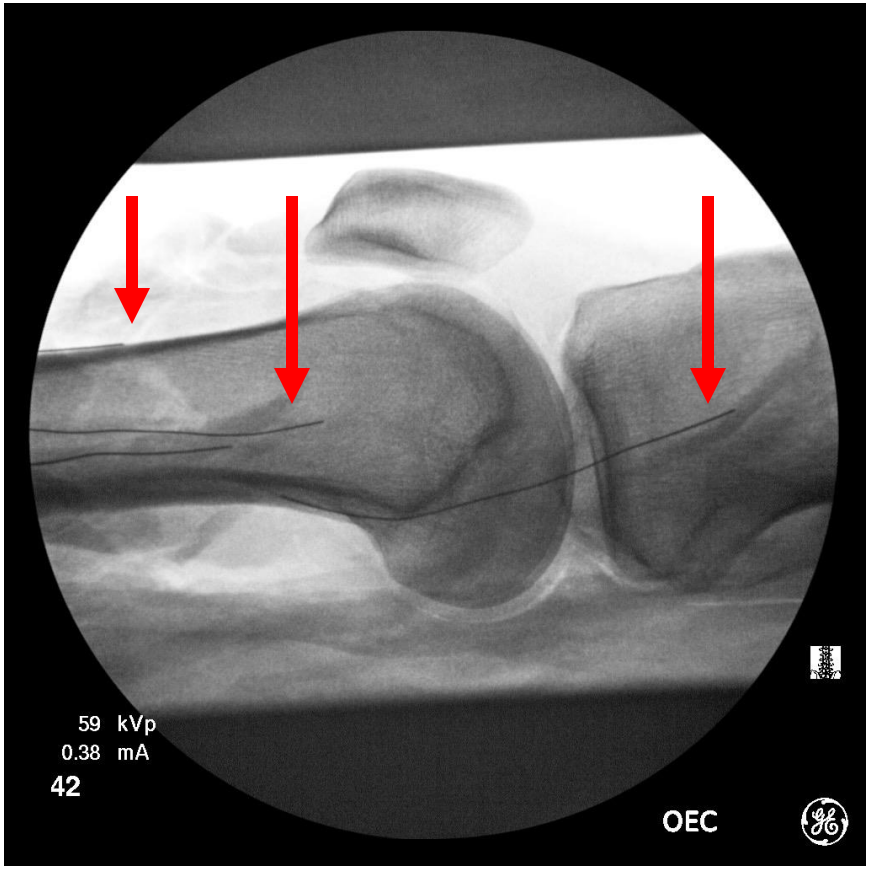


Franco 2015

- All 8 dissections revealed 6 joint nerves:
  - **Superolateral branch from the vastus lateralis**
  - **Superomedial branch from the vastus medialis**
    - **This is medial retinacular br.**
  - **Middle branch from the vastus intermedius**
    - **Incorrect termed medial retinacular br.**
  - **Inferomedial branch from the saphenous nerve**
  - Inferolateral (recurrent) branch from the common peroneal nerve
  - Lateral articular nerve branch from the common peroneal nerve

Franco outlined course of genicular nerves

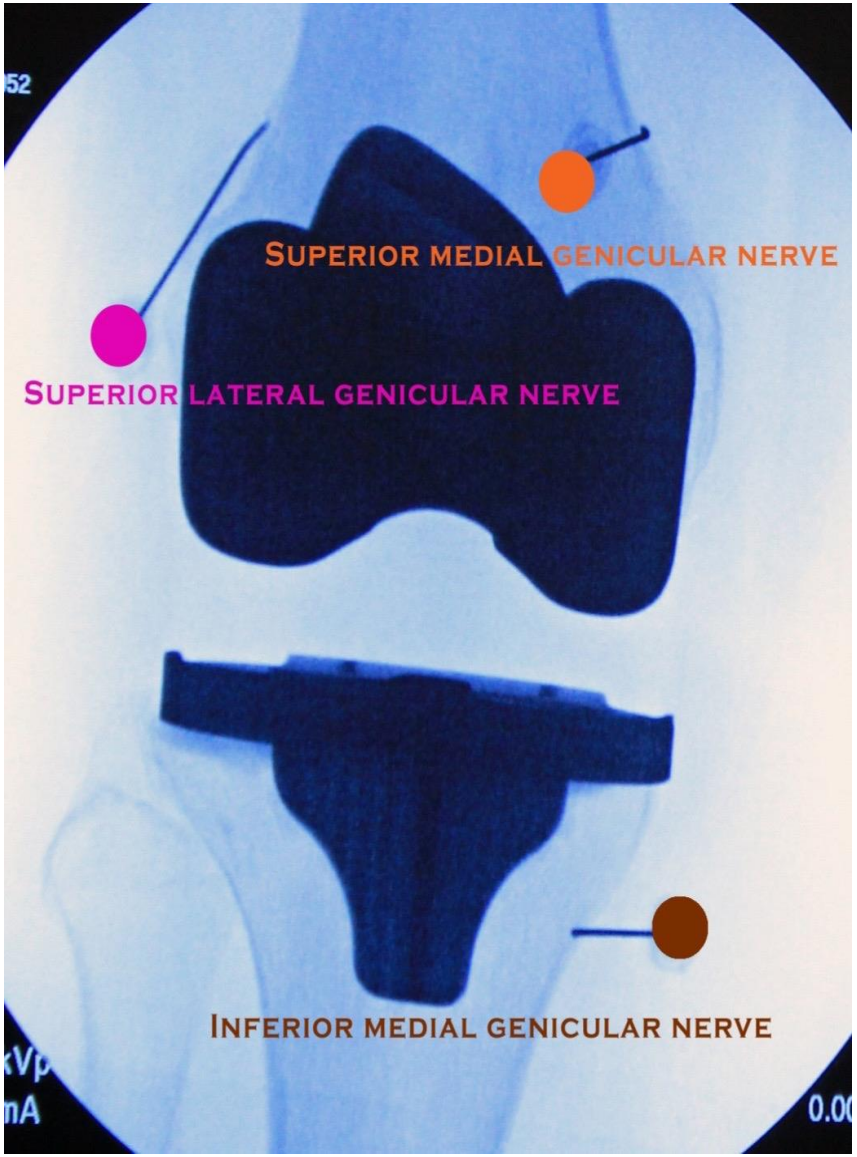




Burchkett-St. Laurant 2016

- Early mobilization is key for rehab in TKA
- Stronger than expected analgesia w/ ACB
  - Saphenous & Nerve to VM (NVM)
- Adductor Canal Nervous anatomy
- Prior anatomical studies did not detail NVM
  - Thought to be solely motor (3-4 br)
  - Significant innervation to knee capsule (1-3 br)
- Obturator br NOT found

Anatomy


SUPERIOR MEDIAL GENICULAR NERVE
SUPERIOR LATERAL GENICULAR NERVE
INFERIOR MEDIAL GENICULAR NERVE

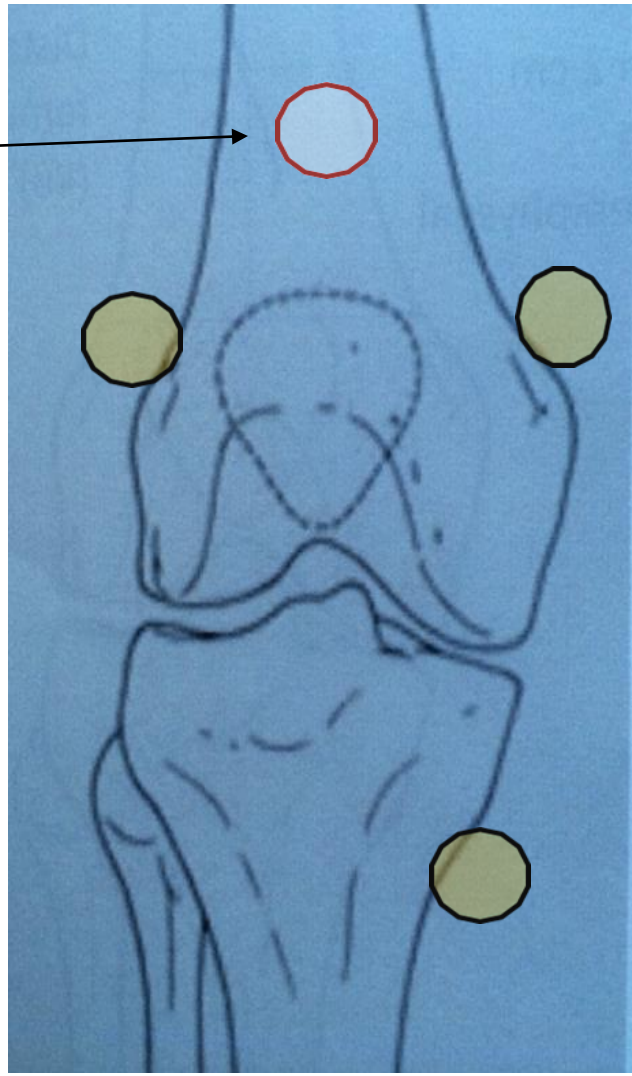
Technique

Geniculate Branch Diagnostic Blocks

Optional lesion for the nerve from the vastus intermedius (midline femur ~2 cm cephalad of patella)

Block superior medial & lateral & inferior medial sites

- AP & lateral images necessary
- Inject Contrast Dye
- Adjust needle tip to be half-way across diaphysis before injecting 0.3 - 0.5 ml local anesthetic at each site



LA volume, Needle & Lesion Size

- 0.3 ml LA area is covered with
  - Single bipolar traditional needle lesion
  - 3 lesions with 18 gauge, 10mm active tip
- 0.5 ml covered with
  - Single cooled lesion
  - Conventional 16 gauge at 80-90°C for 2-3 minutes generate lesions of average width similar to cooled RF
    - Cosman et al. Pain Med 2014. **Factors that affect radiofrequency heat lesion size**
- 0.3 - 0.5 ml for venom is likely

Only use 0.3 – 0.5 cc depending on your RFA technique

Technique – AP view

1. **Superior lateral genicular nerve**
   Lateral femoral shaft meets the epicondyle and advance probe to periosteum
2. **Superior medial genicular nerve**
   Medial femoral shaft meets the epicondyle and advance probe to periosteum
3. **Inferior medial genicular nerve**
   Medial tibia shaft meets the epicondyle and advance probe to periosteum

Technique – Lateral view

- Superior lateral & superior medial genicular nerves
  - Final needle position on mid portion of the diaphysis
- Inferior medial genicular nerves
  - *Final needle position ½ - 1/3*

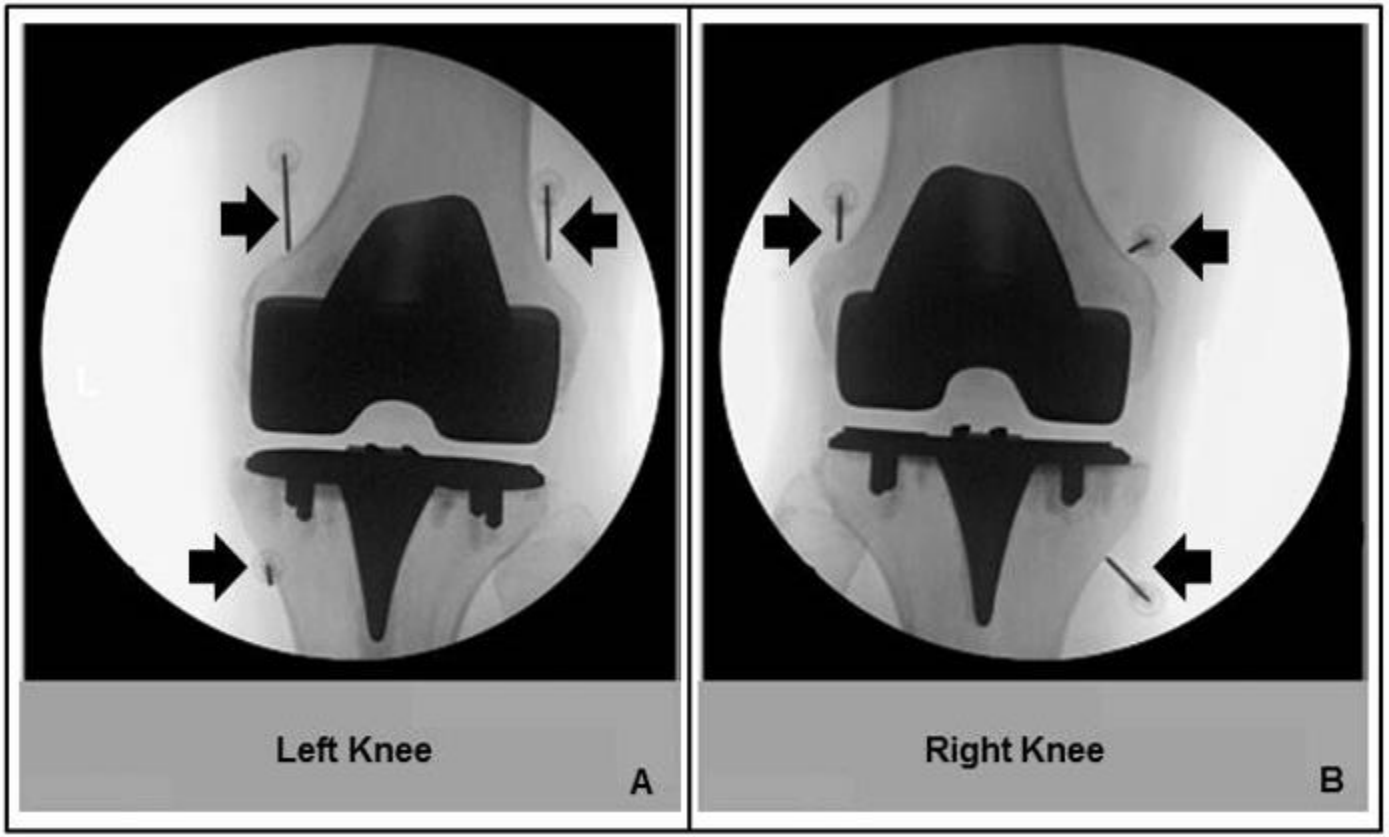
RFA Technique

- Use same positioning and targets as the diagnostic block
  - CHECK YOUR IMAGES
- Very painful procedure
- The companies tell you to test sensory & motor
- No need to test sensory or motor as no study has correlated with outcomes
- No motor nerve to be concerned per anatomical studies

Optional 4th Lesion

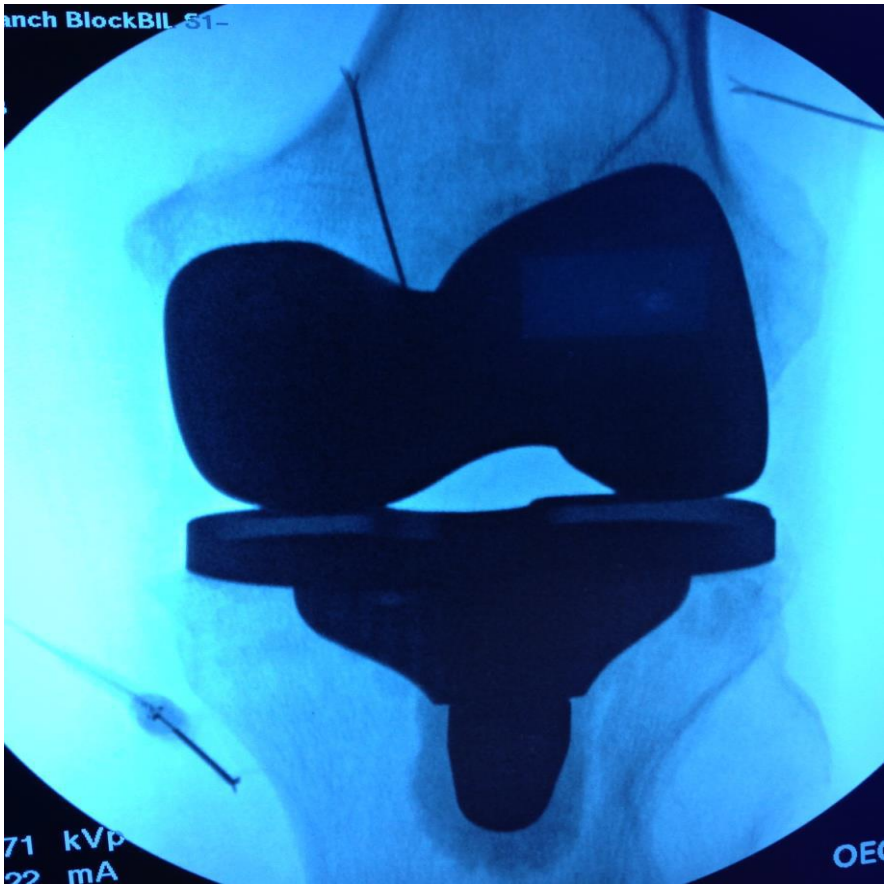
- Nerve from the vastus intermedius supplying the subpatellar plexus – motor test?

Cooled-RF for post TKA knee pain



Menzies, R. D. and Hawkins, J. K. (2015), Analgesia and Improved Performance in a Patient Treated by Cooled Radiofrequency for Pain and Dysfunction Post bilateral Total Knee Replacement. Pain Practice, 15: E54–E58.

Venom Stryker



Evidence

- Woo-Jong Choi, Radiofrequency treatment relieves chronic knee osteoarthritis pain: A double-blind randomized controlled trial. PAIN 2011;152 : 481–487

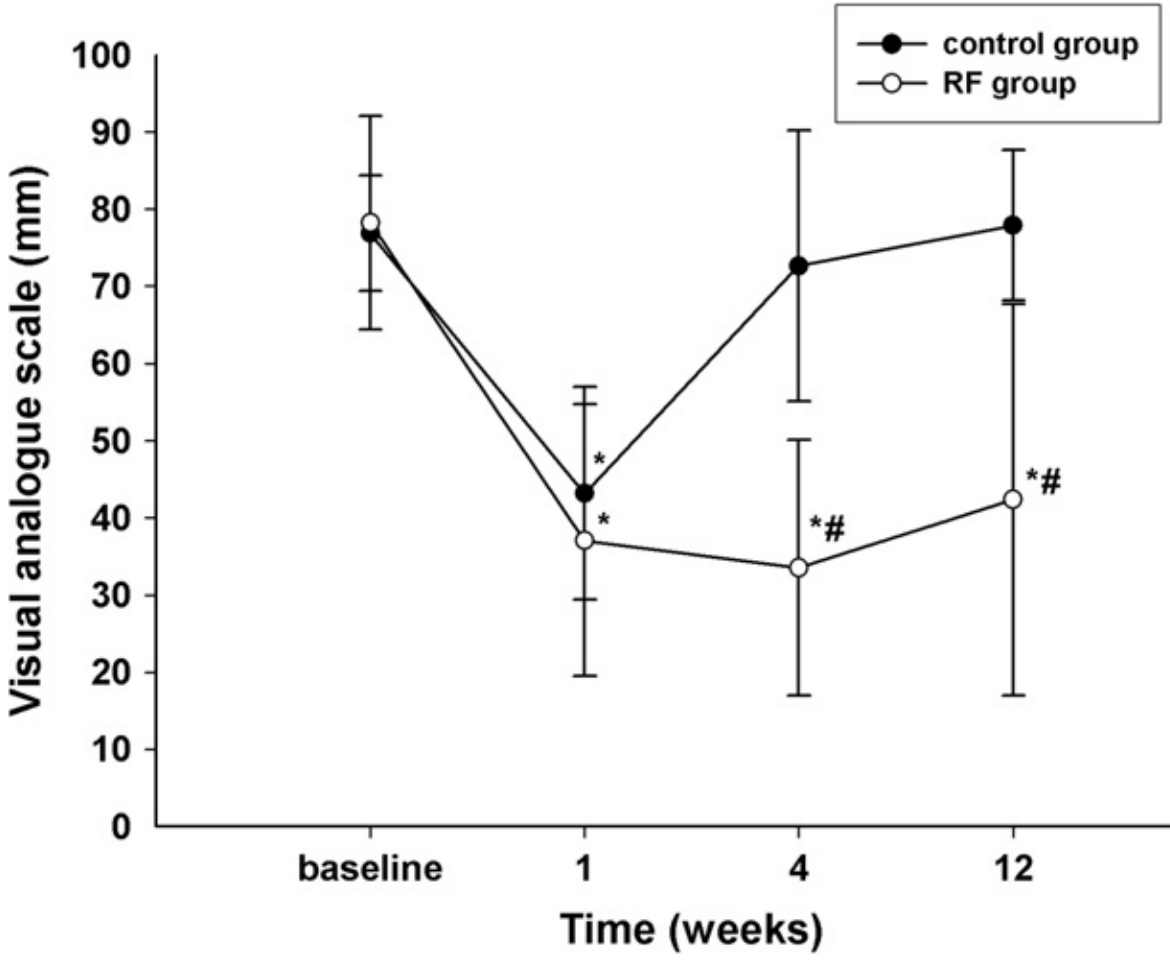
- Masahiko Ikeuchi, Percutaneous Radiofrequency Treatment for Refractory Anteromedial Pain of Osteoarthritic Knees. Pain Medicine 2011; 12: 546–551

- Only case studies for post TKA pain

Evidence Choi 2010

- Double-blind, first small RTC
- 38 elderly ages 50-80 with:
  - Mod or greater chronic knee pain, > 3 months
  - Tibiofemoral OA on radiographs (KL grade 2-4)
  - Failed conservative treatments
  - Positive response to diagnostic genicular nerve blocks
    - Three nerves; > 50% pain relief
- N = 17 RFA; N = 18 control
- Excluded all prior knee surgery patients
- Neurotherm, 22 gauge, 10mm tip, one lesion

Evidence Choi 2010



RF group had less knee pain at 4 ($p<0.001$) and 12 ($p<0.001$) weeks compared to placebo

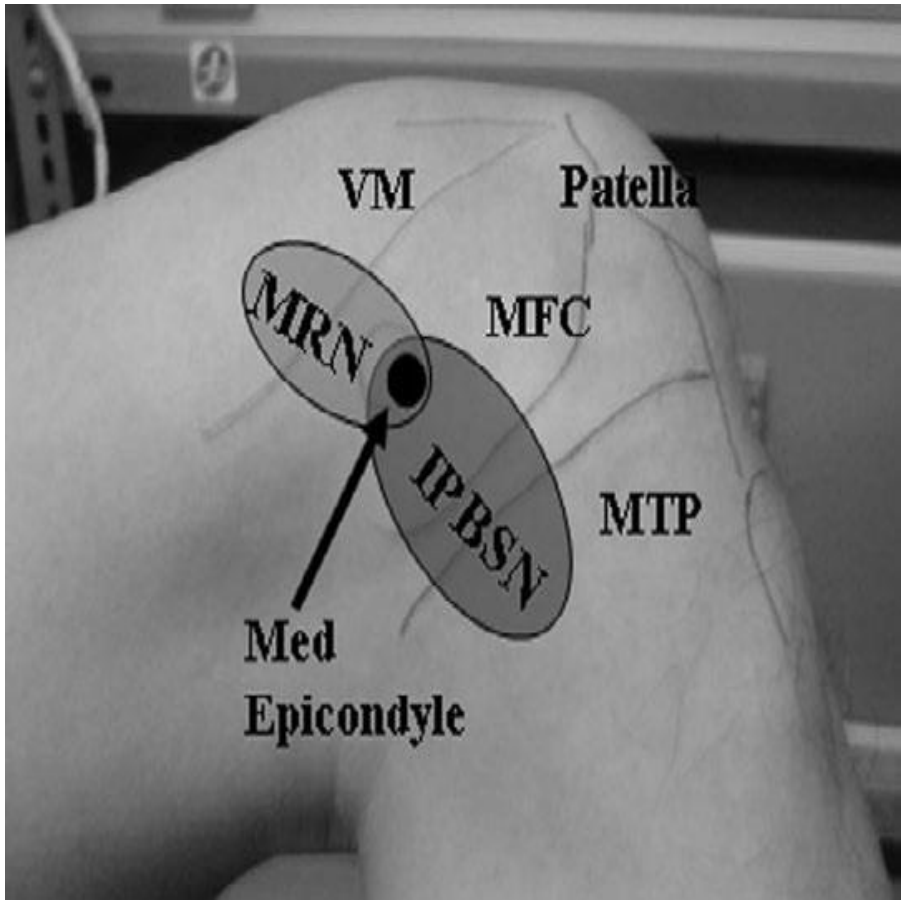
Oxford knee scores showed that 59%, 65%, and 59% of patients in the RF group achieved at least 50% knee pain relief at 1, 4, and 12 weeks

10 patients achieved primary outcomes; 0 in control group

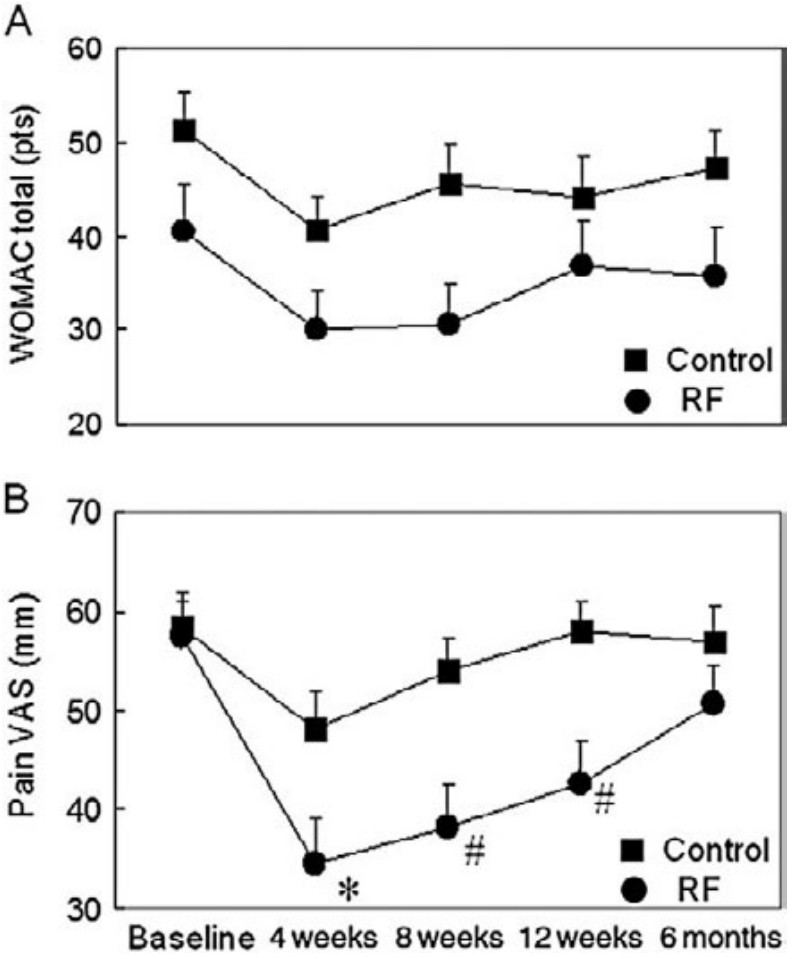
2 RFAs did not respond; 2 lost to final follow up; 3??

Evidence Ikeuchi 2011

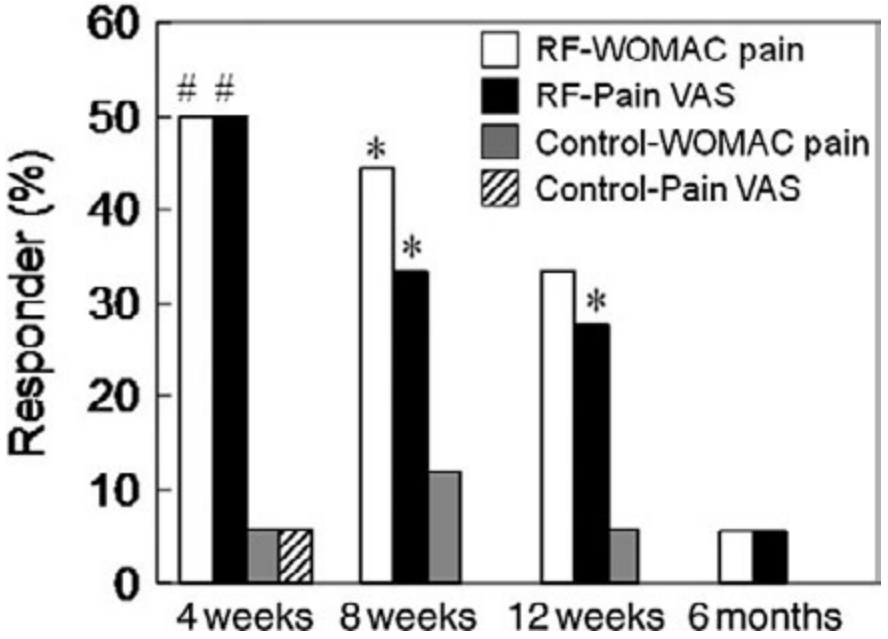
- Open-label, nonrandomized, controlled
- Refractory anteromedial knee pain, Age > 65, radiological osteoarthritis (KL 3-4)
- RFA = 18; Nerve block = 17
- Medial retinacular nerve & infrapatellar branch of saphenous
- Neurotherm, 22 gauge, 5mm
- Western Ontario McMaster Universities osteoarthritis index score, VAS, and patient's global assessment
- 6 months follow up



Evidence Ikeuchi 2011



Percentage of RFA responders
50%, 30%, and <10% of patients in the RF group achieved at least 50% knee pain relief at 4 & 12 weeks, & 6 months



Post TKA pain

- Three case reports & 1 case series
  - Protzman et al. Examining the Feasibility of Radiofrequency Treatment for Chronic Knee Pain After Total Knee Arthroplasty. PMR April 2014: Vol. 6, Issue 4, Pages 373–376.
  - Dhuka et al. Cooled Radiofrequency Ablation of Genicular Nerves in a Patient with Severe Knee Pain and History of Total Knee Replacement: A Case Report, poster at AAPM 2015
  - Menzies et al. Analgesia and Improved Performance in a Patient Treated by Cooled Radiofrequency for Pain and Dysfunction Post bilateral Total Knee Replacement. Pain Practice, 15: E54–E58. 2015.
  - Bellini M, Barbieri M: Cooled radiofrequency system relieves chronic knee osteoarthritis pain: the first case-series. Anaesthesiol Intensive Ther 2015; 47: 30-33.

- Positive outcomes always published
- Will need more research on this indication
- Could be amenable to SCS, DRG, PNS

Adverse Side Effects

- ***Adverse events are still largely unknown***
- None serious reported
- Most common – hypoesthesia, post RF pain flare
- Vascular injuries after genicular nerve RFA have not been reported, genicular vascular complications are well documented in the surgical literature.
- Pseudoaneurysm, arteriovenous fistula (AVF), hemarthrosis, and/or osteonecrosis of the patella
- RARE → but these complications carry significant morbidities

Kim et al. Is Genicular Nerve Radiofrequency Ablation Safe? A Literature Review and Anatomical Study. Pain Physician. 2016 Jul;19(5):E697-705.

Realistic Expectations

- Unclear who will benefit even after successful block(s)
- Will not be 100% pain relief
  - Not complete denervation
  - Anatomical variations
- Can still have sensitivity
  - May need aqua PT / desensitization PT
  - Gabapentin / Lyrica

Challenges

- Inability to visualize target nerves
- How many nerves to RF
- Nociceptive vs neuropathic pain?
- Improper technique
- Difficult or variable anatomy
- Negative predictors
  - Extrapolated → Psych, Medications, Disability

All can lead to ineffective treatment

Summary

- Anatomic basis for therapeutic partial sensory RFA denervation of knee joint has been demonstrated
- Variations in anatomic innervation must be considered
- Do thorough eval for anterior knee pain s/p TKA before RFA
- Evidence exists for knee RF denervation
- Adverse effects & Long term outcomes unknown

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