SOCIETÀ ITALIANA
G.U.I.D.A.
PER LA GESTIONE UNIFICATA E INTERDISCIPLINARE
DEL DOLORE MUSCOLO-SCHELETRICO E DELL'ALGODISTROFIA

V CONGRESSO NAZIONALE

EVERYTHING
YOU NEED TO KNOW

BOLOGNA
ROYAL HOTEL CARLTON
27 Febbraio - 1 Marzo 2025

Meccanismi del dolore acuto chirurgico

Orthopedic Department - University of Florence

Disclosures

Microport

- "This individual is a paid consultant of MicroPort Orthopedics. Additional professional associations presenting a potential conflict of interest may also exist."

Smith & Nephew

- Speakers bureau/paid presentations

Orthofix

- Consulting

No disclosures relevant to this study

Pain management in TJA

Total Joint arthroplasty are the the most painful orthopedic procedures

Pain control is paramount in TJA for:

- Optimize patient satisfaction,
- Reduce hospital length of stay,
- Enhance rehabilitation compliance

Long -term success of TJA

Pain management in TJA

Pain control in TJA it's a long journey that begins well before surgery and ends long after.

Pre-operative

- FANS:
  - Ketorolac 30mg
- COX-2 inhibitors:
  - Celecoxib 200 mg
  - Etoricoxib 90 mg
- Central analgesic:
  - acetaminophen
  - Oxicodon
  - Tapentadol
- Neuropathic:
  - Pregabalina o Gabapentina

Intra-operative

- Local Infiltration Analgesia:

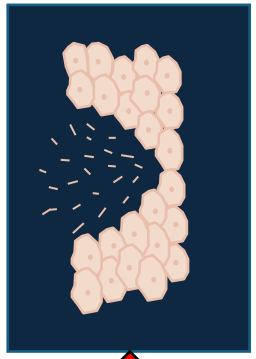
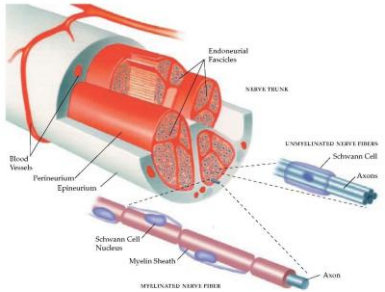
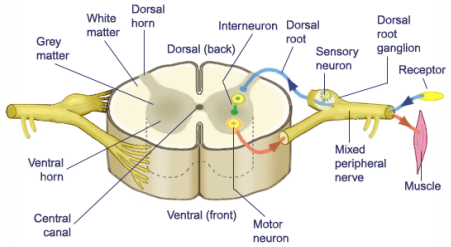
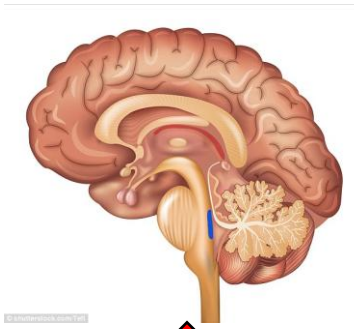
- Regional Nerve Blocks

Post-operative

- FANS:
  - Ketorolac 30mg
- COX-2 inhibitors:
  - Celecoxib 200 mg
- Central analgesic:
  - acetaminophen
  - Oxicodon
  - Tapentadol

Pain management in TJA

Anatomical → **Different sites of action**

Peripheral local tissues	Peripheral Nerves	Spinal Cord	Brain
			
NSAID/antiCOX2 Local Anestetic Opiod	Local Anestetic	Local Anestetic Opiod α-agonist	Opiods Paracetamol Cox2 Inibithors

Acute surgical Pain

- Pathophysiology of surgical pain in TJA
- Modalities of intraoperative pain control
- Somatosensory innervation of the hip and knee

Pathophysiology of surgical pain in TJA

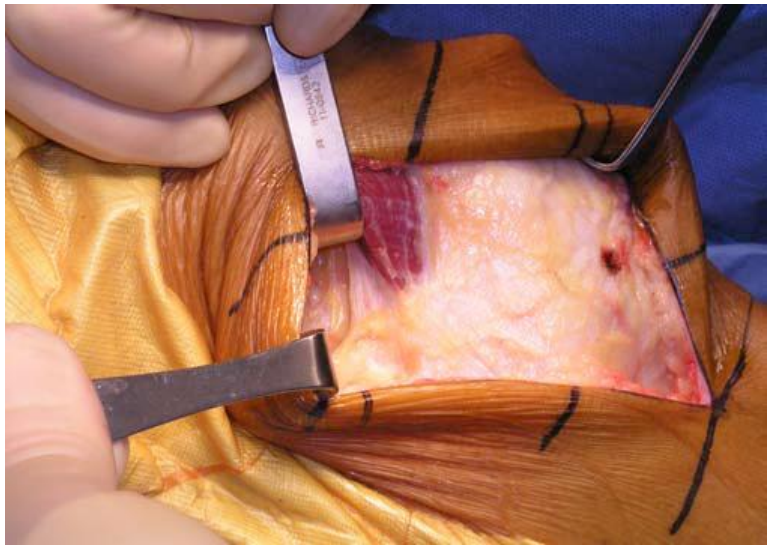
Surgical trauma

↓

• Tissue damage

↓

• Activaction of nociceptor



Skin Incisions, bone cutting, and soft tissue damage activate nociceptors.

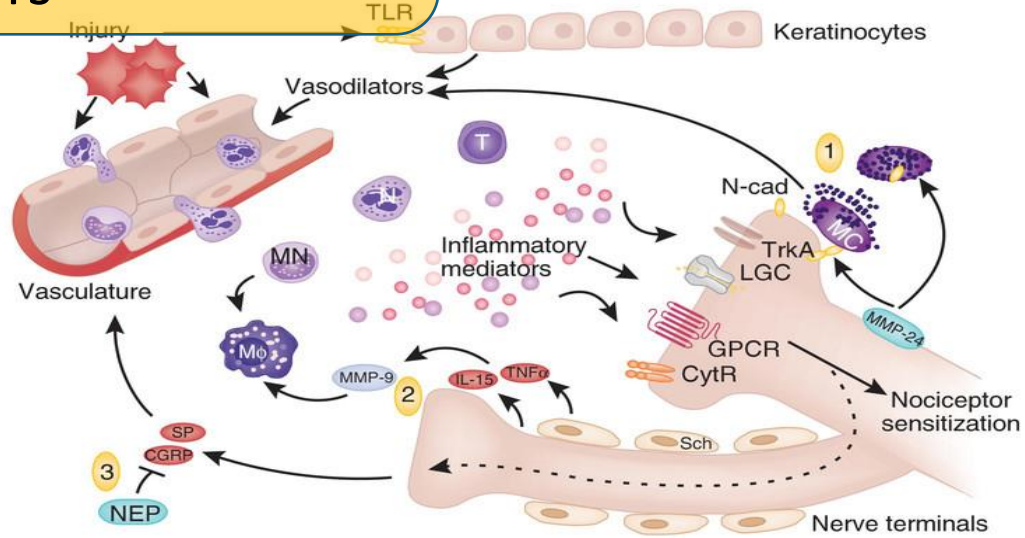
Pathophysiology of surgical pain in TJA

Surgical trauma

• Tissue damage

• Activaction of nociceptor

- Cytokines (TNF-α, IL-6)
- PG Inflammatory Mediators



- Release of cytokines (TNF-α, IL-6) sensitizes nociceptors.
- Prostaglandins amplify pain perception

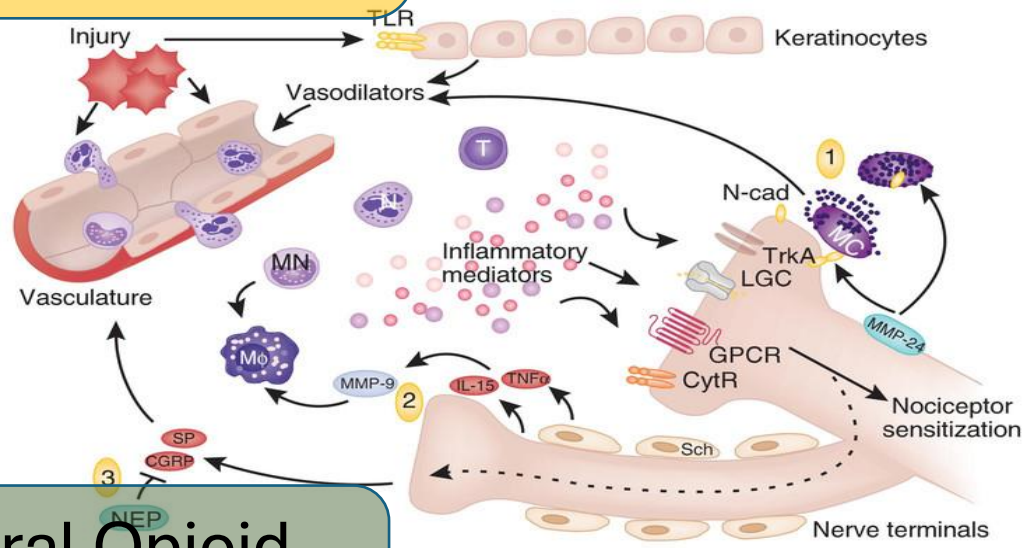
Pathophysiology of surgical pain in TJA

Surgical trauma

• Tissue damage

• Activaction of nociceptor

- Cytokines (TNF-α, IL-6)
- PG Inflammatory Mediators



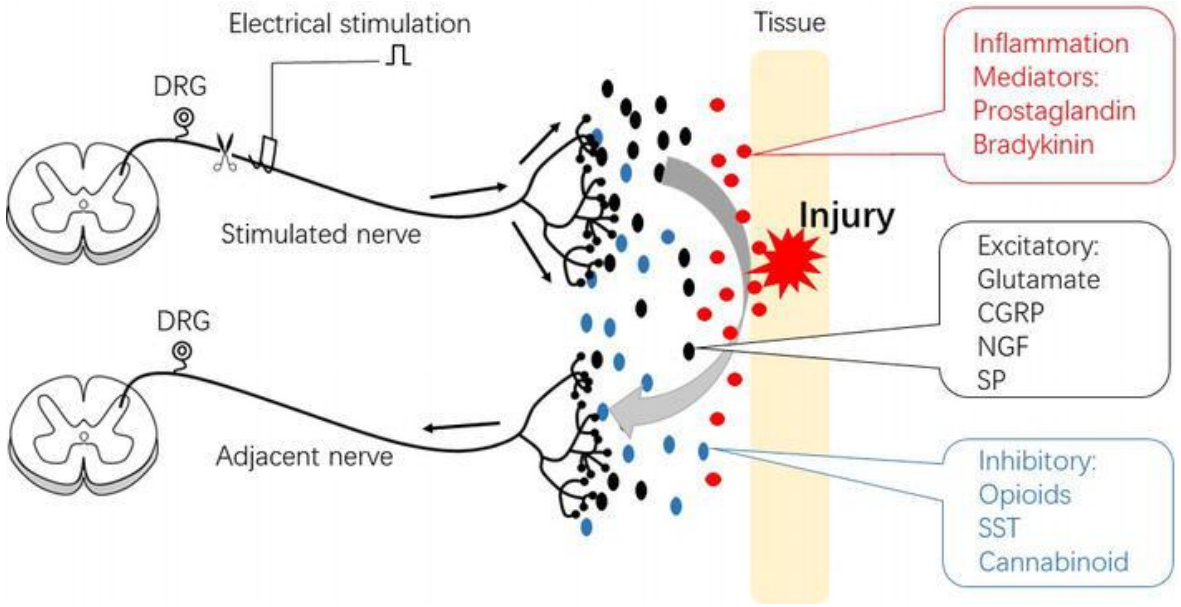
Peripheral Opioid Receptors

Pathophysiology of surgical pain in TJA

Surgical trauma

• Tissue damage

• Activaction of nociceptor



Nociceptors trigger afferent electrical signaling in peripheral nerves

Pathophysiology of surgical pain in TJA

Surgical trauma

• Tissue damage

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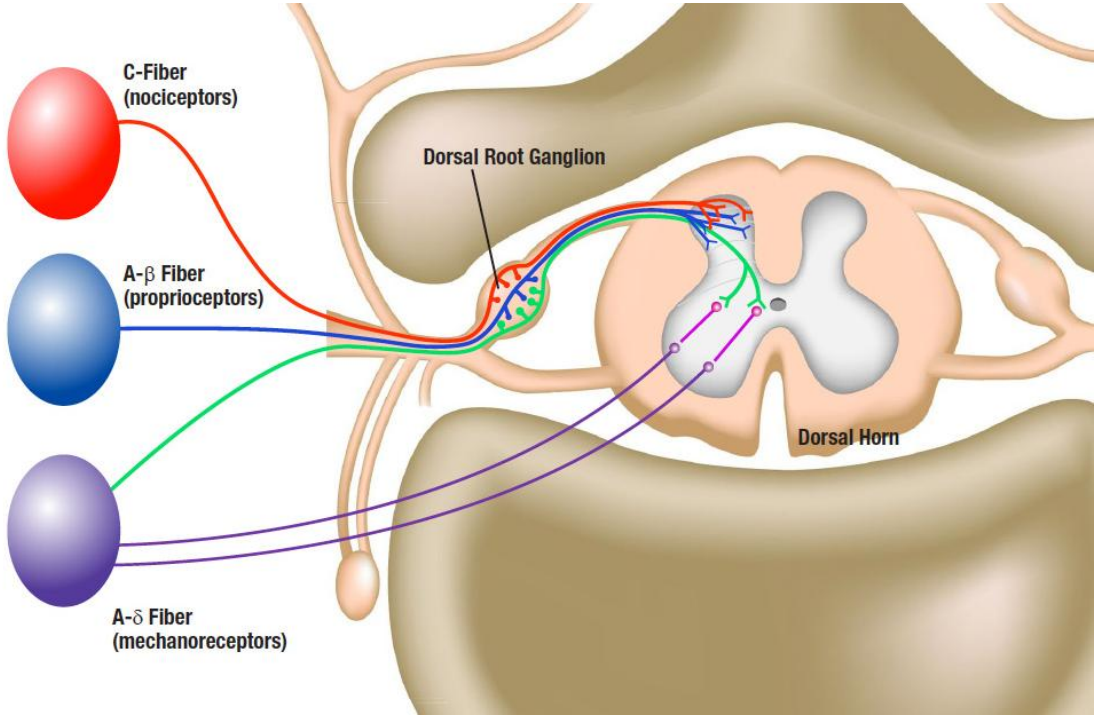


A-delta and C fibers transmit pain signals to the CNS

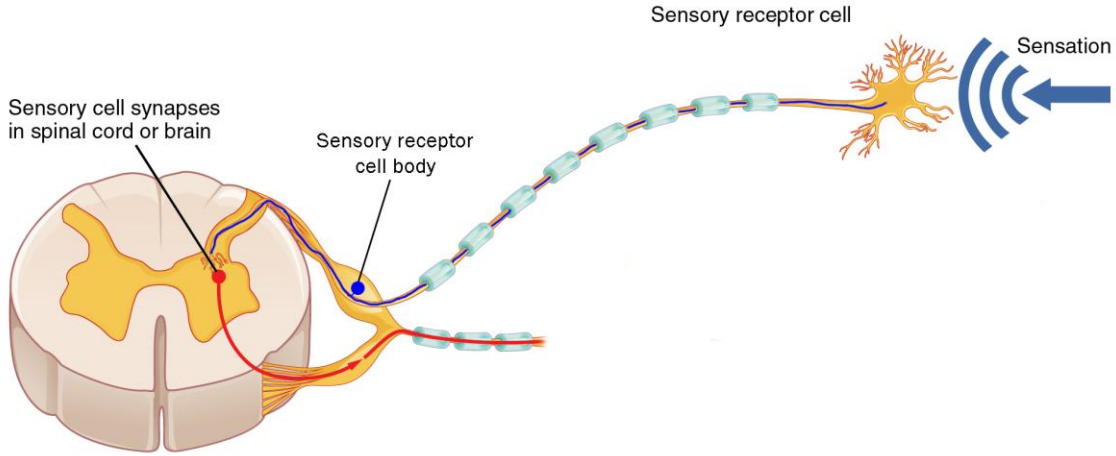
A-delta fibers transmit sharp pain, while C fibers mediate dull, aching pain

Pathophysiology of surgical pain in TJA

Surgical trauma

• Tissue damage

• Activaction of nociceptor



• Signals reach the dorsal root ganglion and synapse in the dorsal horn

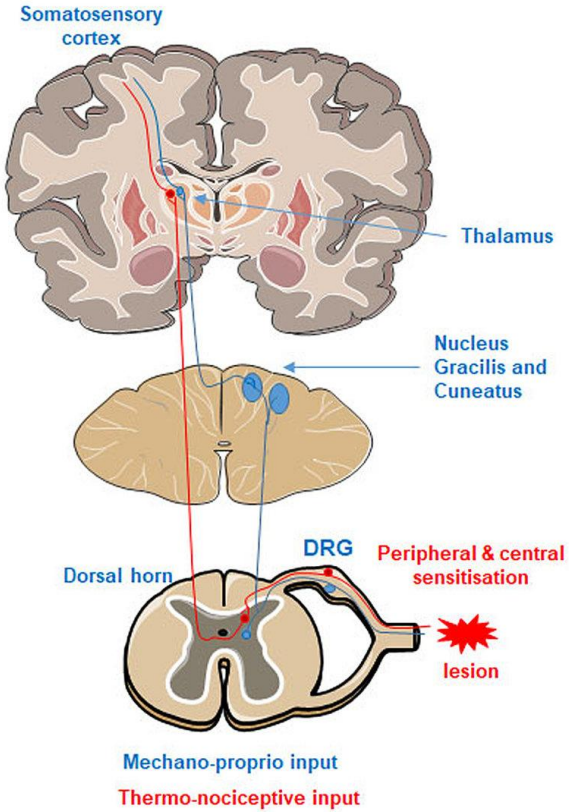
Pathophysiology of surgical pain in TJA

Surgical trauma

• Tissue damage

• Activaction of nociceptor

• Signals reach the dorsal root ganglion and synapse in the dorsal horn



Secondary afferent neurons then project the somatosensory information to the brainstem of CNS where it is further modulated and projected to the the brain.

Acute surgical Pain

- Pathophysiology of surgical pain in TJA
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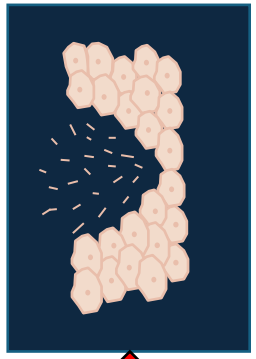
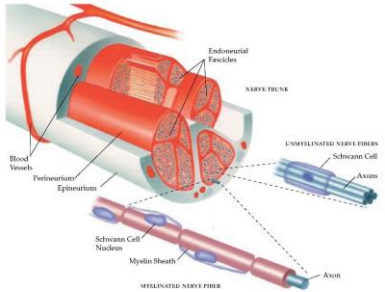
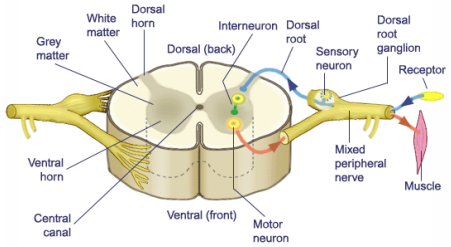
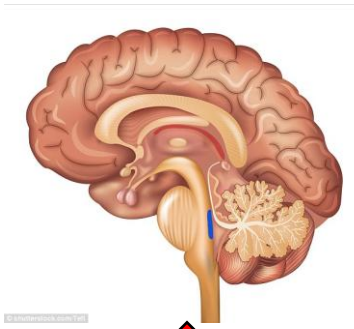
Pain management in TJA

Anatomical → **Different sites of action**

Peripheral local tissues	Peripheral Nerves	Spinal Cord	Brain
			
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Pain management in TJA

Pain control in TJA it's a long journey that begins well before surgery and ends long after.

Local Infiltration Analgesia:

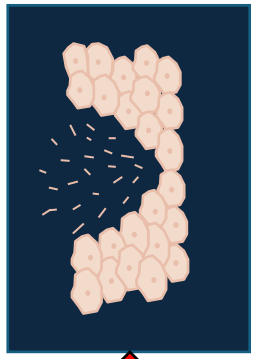
Regional Nerve Blocks

Pre-operative | Intra-operative | Post-operative

Multimodal Pain Control

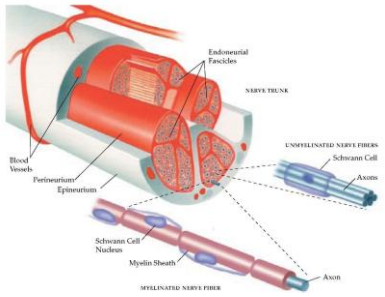
Anatomical → Different sites of action

Peripheral local tissue



NSAID/antiCOX2
Local Anestetic
Opiod

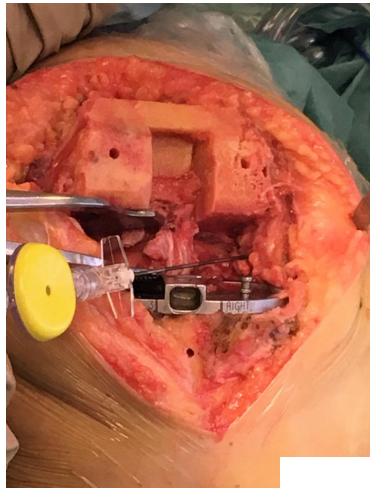
Peripheral Nerves



Local Anestetic

- Local Infiltration analgesia
- Regional nerve blocks

Local Infiltration Analgesia



Is the only complete intra-operative pain control modality

The Clinical Practice Guidelines

Guideline Question 1

For patients undergoing primary TJA, does intraoperative peri-articular injection affect postoperative pain and/or opioid consumption?

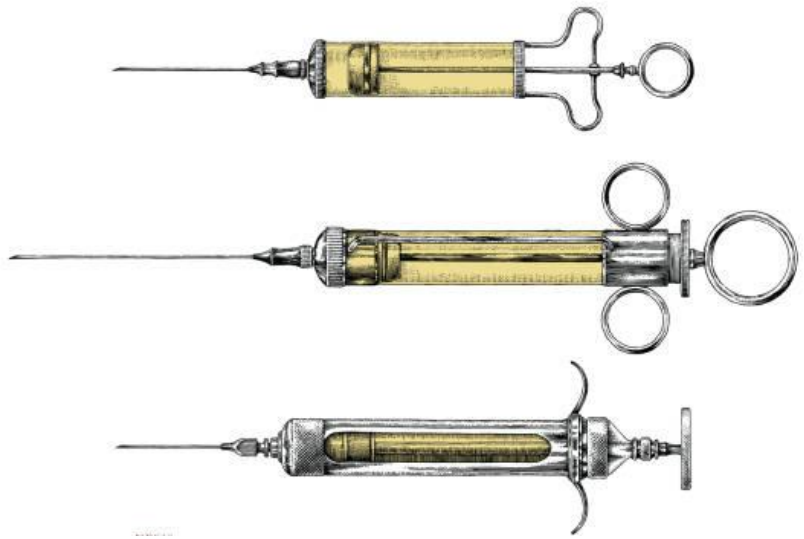
Strength of Recommendation: STRONG

Hannon CP et al: Periarticular Injection in Total Joint Arthroplasty: The Clinical Practice Guidelines of the American Association of Hip and Knee Surgeons, American Society of Regional Anesthesia and Pain Medicine, American Academy of Orthopaedic Surgeons, Hip Society, and Knee Society. J Arthroplasty 2022

Local Infiltration Analgesia

Total Joint Arthoplasty

1. What to inject with ?
2. Where to inject ?
3. How to inject ?



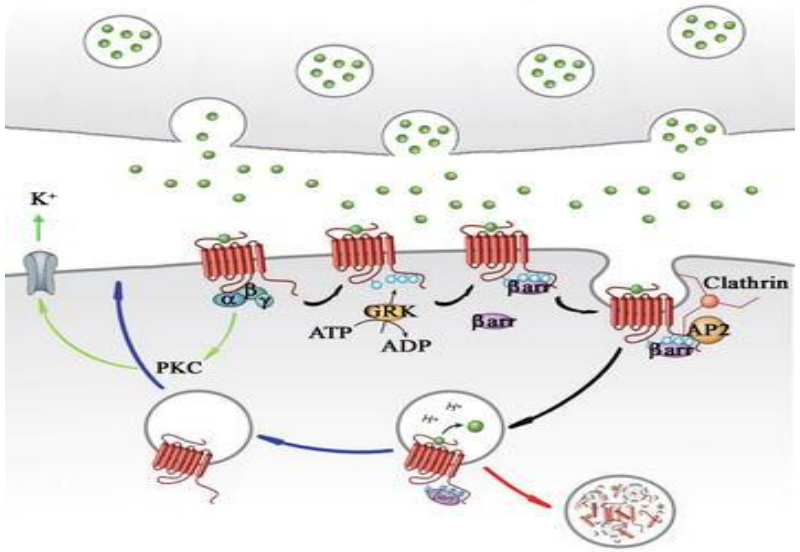
Compound mixture of Drugs

Surgical trauma

• Tissue damage

Long-acting anesthetic:

- Ropivacaine
- Bupivacaine



- Skin Incisions, bone cutting, and soft tissue damage activate nociceptors

Compound mixture of Drugs

Activation of Nociceptor

Long-acting anesthetic:

- Ropivacaine
- Bupivacaine

The Clinical Practice Guidelines

Response/Recommendation 2A

Long-acting local anesthetics in periarticular injection are effective at reducing postoperative pain and opioid consumption without an increase in adverse events after primary total hip and knee arthroplasty.

Strength of Recommendation: Strong.

Hannon CP et al: Periarticular Injection in Total Joint Arthroplasty: The Clinical Practice Guidelines of the American Association of Hip and Knee Surgeons, American Society of Regional Anesthesia and Pain Medicine, American Academy of Orthopaedic Surgeons, Hip Society, and Knee Society. J Arthroplasty 2022

Compound mixture of Drugs

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Long-acting anesthetic:

- Ropivacaine
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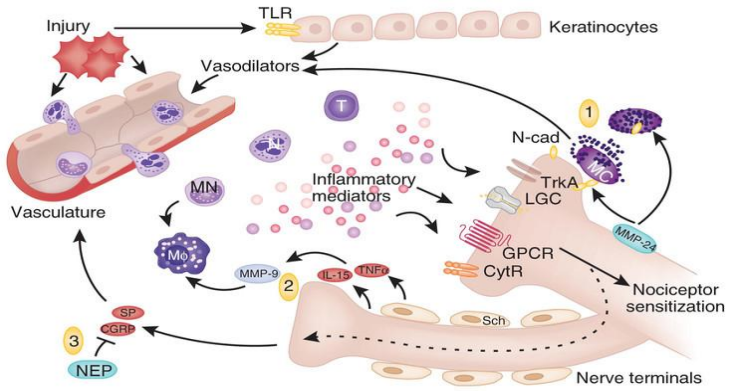
NSAID:

- Ketorolac
- Steroids



Compound mixture of Drugs

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NSAID:

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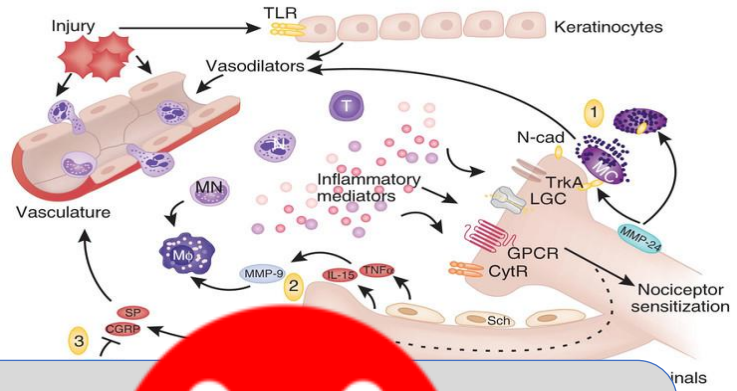
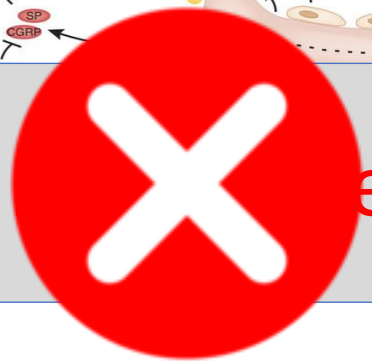




No additive effect in reducing postoperative pain and opioid consumption and may increase postoperative nausea and vomiting

Compound mixture of Drugs

Surgical trauma

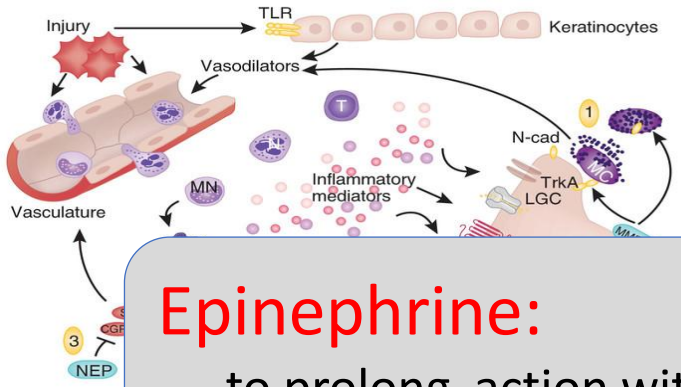
• Tissue damage

Long-acting anesthetic:

- Ropivacaine
- Bupivacaine

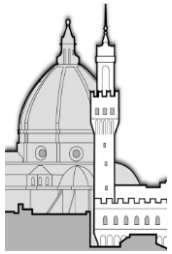
NSAID:

- Ketorolac
- Steroids



Epinephrine:

to prolong action with vasoconstriction



Florence Pain Potion (FPP)

1) What to inject with ?		
	Weight < 70kg	Weight > 70 kg
Ropivacaine	225 mg	300 mg
Epinephrine	100 µg	200 µg
Ketorolac	30 mg	30 mg
Tranexamic Acid	Less hemarthrosis lowers the level of postoperative pain	

Normal saline (20–30 mL) is added to the solution

Local Infiltration Analgesia

2) Where and How to inject ?

We try to identify and map the periarticular neural anatomy of hip and knee to find the area with increased nociceptor density:

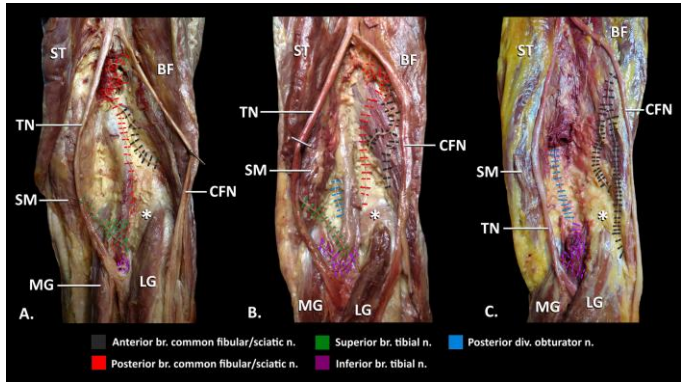
- Sensory fibers
- Nerve endings
- Mechanoreceptors

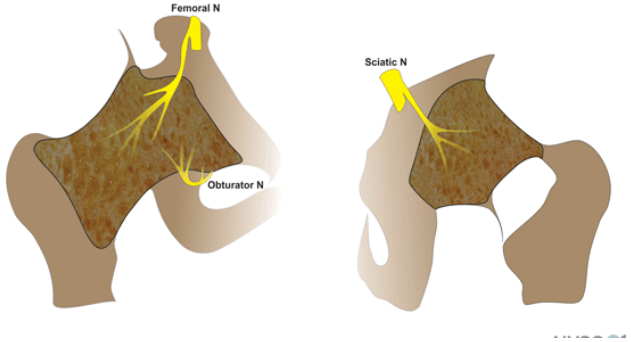
Tran J et al: Anatomical study of the innervation of posterior knee joint capsule: implication for imageguided Intervention Reg Anesth Pain Med 2019.

Local Infiltration Analgesia

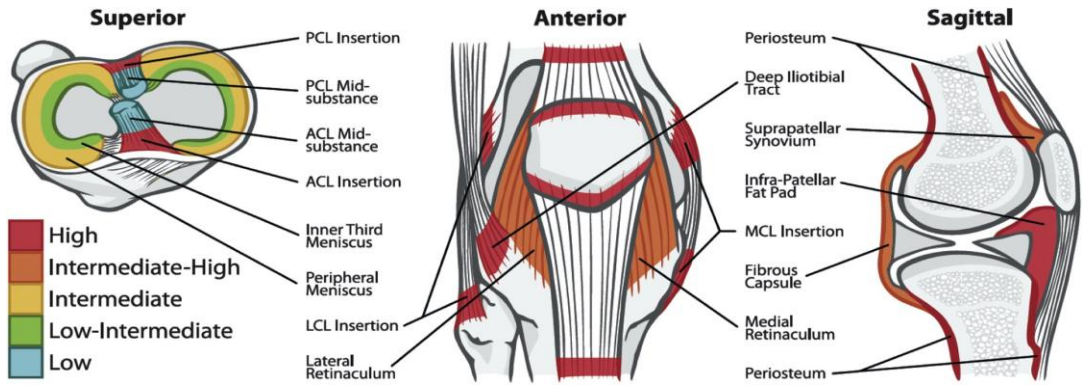
Characterization of the Neural Anatomy in the Hip Joint to Optimize Periarticular Regional Anesthesia in Total Hip Arthroplasty

Matthew J. Simons, MD[1]; Nirav H. Amin, MD[2]; Fred D. Cushner, MD[3]; and Giles R. Scuderi, MD[3]





Human Knee Joint Nociceptor Density



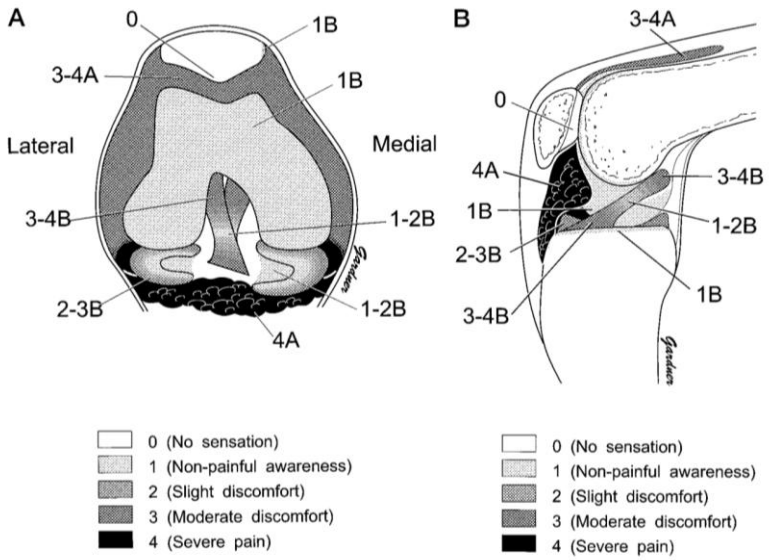
Tran J et al: Anatomical study of the innervation of posterior knee joint capsule: implication for imageguided Intervention Reg Anesth Pain Med 2019.

Local Infiltration Analgesia

Zonal Method:

- There are 6 knee regions that have been identified as having increased neurosensory perception and elevated concentration of mechanoreceptors:

- These area provide a framework for targeted periarticular knee infiltration and to maximize the effect of Local Infiltration Analgesia



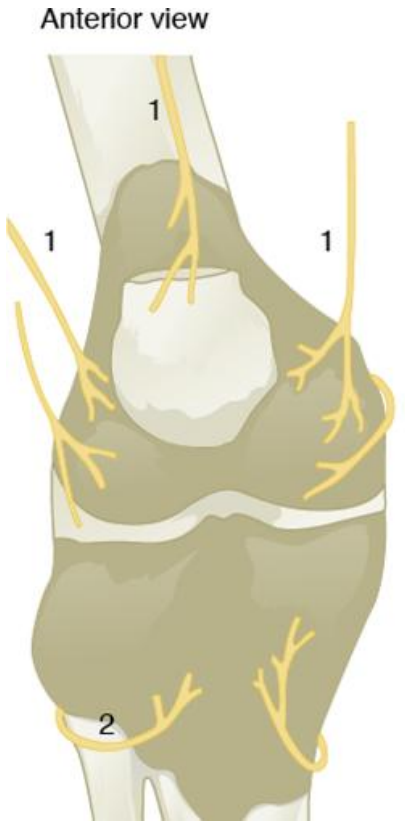
Dye SF et al: Conscious neurosensory mapping of the internal structures of the human knee without intraarticular anesthesia. Am J Sport Med 1997.

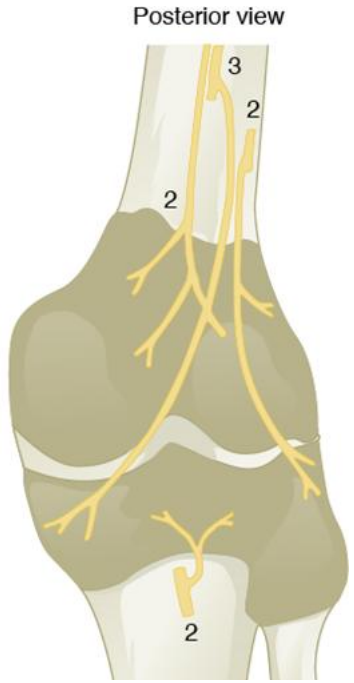
Periarticular Injection

Zonal method

2) Where to inject ?

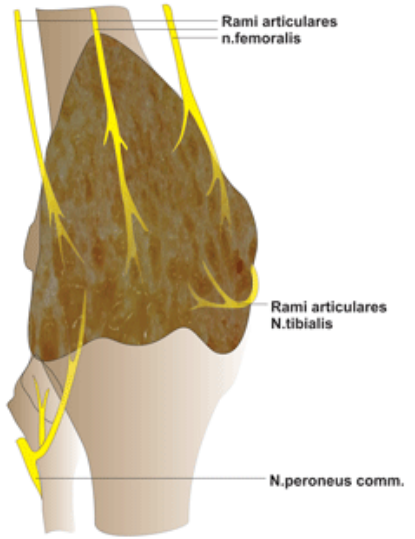
1. Postero-medial
2. Postero-lateral
3. Residual medial meniscal rim and LCM
4. Patellar tendon and Fat Pad
5. Adductor channel
6. Periosteum

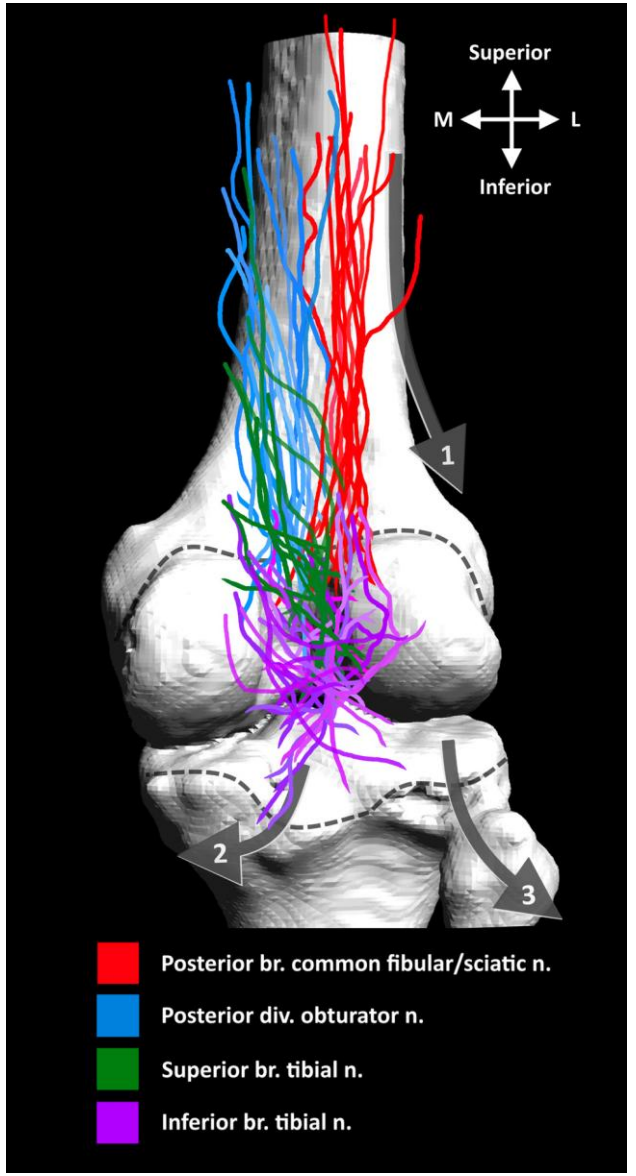




Zonal Method: posterior capsule

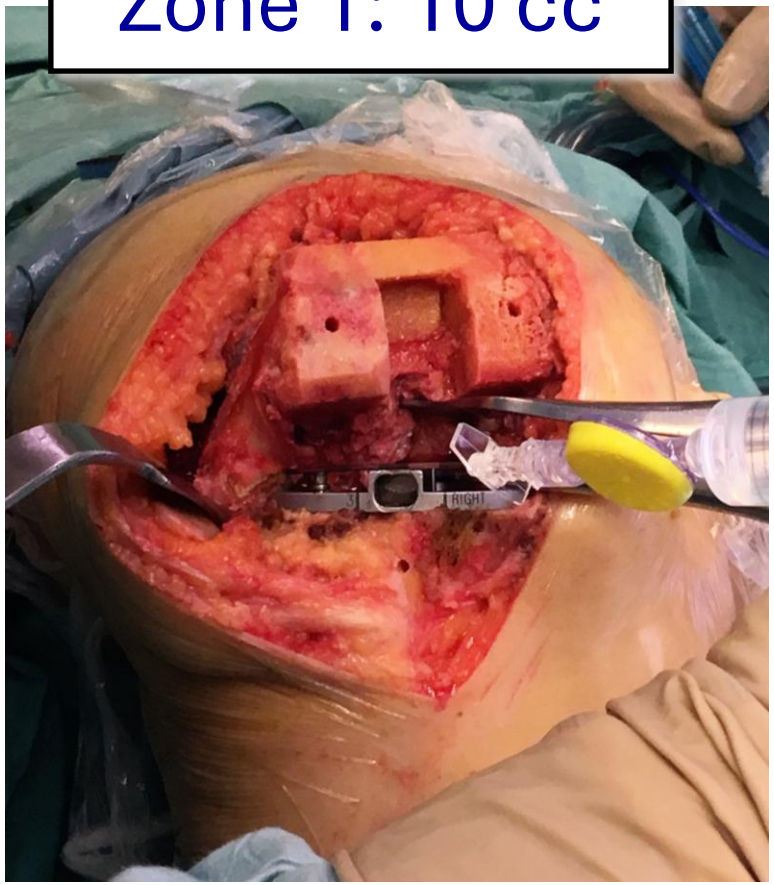
- The posterior knee joint capsule was innervated by articular branches of Obturator nerve
- The Tibial nerve projects articular branches at the popliteal fossa, innervating the posterolateral capsule
- The Common peroneal nerve also projects an articular branch.





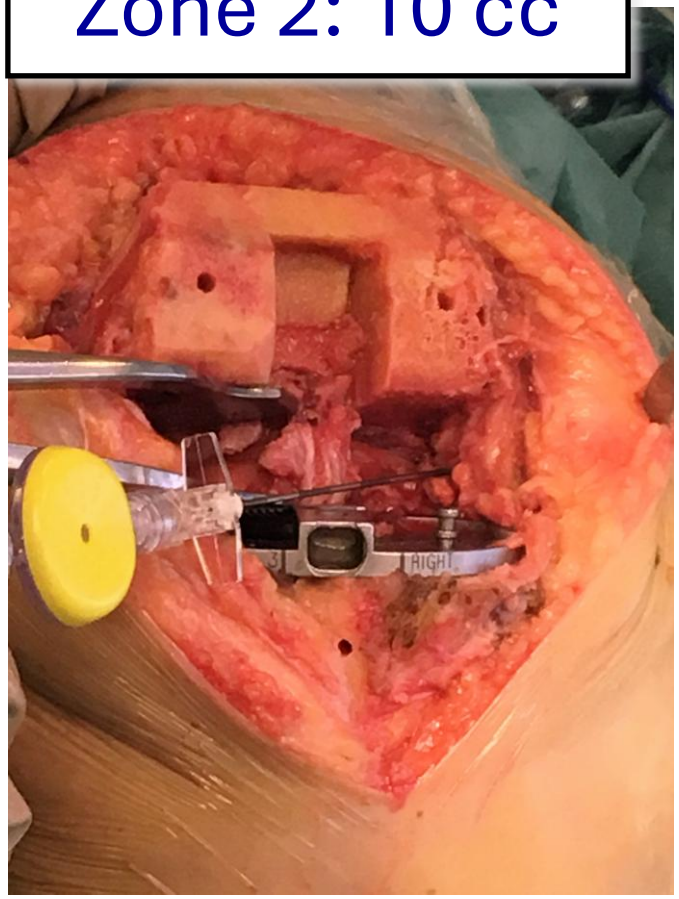
Zonal Method: posterior capsule

Zone 1: 10 cc



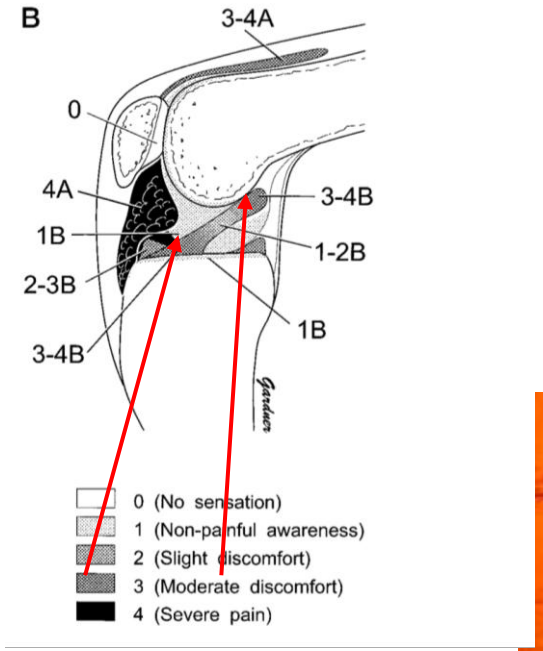
Postero-lateral

Zone 2: 10 cc

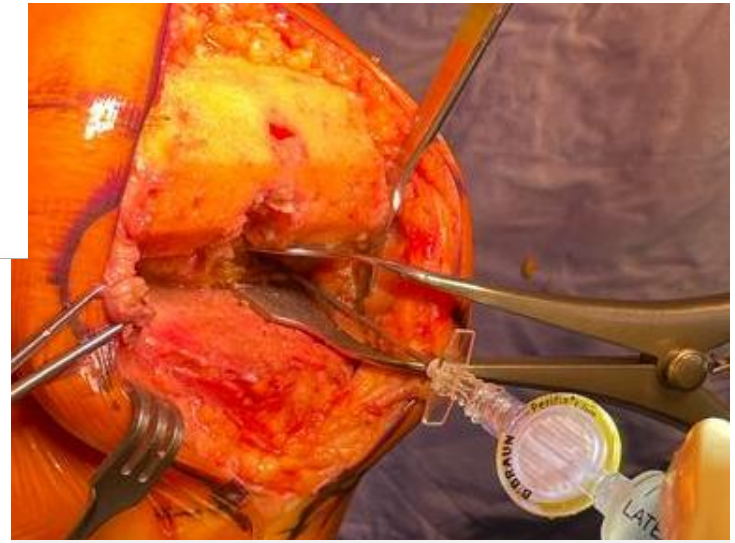


Postero-medial

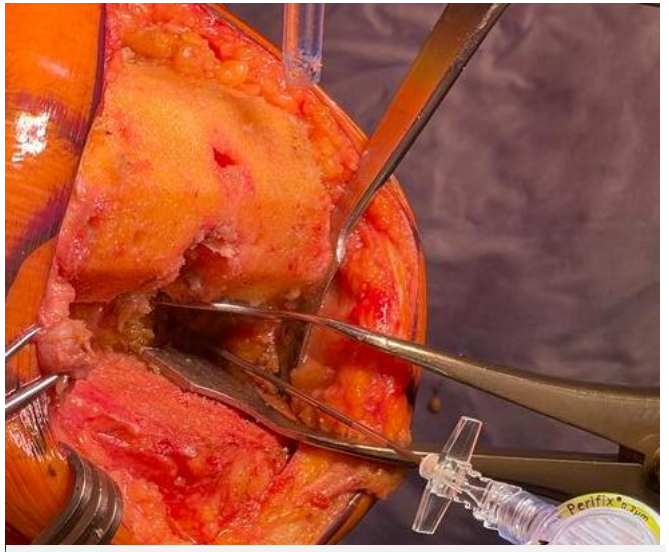
Zonal Method: posterior capsule



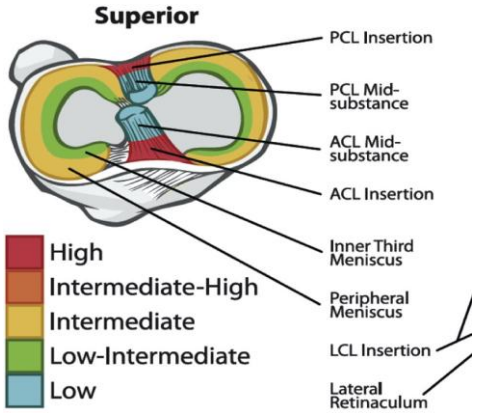
There are 2 regions in the posterior capsule that have been identified as having increased neurosensory perception and elevated concentration of mechanoreceptors



Region of the ACL origin



PCL tibial attachment

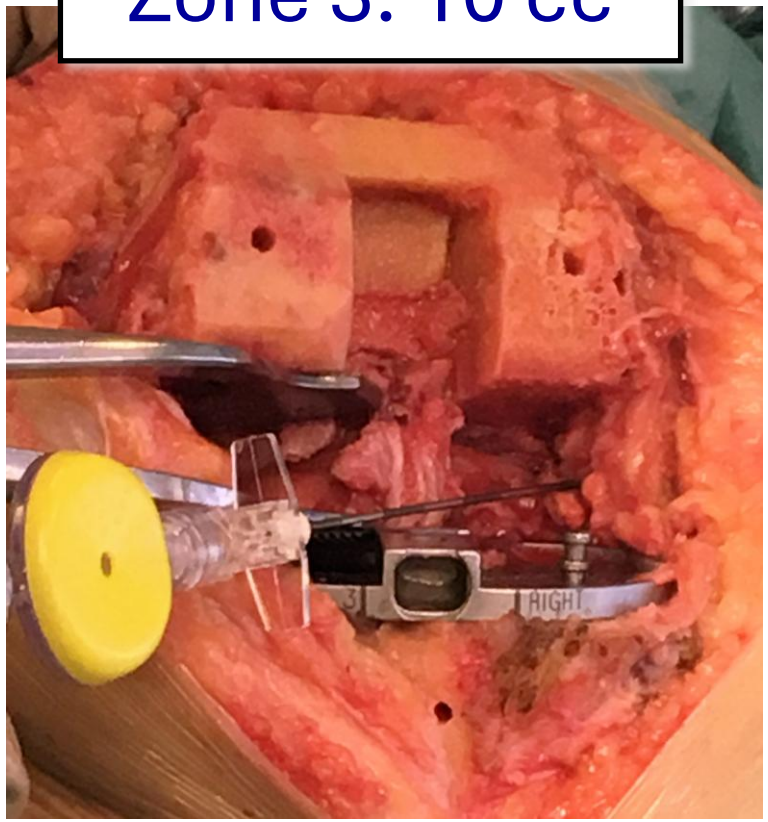


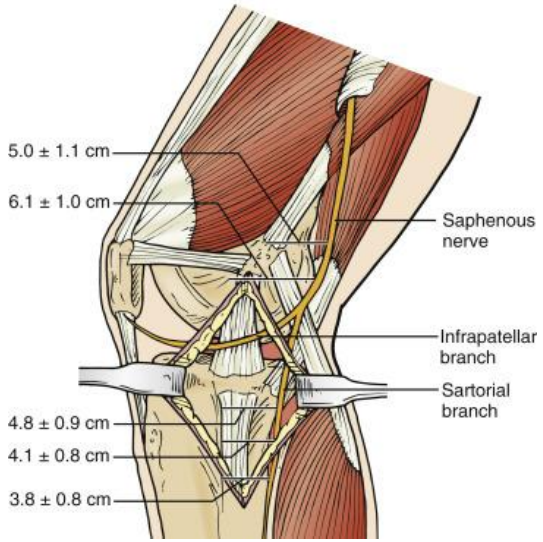
Several cc's of the PAI cocktail is injected into the area of the ACL femoral attachment and PCL tibial attachment,

Zonal Method: medial

The sartorial branch of the saphenous nerve, supplies a wide area covering the articular capsule, medial collateral ligament, and meniscal capsular attachment

Zone 3: 10 cc

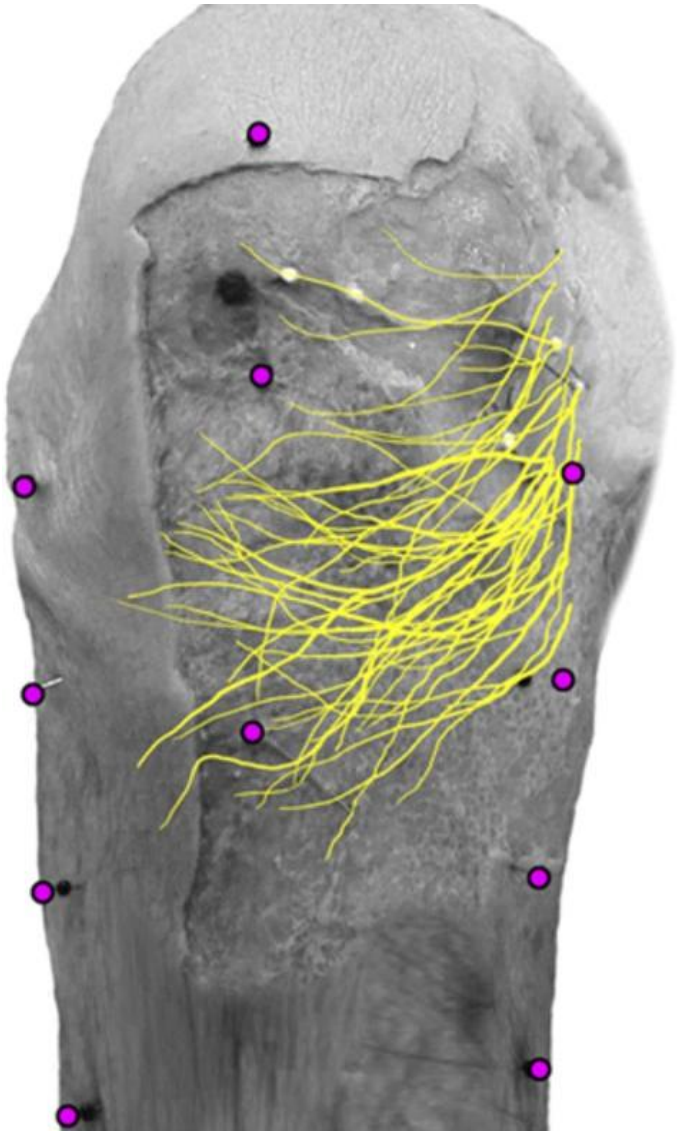




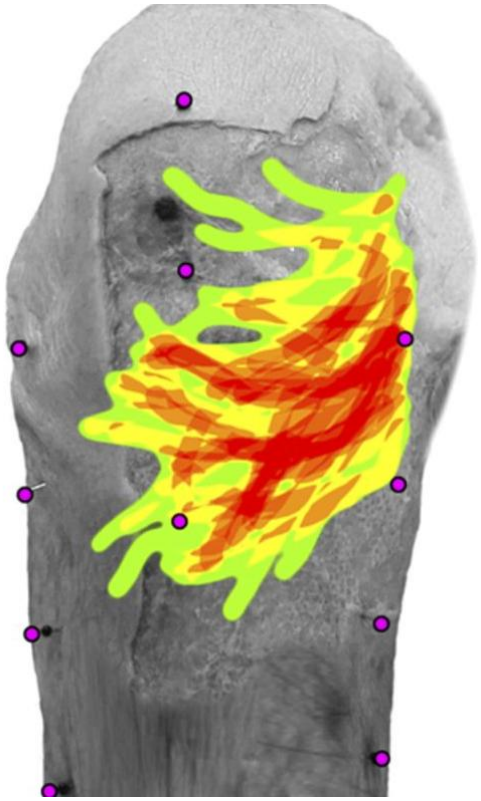
Residual medial meniscal rim and LCM

Zonal Method: patellar

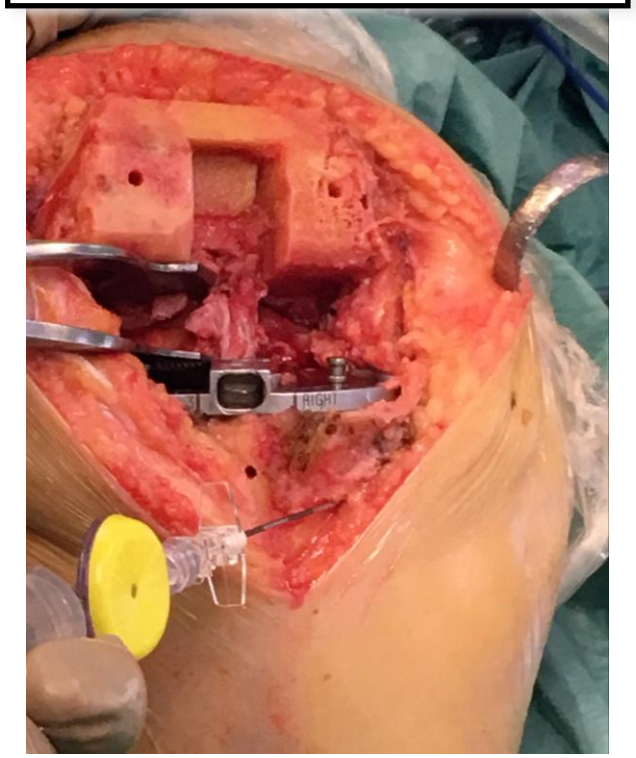
The fat pad is densely innervated structure, receiving nerve contribution from the infrapatellar branch of the saphenous nerves.



Zonal Method: patellar

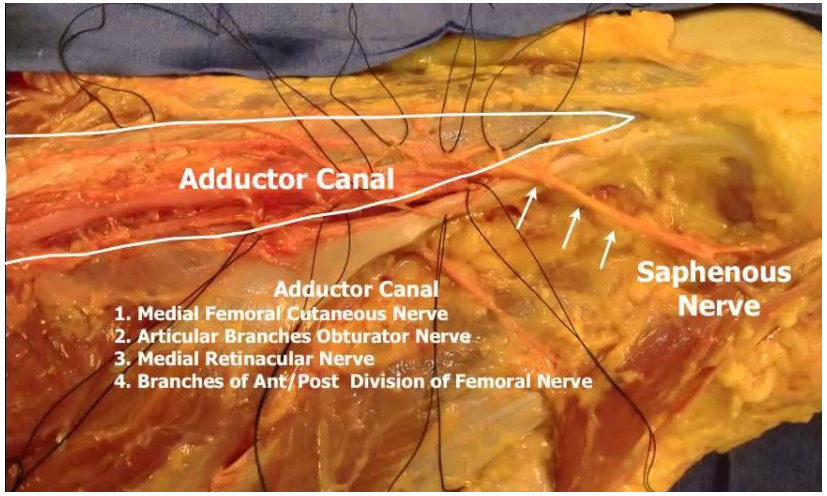


Zone 4: 10cc



Patellar tendon and Fat Pad

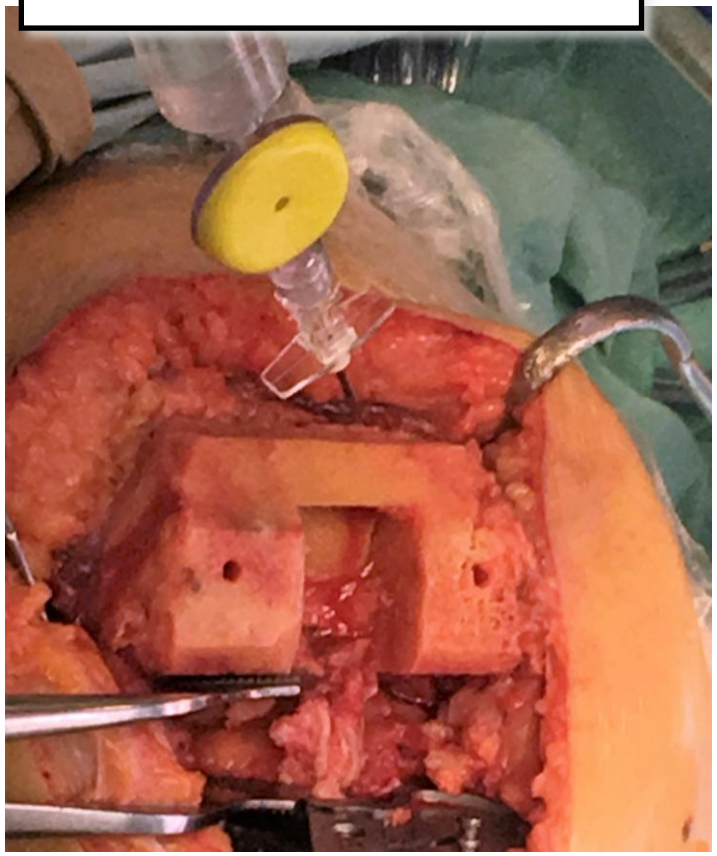
Zonal Method: Hunter canal



In the Adductor Canal the Saphenous Nerve lays anteromedial to the femoral artery and vein.

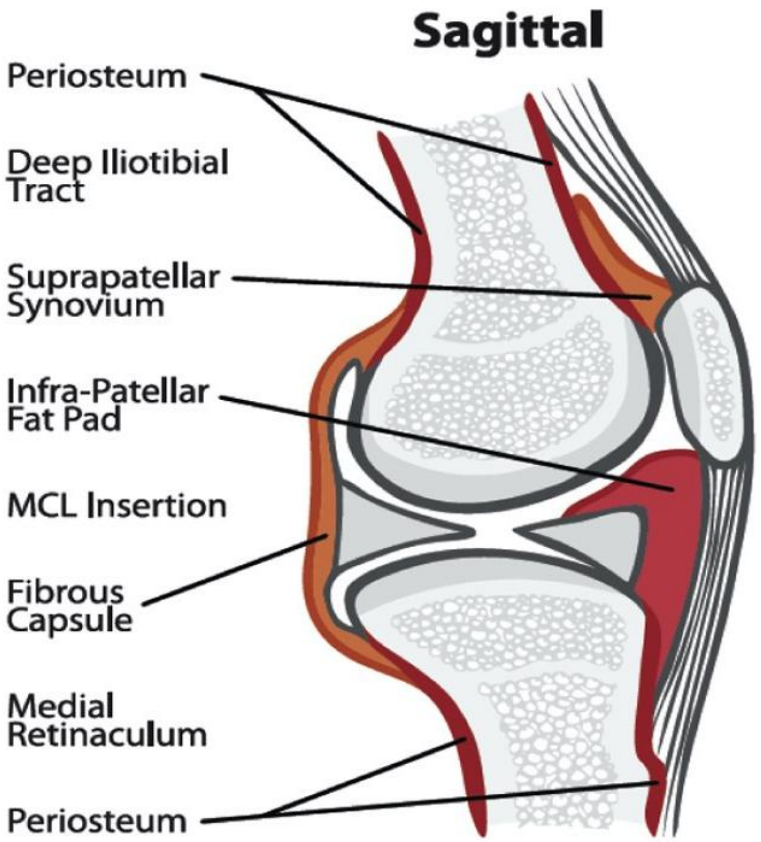
In addition to the saphenous nerve and the femoral vessels, the canal also includes the Nerve to the Vastus Medialis

Zone 5: 20cc



Zonal Method: periosteum

Human Knee Joint Nociceptor Density

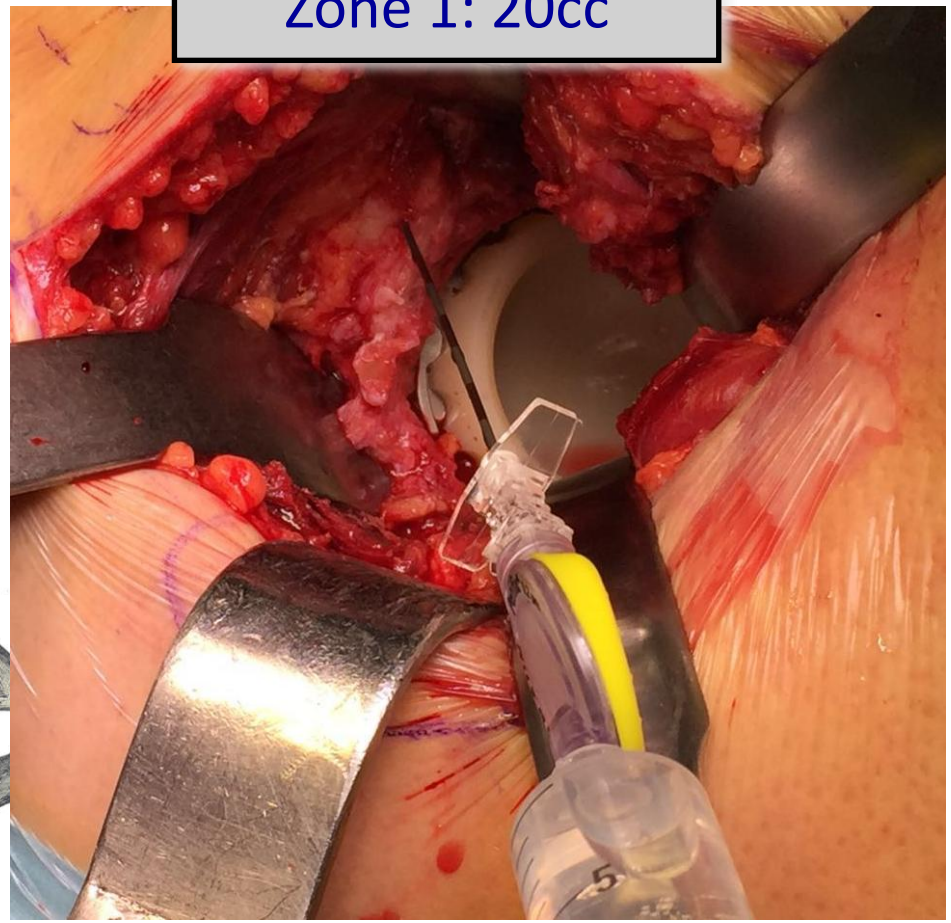


Zone 6: 10cc

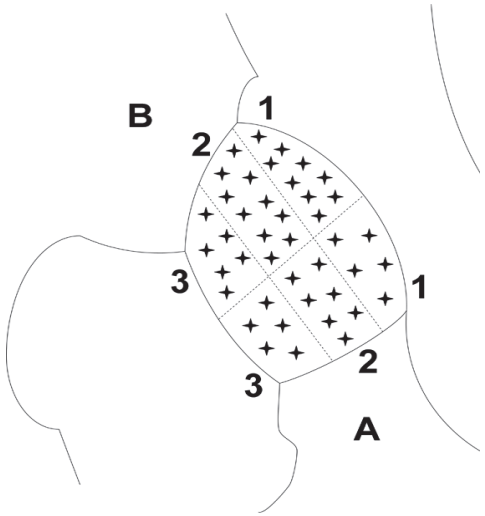
Hip Local Infiltration analgesia

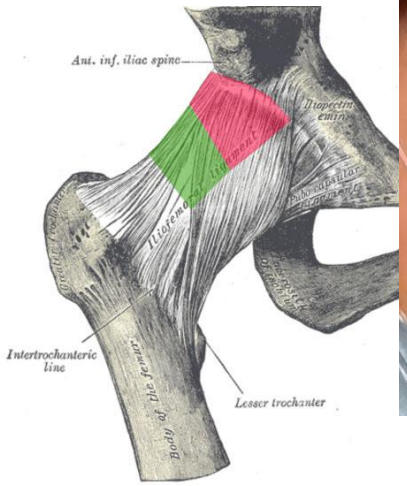
Zone 1

Zone 1: 20cc



Superolateral capsule



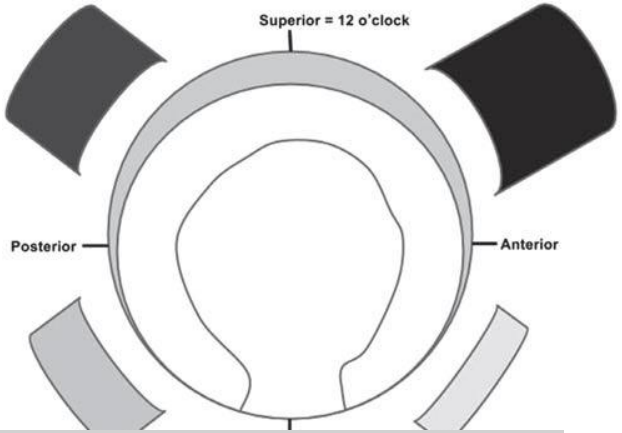


M. Haversath et al: The distribution of nociceptive innervation in the painful hip. Bone Joint J 2013.

Local Infiltration analgesia

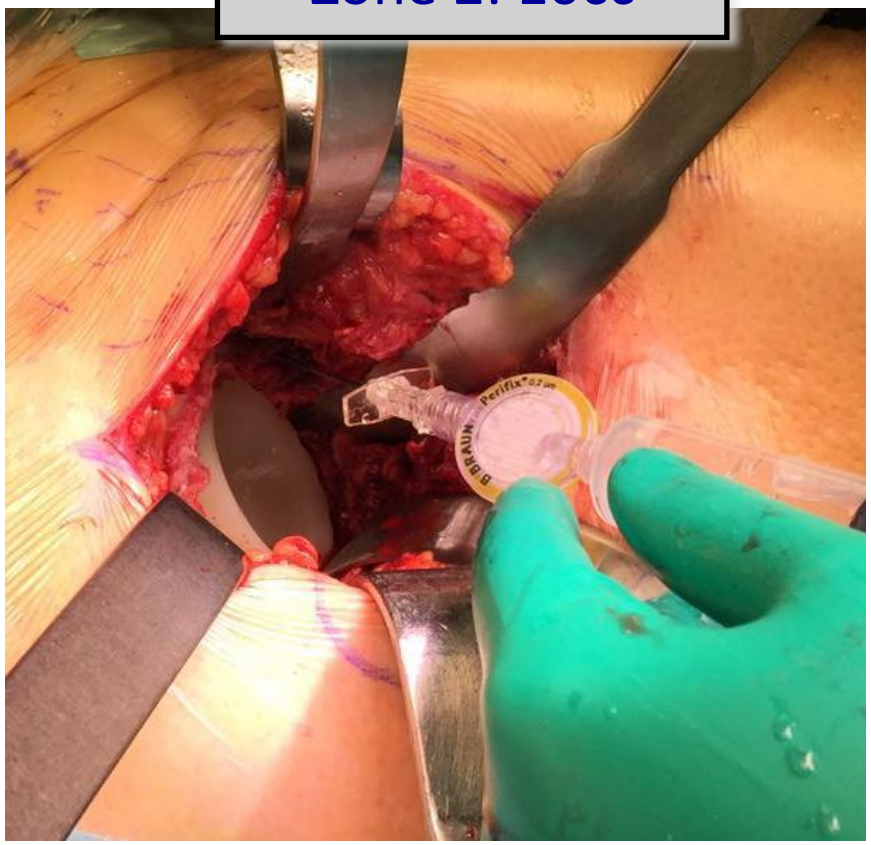
Zone 2

Labral attachment from 10 to 2 o'clock



Remnant labral nerve endings.

Zone 2: 10cc

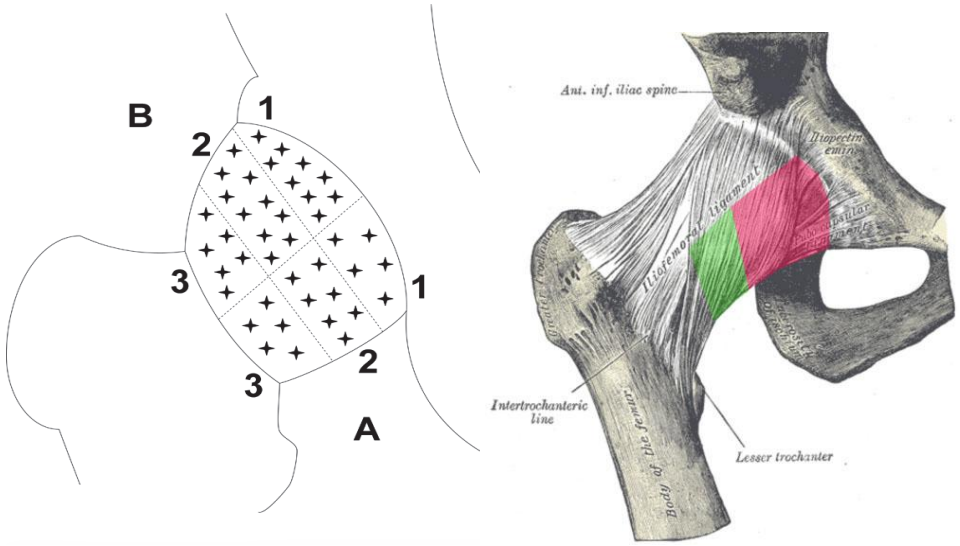


Simons J et al: Characterization of the Neural Anatomy in the Hip Joint to Optimize Periarticular Regional Anesthesia in Total Hip Arthroplasty Bone Joint J 2013.

Local Infiltration analgesia

Zone 3

Medial capsule



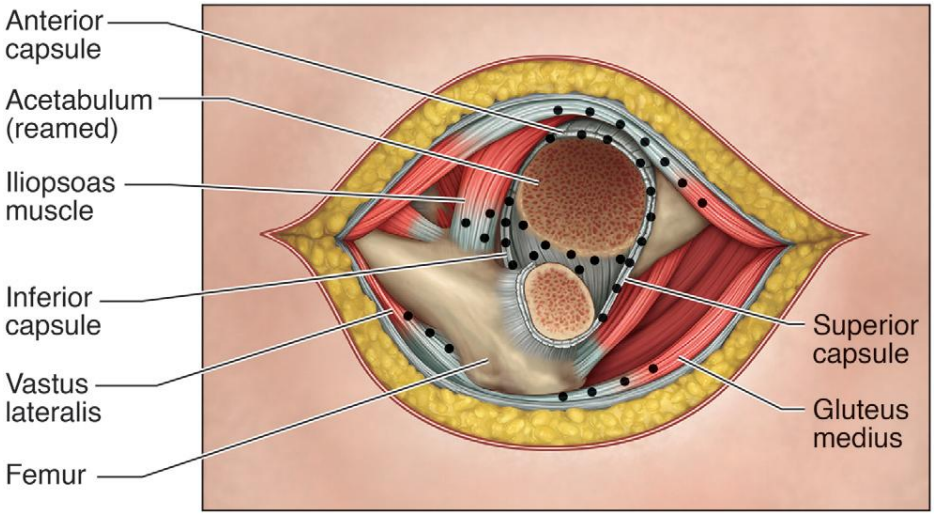
Zone 3: 20cc

M. Haversath et al: The distribution of nociceptive innervation in the painful hip. Bone Joint J 2013.

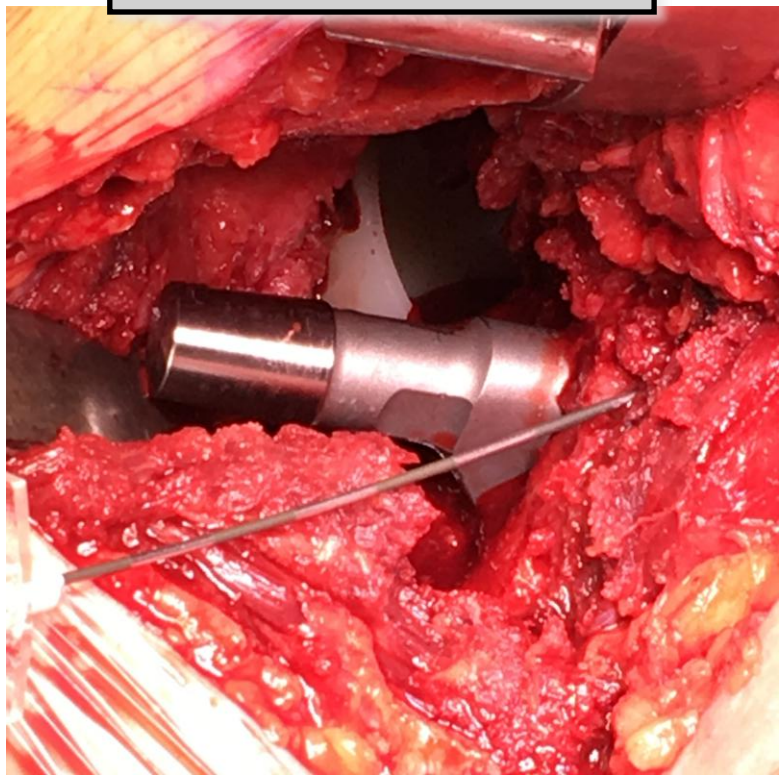
Local Infiltration analgesia

Zone 4

Periosteum about the vastus lateralis



Zone 4: 20cc



Joshi GP et al: Techniques for Periarticular Infiltration With Liposomal Bupivacaine for the Management of Pain After Hip and Knee Arthroplasty Journal Of Surgical Orthopaedic Advances, 2015

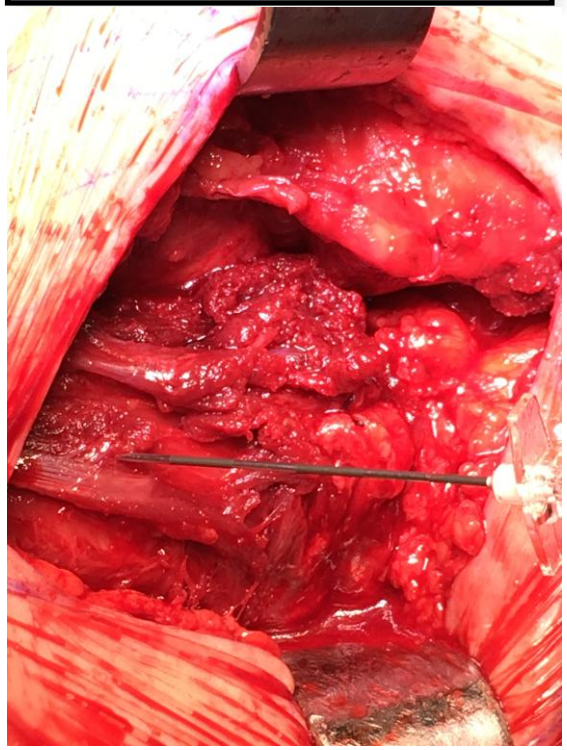
Local Infiltration analgesia

Zone 5

Gluteus Medius, Maximus

and Tensor Fascia Muscle belly

Zone 5: 20cc

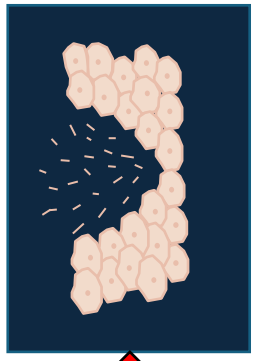


Joshi GP et al: Techniques for Periarticular Infiltration With Liposomal Bupivacaine for the Management of Pain After Hip and Knee Arthroplasty Journal Of Surgical Orthopaedic Advances, 2015

Pain management in TJA

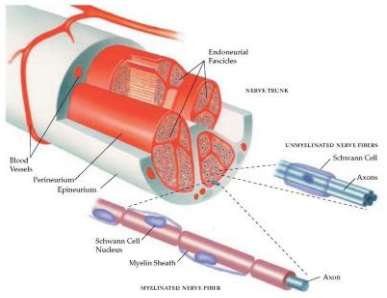
Anatomical → Different sites of action

Peripheral local tissue



NSAID/antiCOX2
Local Anestetic
Opiod

Peripheral Nerves

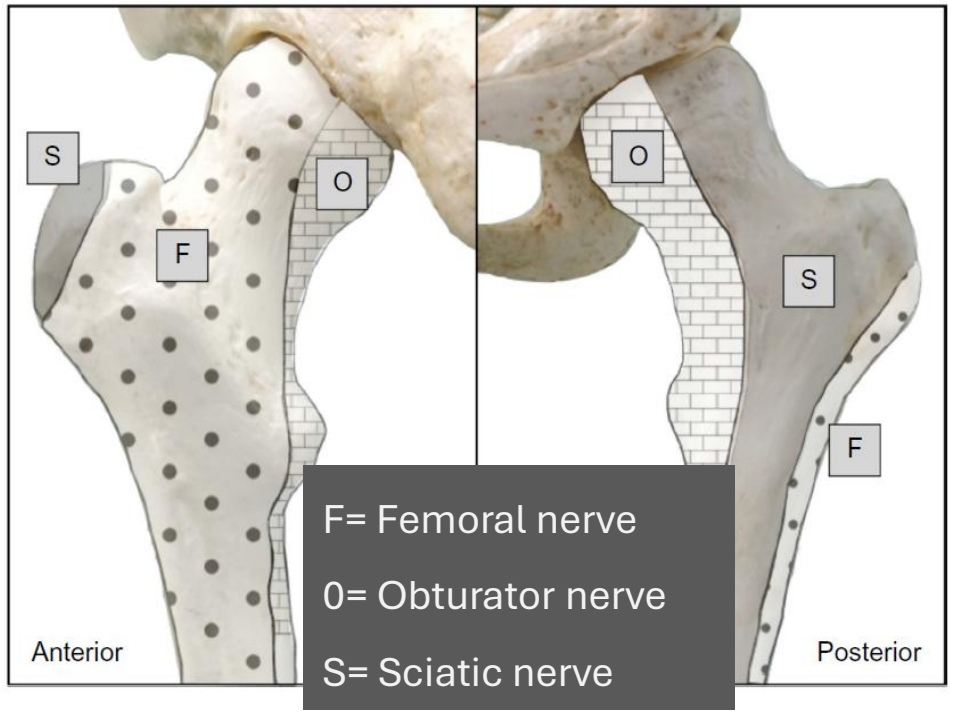


Local Anestetic

- Local Infiltration analgesia
- Regional nerve blocks

Regional Nerve Block

Regional nerve blocks provides analgesia through the administration of local anesthetic to reduce the transmission of neuropathic pain signals



The complex sensory innervation of the hip comes from branches of both lumbar and sacral plexi.

Knee Regional Nerve Block

Regional nerve blocks provides analgesia through the administration of local anesthetic to reduce the transmission of neuropathic pain signals

The Clinical Practice Guidelines

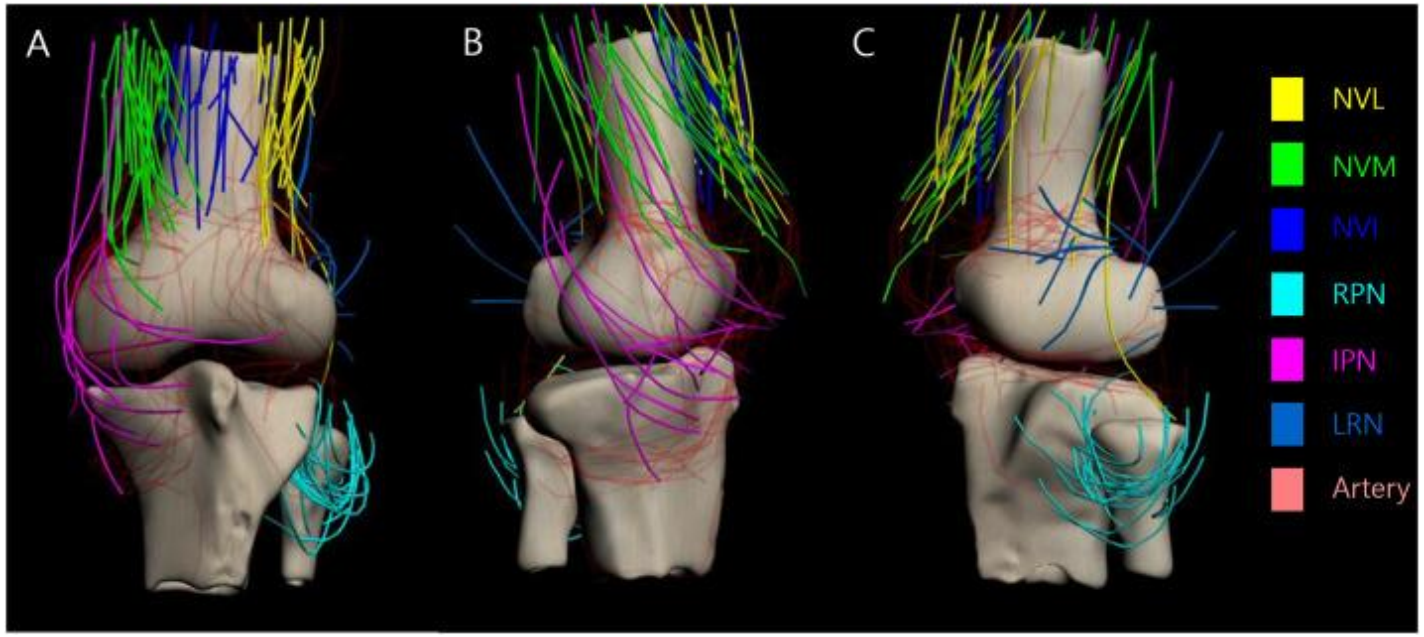
Response/Recommendation 1A

Regional nerve blocks, including single-shot or continuously administered femoral nerve block or adductor canal block, effectively reduce postoperative pain and opioid consumption without an increase in adverse events, but femoral nerve blocks are associated with decreased quadriceps strength after primary total knee arthroplasty.

Strength of Recommendation: STRONG

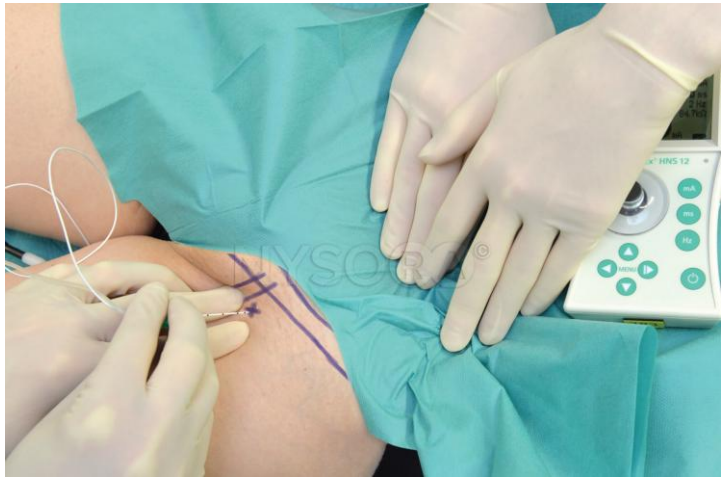
Fillingham YA et al: Regional Nerve Blocks in Primary Total Knee Arthroplasty: The Clinical Practice Guidelines of the American Association of Hip and Knee Surgeons, American Society of Regional Anesthesia and Pain Medicine, American Academy of Orthopaedic Surgeons, Hip Society, and Knee Society J Arthroplasty 2022

Nerve supply to the knee



Sensory innervation of the knee

- Sciatic nerve
- Femoral nerve
- Tibial nerve
- Saphenous nerve
- Common peroneal nerve
- Obturator nerve



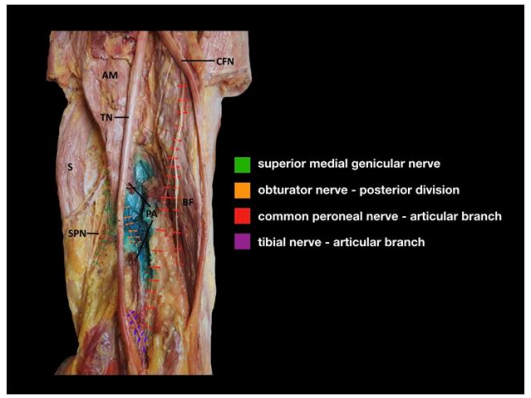
“Non motor sparing” Nerve blocks

- Sciatic Nerve Block
- Femoral Nerve Block
- Adductor Canal Block
- IPACK: Infiltration between the Popliteal Artery and Capsule of the posterior Knee.

→

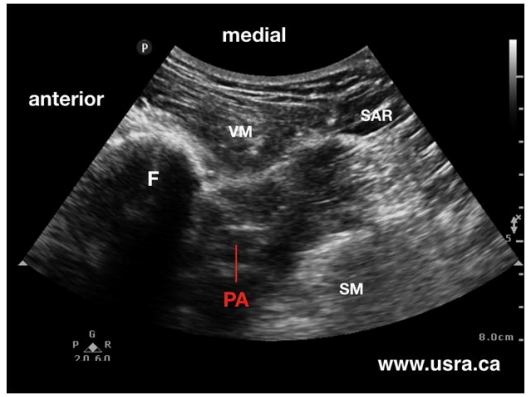
- Decreased quadriceps strength
- Risks of falls
- Delayed rehabilitation

Fillingham YA et al: Regional Nerve Blocks in Primary Total Knee Arthroplasty: The Clinical Practice Guidelines of the American Association of Hip and Knee Surgeons, American Society of Regional Anesthesia and Pain Medicine, American Academy of Orthopaedic Surgeons, Hip Society, and Knee Society J Arthroplasty 2022



"Motor sparing" Nerve blocks

- IPACK: Infiltra[redacted]etween the Popliteal Artery and Caps[redacted]the posterior Knee.



The Clinical Practice Guidelines

Response/Recommendation 1B

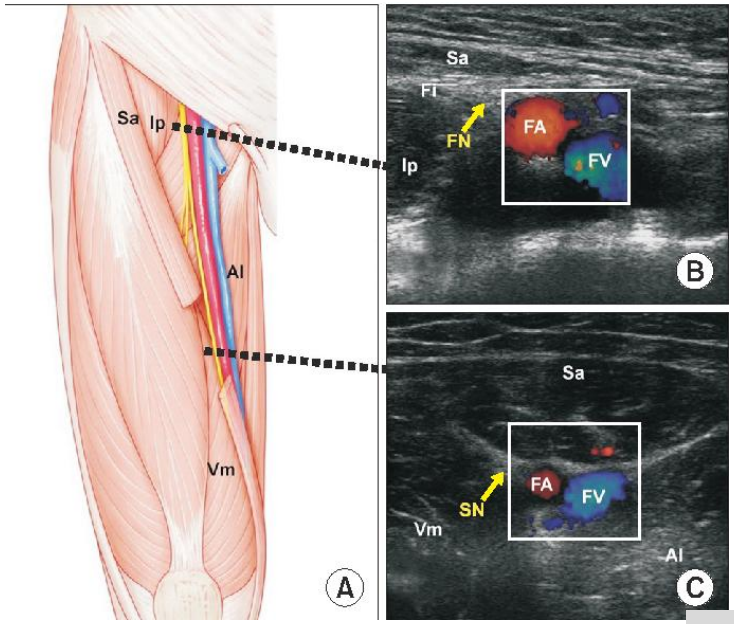
The infiltration between Popliteal Artery and Capsule of Knee (iPACK) may reduce postoperative pain, but iPACK does not effectively reduce postoperative opioid consumption after primary TKA.

Strength of Recommendation: LIMITED

Based on the inconsistency in the results of the reported outcomes

Fillingham YA et al: Regional Nerve Blocks in Primary Total Knee Arthroplasty: The Clinical Practice Guidelines of the American Association of Hip and Knee Surgeons, American Society of Regional Anesthesia and Pain Medicine, American Academy of Orthopaedic Surgeons, Hip Society, and Knee Society J Arthroplasty 2022

“Motor sparing” Nerve blocks



Adductor canal block

A single-shot ACB results in a better early rehabilitation, a longer ambulatory distance, and a reduction in length of hospital stay

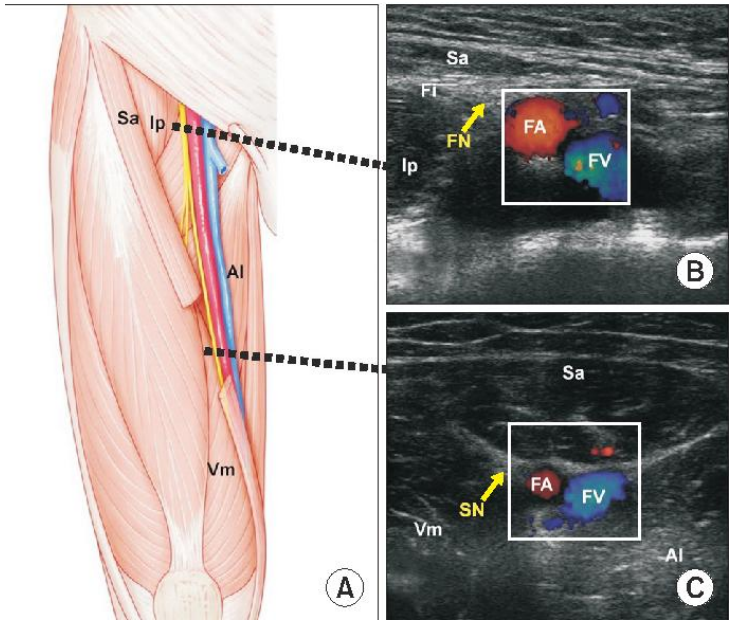
The Clinical Practice Guidelines

Response/Recommendation 1A

Regional nerve blocks, including single-shot or continuously administered femoral nerve block or adductor canal block, effectively reduce postoperative pain and opioid consumption without an increase in adverse events, but femoral nerve blocks are associated with decreased quadriceps strength after primary total knee arthroplasty.

Strength of Recommendation: STRONG

Fillingham YA et al: Regional Nerve Blocks in Primary Total Knee Arthroplasty: The Clinical Practice Guidelines of the American Association of Hip and Knee Surgeons, American Society of Regional Anesthesia and Pain Medicine, American Academy of Orthopaedic Surgeons, Hip Society, and Knee Society J Arthroplasty 2022



"Motor sparing" Nerve blocks

- Adductor canal block

Evidence-based guidelines on the use of regional nerve blocks in primary total knee arthroplasty (TKA).

Based on the best available evidence, the workgroup believes that a femoral nerve block has a limited role in primary TKA due to the association of quadriceps weakness and demonstrated efficacy of an adductor canal block. We recommend the use of a single-shot adductor canal block when regional anesthesia is used in primary TKA; however, the workgroup would recommend consideration of a continuous adductor canal block in patients at risk for poor postoperative pain control.

Fillingham YA et al: Regional Nerve Blocks in Primary Total Knee Arthroplasty: The Clinical Practice Guidelines of the American Association of Hip and Knee Surgeons, American Society of Regional Anesthesia and Pain Medicine, American Academy of Orthopaedic Surgeons, Hip Society, and Knee Society J Arthroplasty 2022

Regional anesthesia in primary TKA

- Adductor canal block……

+

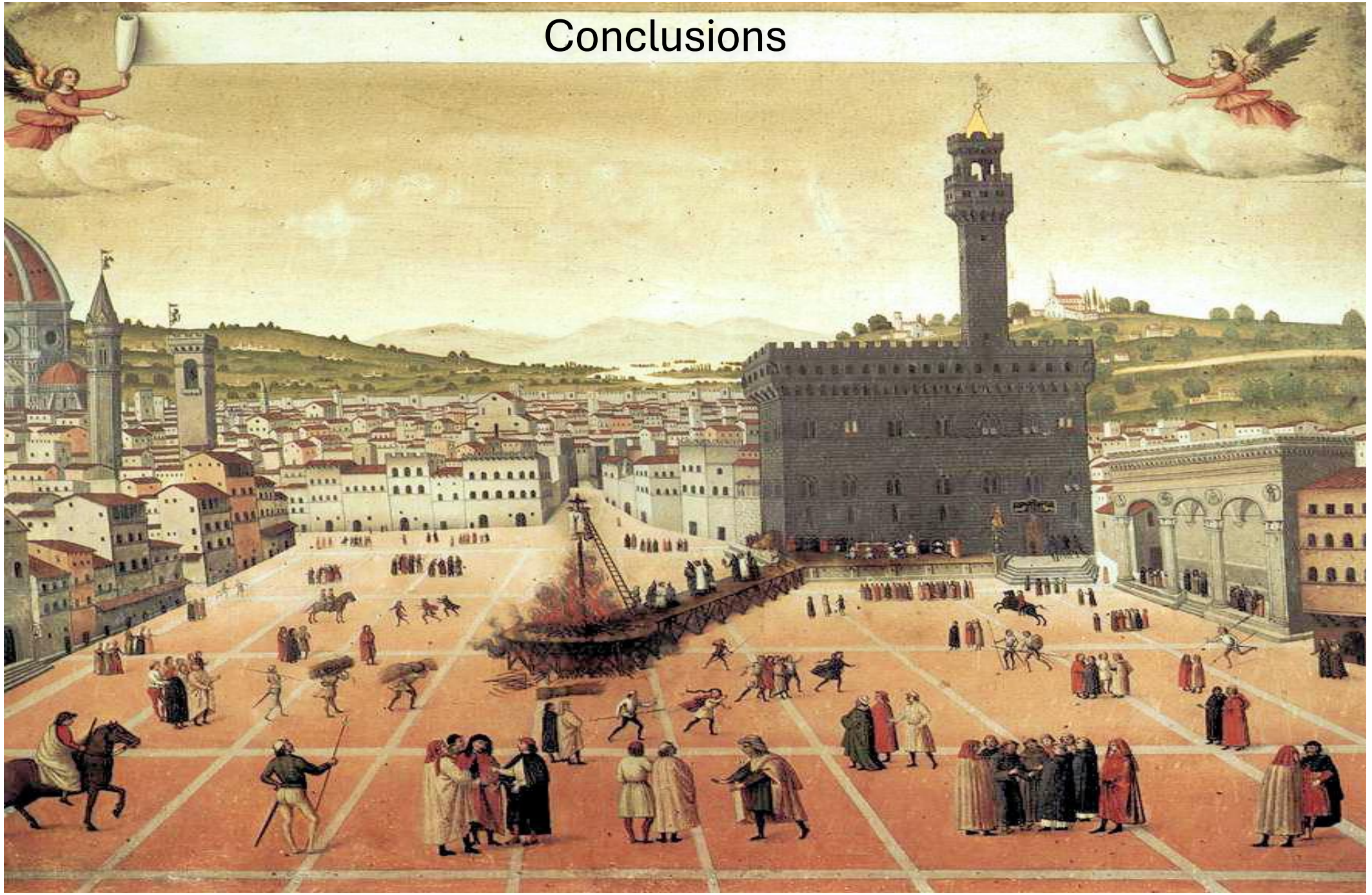
- Local Infiltration Analgesia

The workgroup recommends routine use of either a single-shot adductor canal block or periarticular local anesthetic infiltration for patients undergoing primary TKA…….

…the combination of a single-shot adductor canal block and periarticular local anesthetic infiltration could provide additional reduction in postoperative pain and opioid consumption compared to either alone.

Fillingham YA et al: Regional Nerve Blocks in Primary Total Knee Arthroplasty: The Clinical Practice Guidelines of the American Association of Hip and Knee Surgeons, American Society of Regional Anesthesia and Pain Medicine, American Academy of Orthopaedic Surgeons, Hip Society, and Knee Society J Arthroplasty 2022

Conclusions



Pain management in TJA

Pain control in TJA it's a long journey that begins well before surgery and ends long after.

Pre-operative

- FANS:
  - Ketorolac 30mg
- COX-2 inhibitors:
  - Celecoxib 200 mg
  - Etoricoxib 90 mg
- Central analgesic:
  - acetaminophen
  - Oxicodon
  - Tapentadol
- Neuropathic:
  - Pregabalina o Gabapentina

Intra-operative

- Local Infiltration Analgesia:

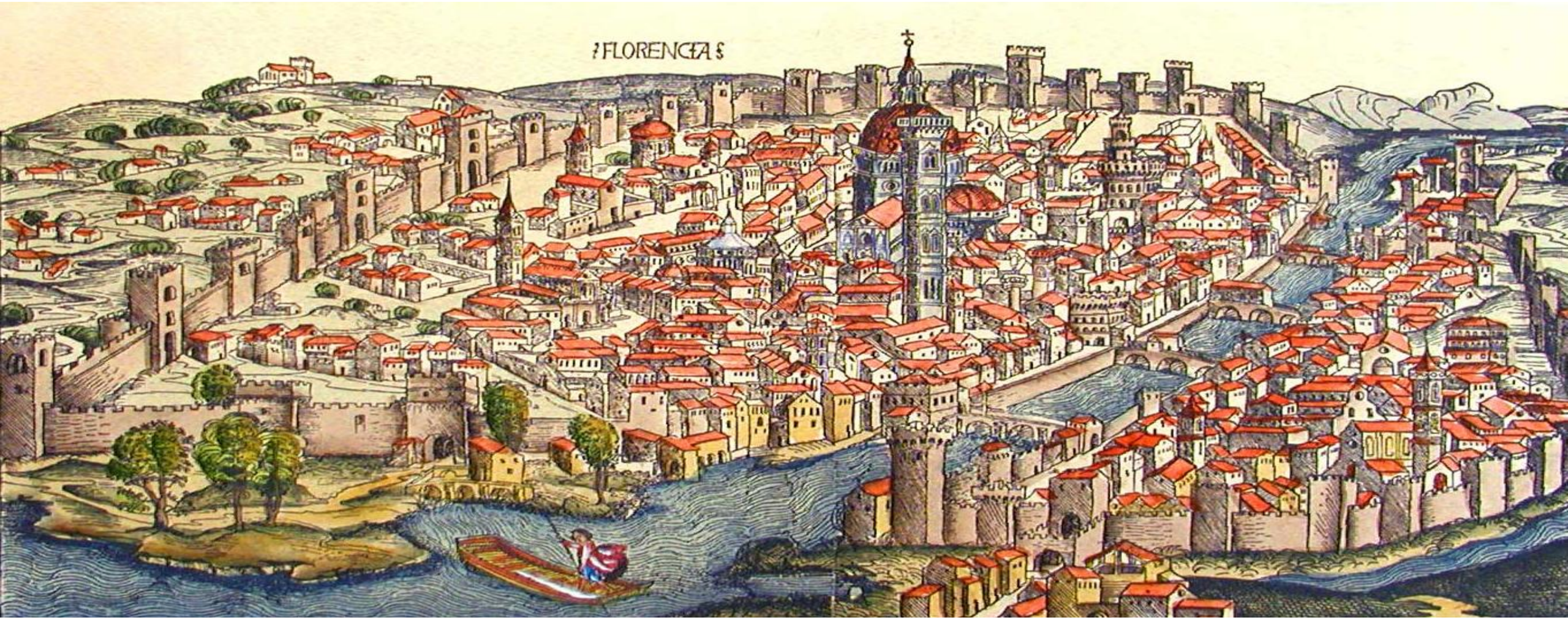
- Regional Nerve Blocks

Post-operative

- FANS:
  - Ketorolac 30mg
- COX-2 inhibitors:
  - Celecoxib 200 mg
- Central analgesic:
  - acetaminophen
  - Oxicodon
  - Tapentadol

Specola Museum in Florence Anatomical Waxworks.

Thank for your attention


FLORENCIA