

UNHAPPY KNEE PROSTHESIS

Paolo Grossi MD

Director

Dept of Anesthesia,
Intensive Care and Pain Treatment



Centro Specialistico Ortopedico Traumatologico
Gaetano Pini-CTO

Sistema Socio Sanitario



Regione
Lombardia
ASST Gaetano Pini



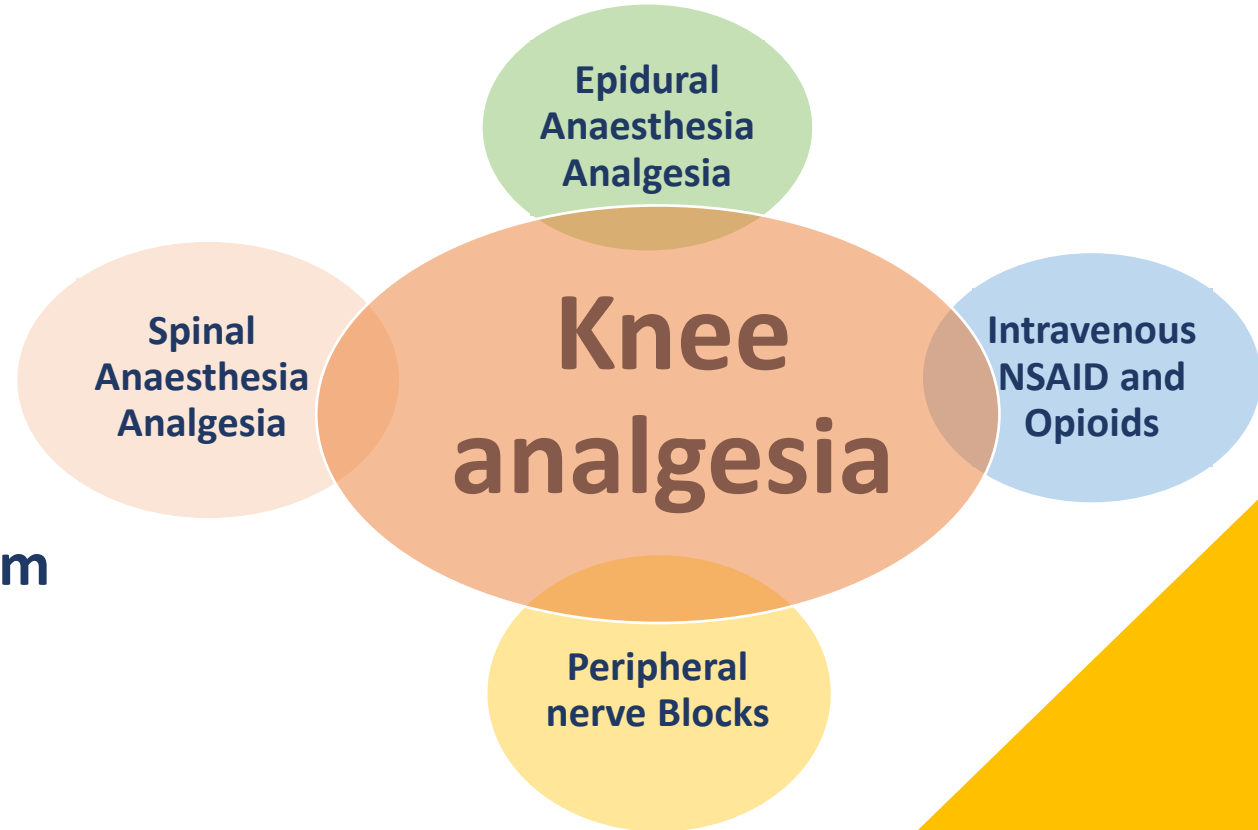
European Society of
Regional Anaesthesia
& Pain Therapy
ESRA ITALIA



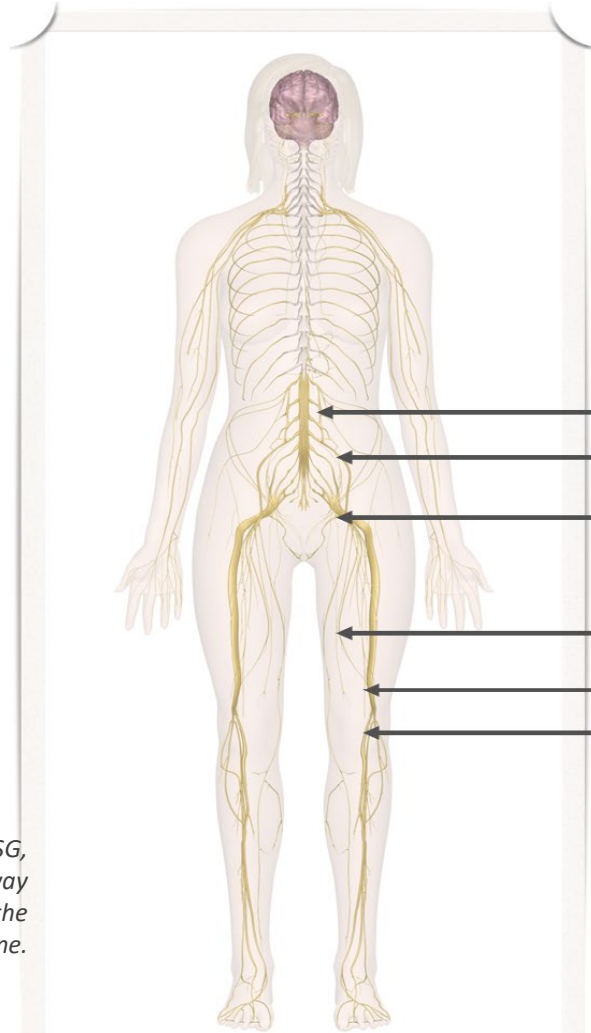
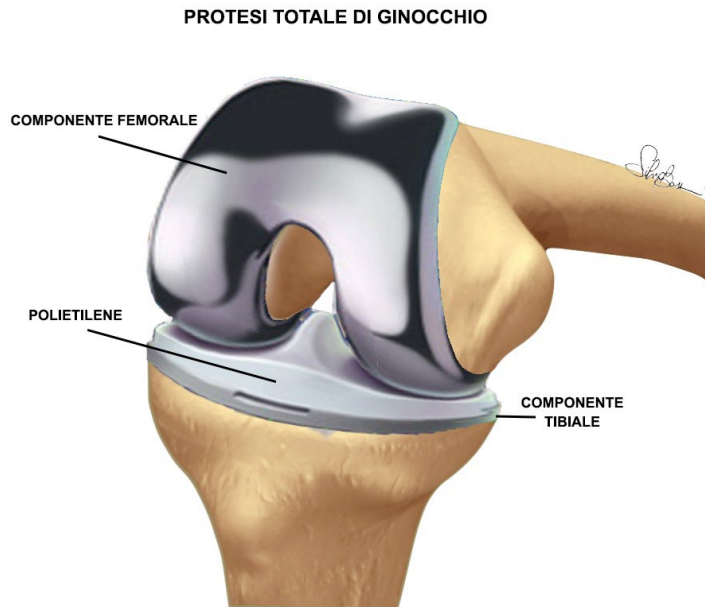
State of the Art Safety Standards in RA
THE EUROPEAN SOCIETY OF REGIONAL
ANAESTHESIA & PAIN THERAPY

ANESTHESIOLOGIC AIMS FOR TOTAL KNEE POSTOPERATIVE MANAGEMENT

- ▶ Postop pain
- ▶ Motor sparing
- ▶ Opioid Sparing
- ▶ Early mobilitation
- ▶ No PONV
- ▶ Early oral intake
- ▶ No Postoperative Delirium



ANESTHESIA/ANALGESIA PRACTICE PATHWAY OPTIONS



EPIDURAL

LUMBAR

FEMORAL

SCIATIC

OBTURATOR

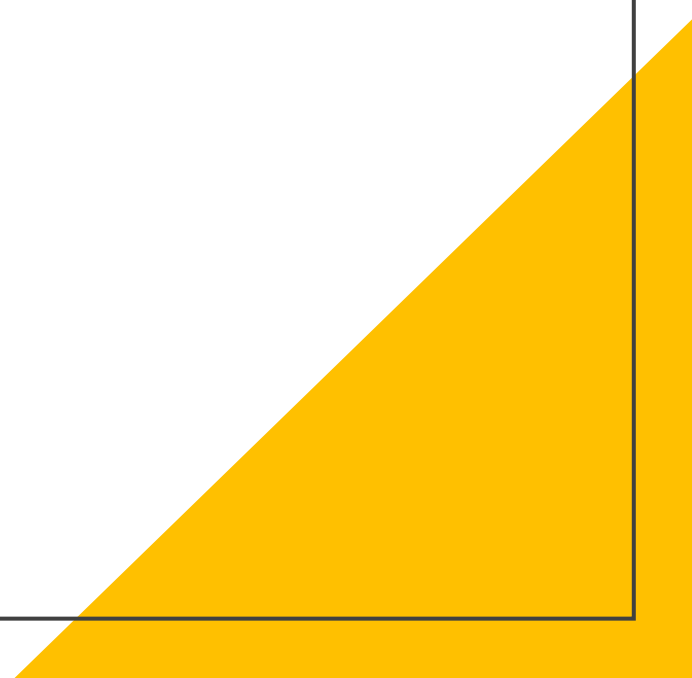
ACB

iPACK

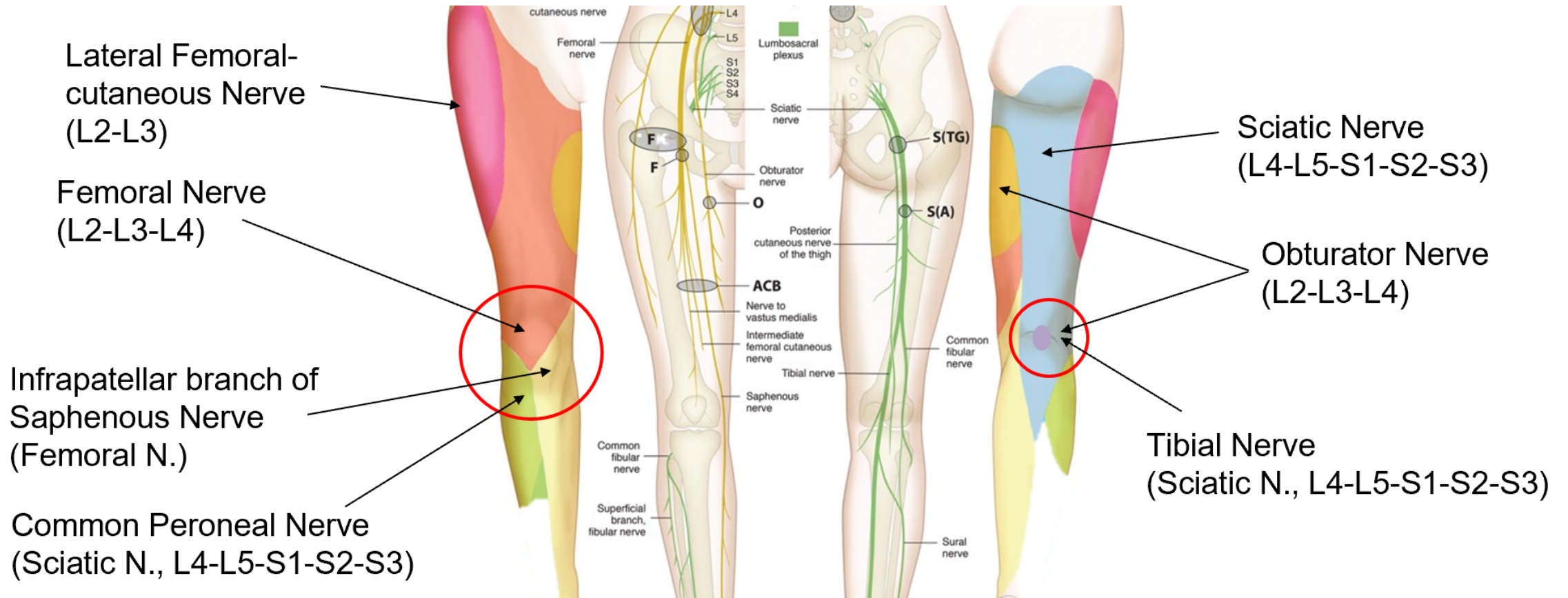
LIA

Kopp SL, Børglum J, Buvanendran A, Horlocker TT, Ilfeld BM, Memtsoudis SG, Neal JM, Rawal N, Wegener JT. Anesthesia and Analgesia Practice Pathway Options for Total Knee Arthroplasty: An Evidence-Based Review by the American and European Societies of Regional Anesthesia and Pain Medicine. *Reg Anesth Pain Med.* 2017 Nov/Dec;42(6):683-697. doi: 10.1097/AAP.0000000000000673. PMID: 29053504.

PERIPHERAL NERVE BLOCKS (PNB)

- ↓ Complications
 - ↓ Time to discharge
 - ↓ Costs
 - ↑ Satisfaction
 - PNB > Epidural analgesia
 - FNB = Δt vs. quadriceps weakness
 - Adductor Canal = ↓ opioids
 - Continuous Block
- 
- A large yellow triangle is positioned in the bottom right corner of the slide, pointing towards the top right.

INNERVATION: LUMBAR + SACRAL PLEXUS



TERMINAL SENSORY BRANCHES

ANTERIOR COMPARTMENT

Anterior Femoral-cutaneous nerves (Femoral N.)

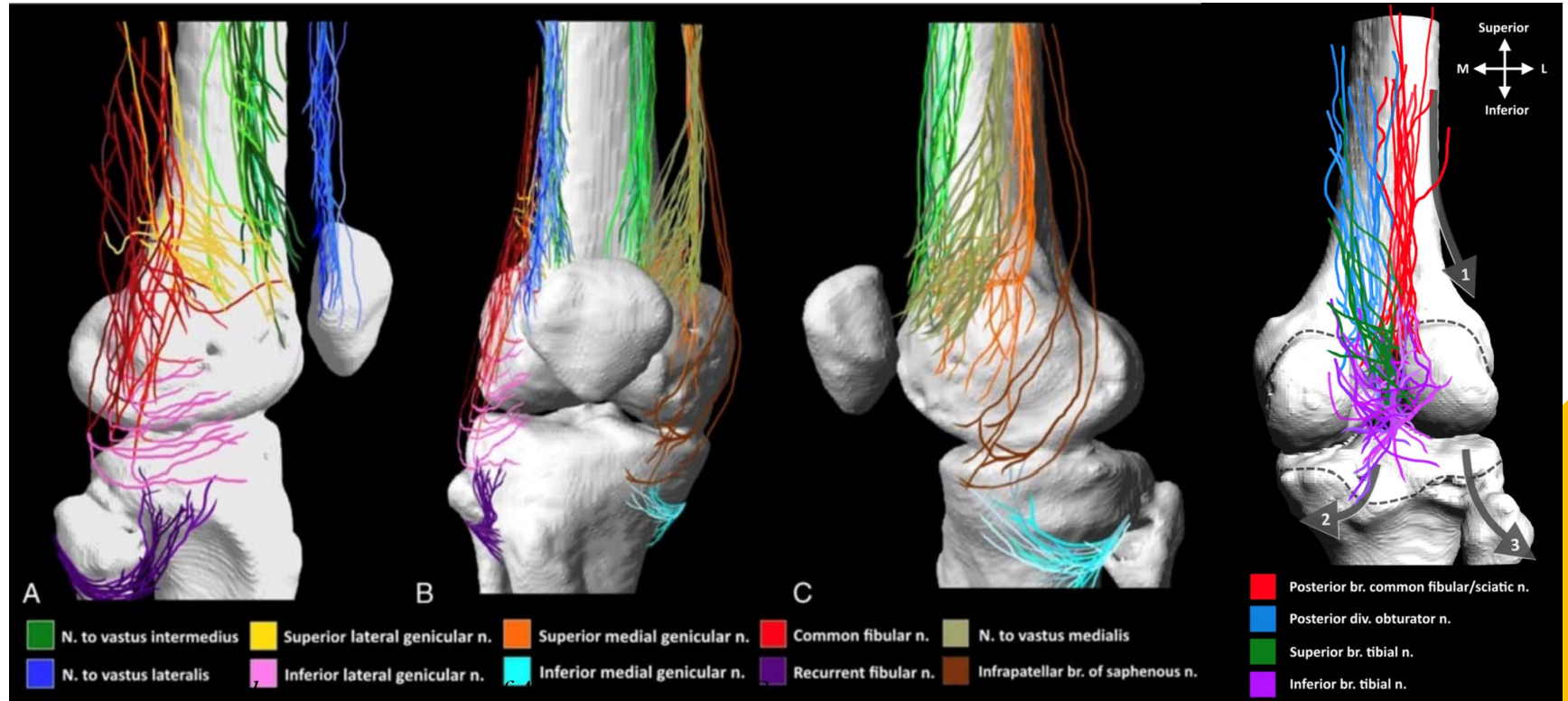
Medial Retinacular Nerve (vastus medialis nerve)

Infrapatellar branch of Saphenous Nerve (Femoral N.)

POSTERIOR COMPARTMENT

Genicular br. (Obturator Nerve, post. div.) } Popliteal Plexus

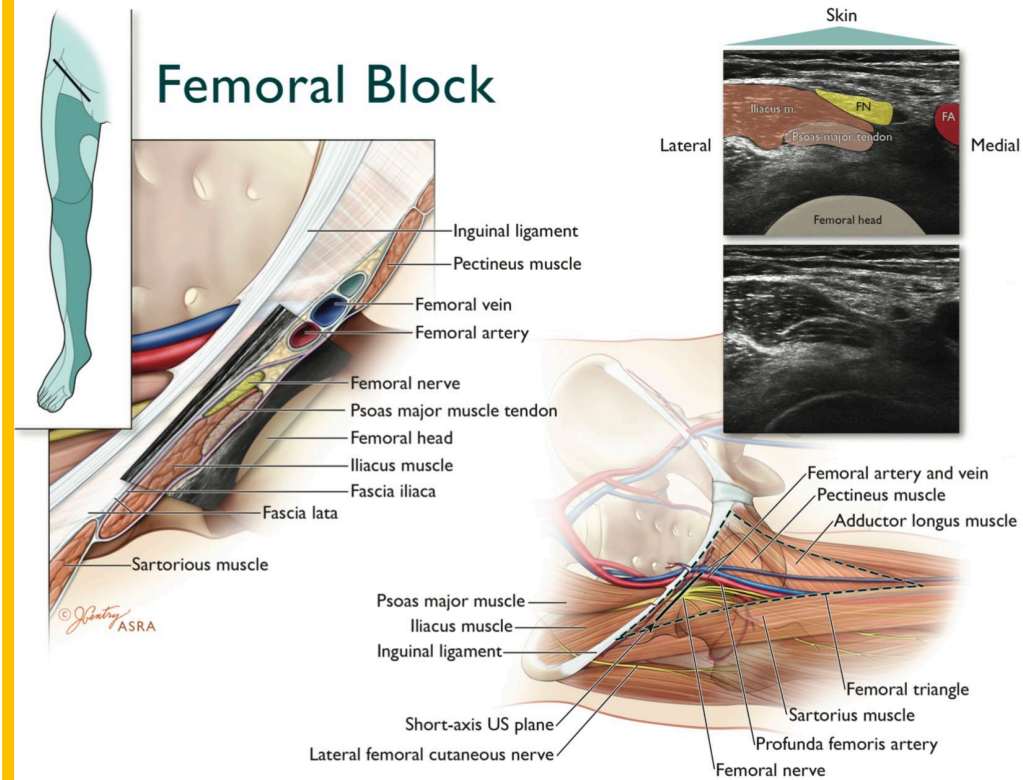
Sup, middle and inf geniculate br. (Tibial Nerve)



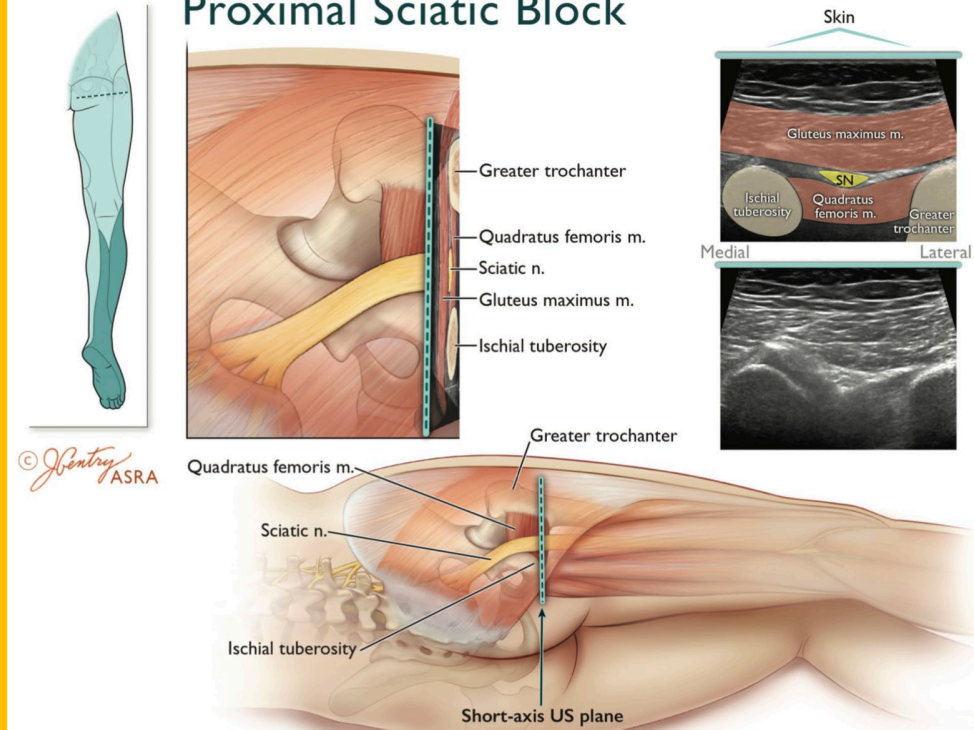
Anatomical Study of the Innervation of Anterior Knee Joint Capsule
 Tran et al. Reg Anesth Pain Med 2018;43: 407-414

PERIPHERAL NERVE BLOCKS (PNB)

Femoral Block



Proximal Sciatic Block



PERIPHERAL NERVE BLOCKS (PNB)

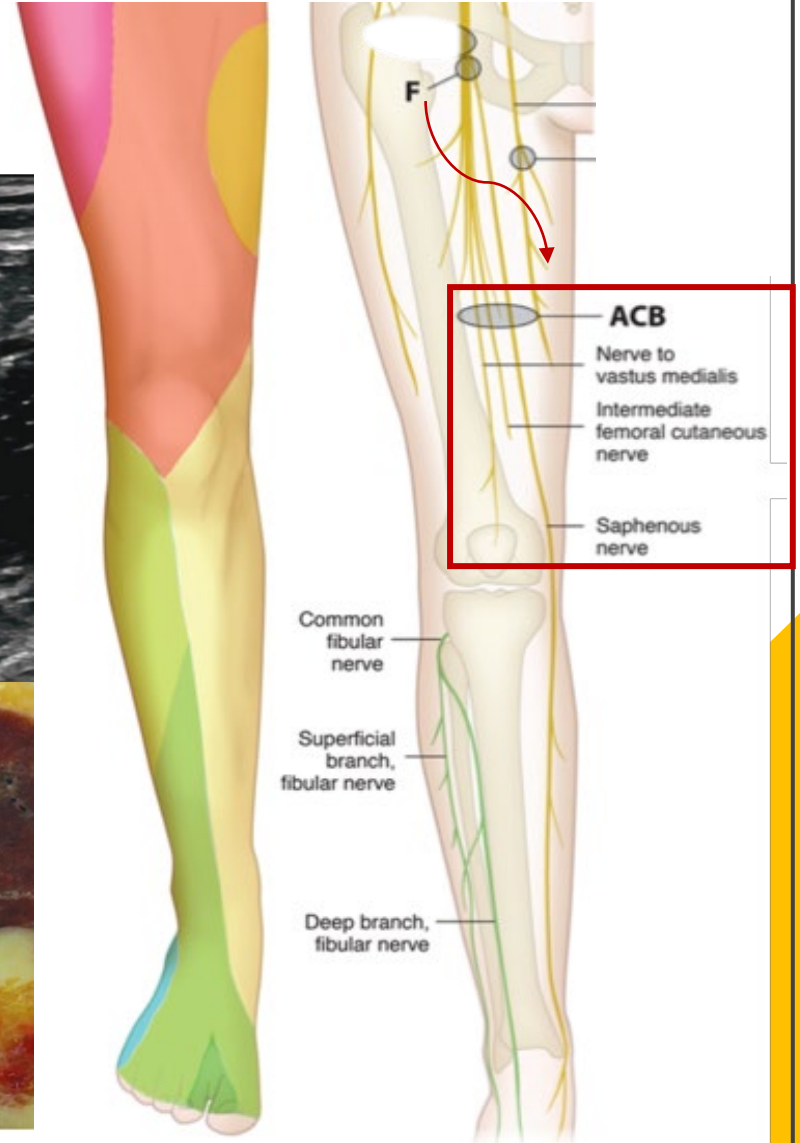
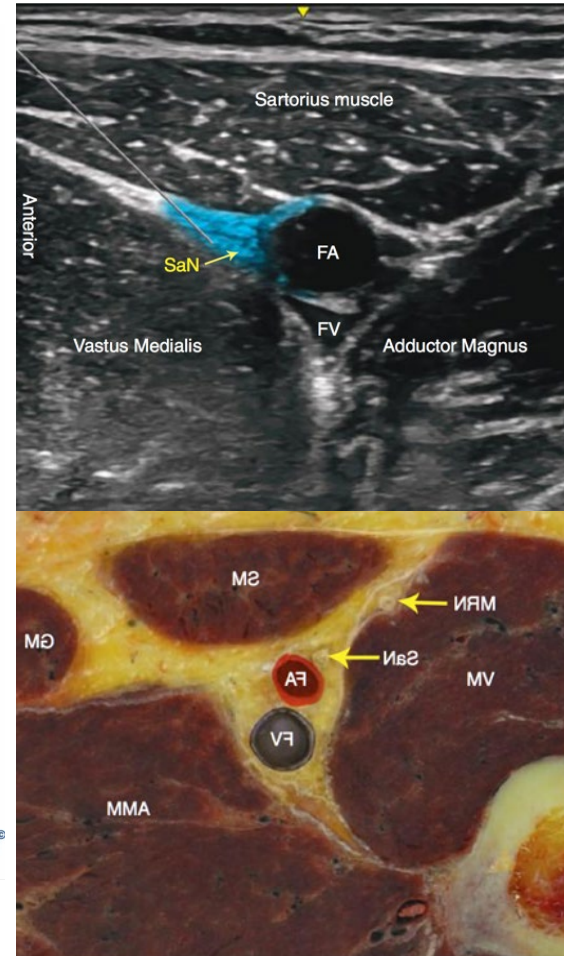
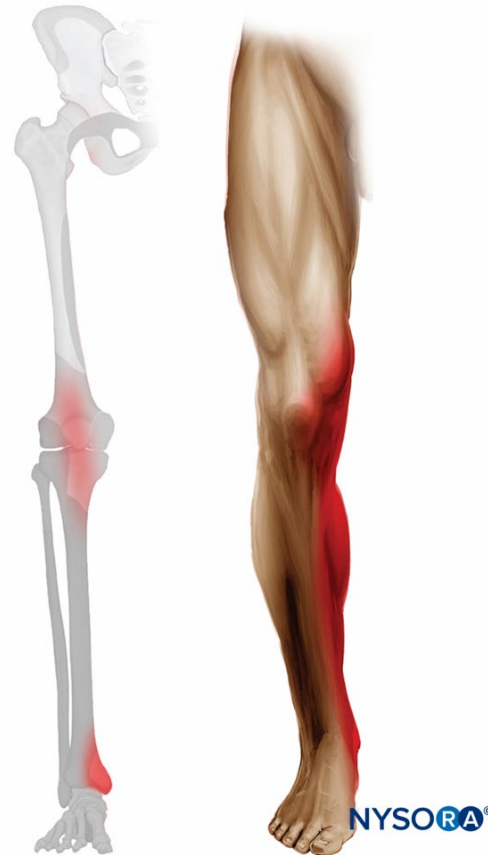


MOTOR
SPARING

OPIOID
SPARING



ADDUCTOR CANAL BLOCK



ADDUCTOR CANAL BLOCK

Adductor Canal Block versus Femoral Nerve Block for Total Knee Arthroplasty

A Prospective, Randomized, Controlled Trial

David H. Kim, M.D., Yi Lin, M.D., Ph.D., Enrique A. Goytizolo, M.D., Richard L. Kahn, M.D., Daniel B. Maalouf, M.D., M.P.H., Asha Manohar, M.D., Minda L. Patt, M.D., Amanda K. Goon, B.A., Yuo-yu Lee, M.S., Yan Ma, Ph.D., Jacques T. YaDeau, M.D., Ph.D.

Table 2. Joint Hypothesis Testing for Outcomes at Postanesthesia 6–8 h

Outcome at Postanesthesia 6–8 h	ACB N = 46	FNB N = 47	Noninferiority One-tailed Test			Superiority One-tailed Test	
			Difference		Difference		
			ACB-FNB (95% CI)*	Delta	P Value	ACB-FNB (98.3% CI)†	P Value (Holm–Bonferroni)
Dynamometer readings	7.3 ± 5.4 6.1 [3.5, 10.9]	2.2 ± 3.8 0.0 [0.0, 3.9]	5.2 (3.1, 7.2)	–3	<0.0001	5.2 (2.7, 7.7)	<0.0001
NRS pain scores at rest	1.7 ± 1.9 1.0 [0.0, 3.5]	0.9 ± 1.8 0.0 [0.0, 1.0]	0.75 (–0.06, 1.55)	1.6	0.019	0.75 (–0.24, 1.74)	0.9999
Opioids (oral opioids + PCA)	36.6 ± 17.9 32.2 [22.4, 47.5]	35.8 ± 20.7 26.6 [19.6, 49.0]	1.05 (0.83, 1.32)‡	1.5	0.0115	1.05 (0.79, 1.39)‡	0.9999

Results presented as mean ± SD, median [first, third quartiles]. Overall alpha is 0.025 for both noninferiority and superiority tests. Noninferiority was found on all three outcomes with the given deltas ($P < 0.025$) and superiority on dynamometer readings ($P < 0.008$).

* Noninferiority test is significant for dynamometer readings (NRS, opioids) if the lower (upper) confidence limit is greater (less) than delta. † Superiority test is significant for dynamometer readings (NRS) if lower (upper) confidence limit is greater (less) than zero; superiority test is significant for opioids use if the upper confidence limit is <1. ‡ Ratio of ACB/FNB.

ACB = adductor canal block; FNB = femoral nerve block; NRS = Numeric Rating Scale; PCA = patient-controlled analgesia.

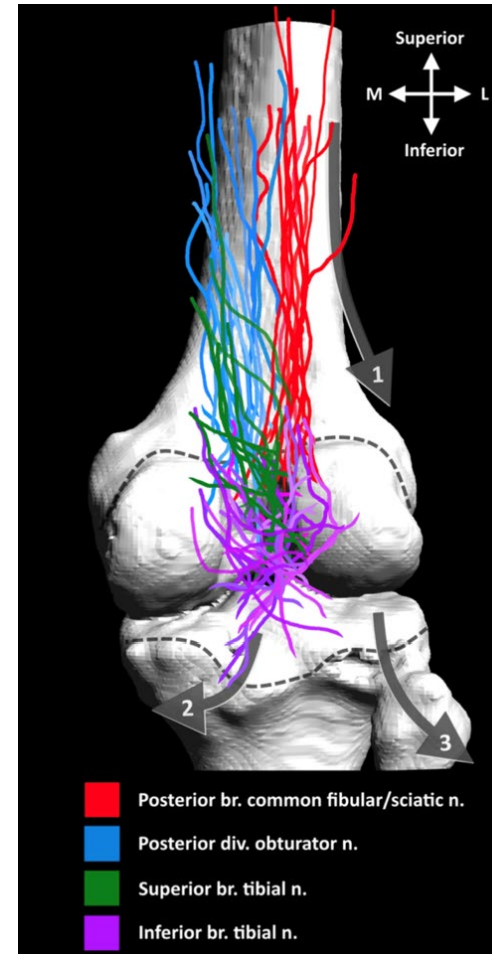
POSTERIOR CAPSULE INNERVATION

POSTERIOR COMPARTMENT

Genicular br.
(Obturator
Nerve, post. div.)

Popliteal
Plexus

Sup, middle and
inf geniculate br.
(Tibial Nerve)



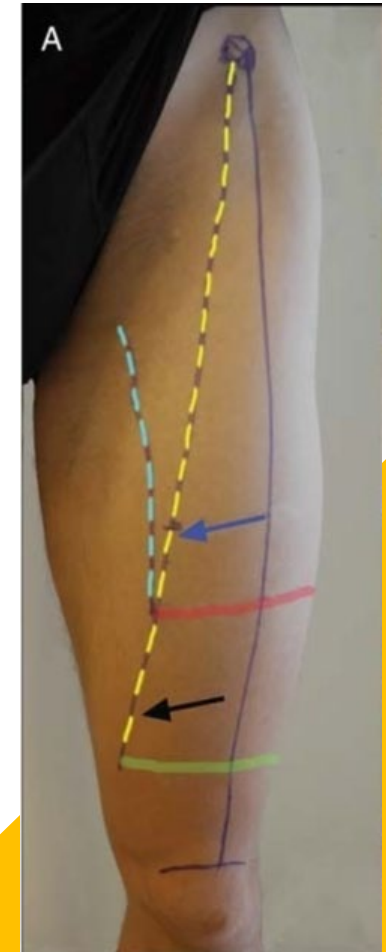
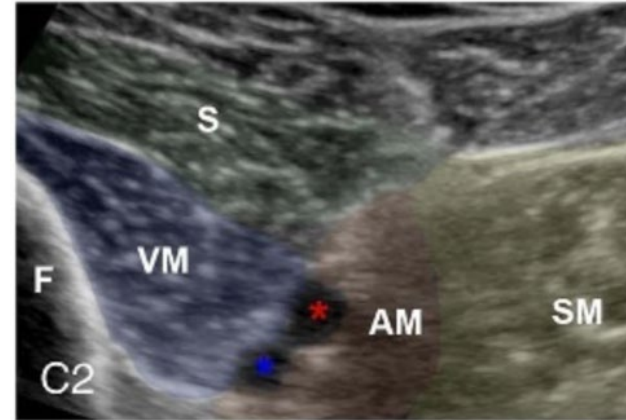
POSTERIOR CAPSULE: distal ACB

Defining the Location of the Adductor Canal Using Ultrasound

Wan Yi Wong, MMed, MBBS,* Siska Bjørn, MS,† Jennie Maria Christin Strid, MD,†
Jens Børglum, MD, PhD,‡ and Thomas Fichtner Bendtsen, MD, PhD†

Regional Anesthesia and Pain Medicine • Volume 42, Number 2, March-April 2017

important contributor to knee innervation. In addition, an injection of a small volume of local anesthetic into the distal part of the true AC can be speculated to spread into the popliteal fossa and anesthetize the posterior branch of the obturator nerve and the popliteal plexus, which provide intra-articular innervation of the knee.⁴ An injection of a large volume of local anesthetic into



Acta Anaesthesiol Scand. 2018 May 24. doi: 10.1111/aas.13145. [Epub ahead of print]

The analgesic effect of a popliteal plexus blockade after total knee arthroplasty: A feasibility study.

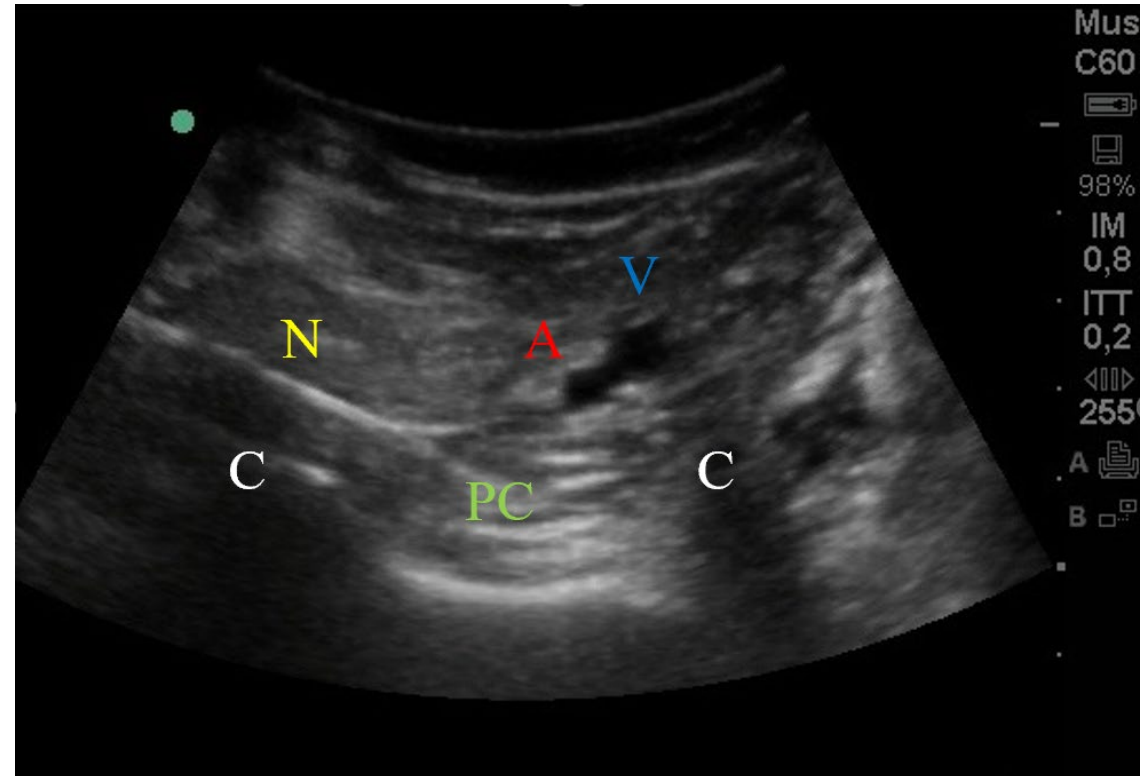
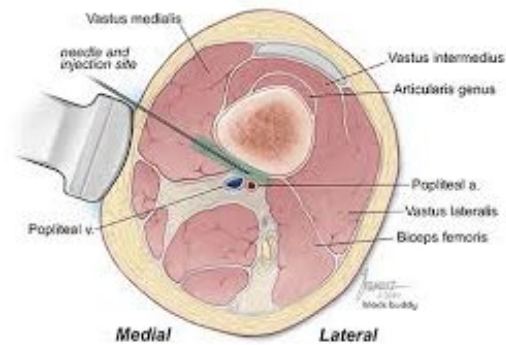
Runge C¹, Bjørn S², Jensen JM³, Nielsen ND¹, Vase M¹, Holm C¹, Bendtsen TF³.

RESULTS: Ten subjects with a median pain of NRS 5.5 (interquartile range [IQR] 4-8) after unilateral TKA received a PPB. All 10 subjects experienced a reduction in pain to NRS 3 or below (NRS 1.5 [IQR 0-3]) within a mean time of 8.5 (95% CI 6.8-10.2) minutes. Three subjects were completely pain free after the PPB. The ankle muscle strength was not affected.

CONCLUSIONS: The PPB provided effective pain relief without affecting the ankle muscle strength in all 10 subjects with significant pain after TKA and an FTB.

IPACK

Infiltration of the interspace between Popliteal Artery and posterior Capsule of the Knee

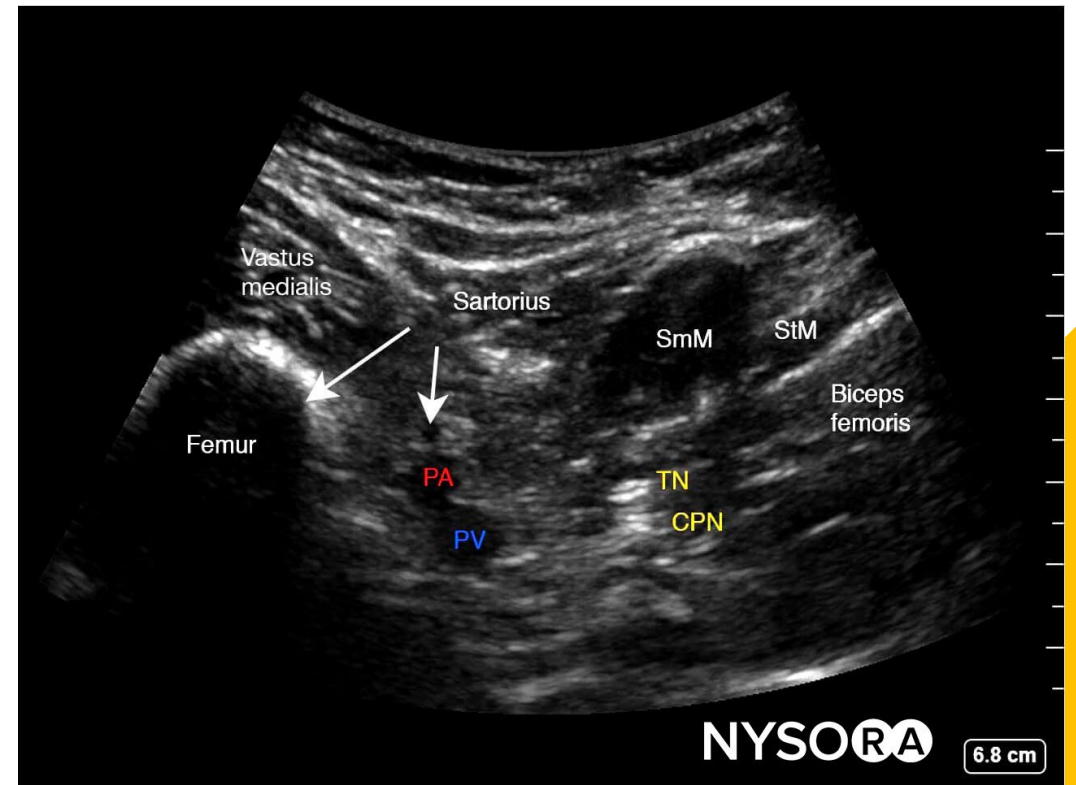


20-30 mL Ropivacaine 0.2-0.3% between
Popliteal Artery and posterior Capsule of the Knee

N: Needle; A: Popliteal Artery; V: Popliteal Vein;
C: Femoral Condyles; PC: Posterior Capsule

IPACK

Infiltration of the interspace between Popliteal Artery and posterior Capsule of the Knee



Comparison of adductor canal block and IPACK block (interspace between the popliteal artery and the capsule of the posterior knee) with adductor canal block alone after total knee arthroplasty: a prospective control trial on pain and knee function in immediate postoperative period.

Sankineani SR¹, Reddy ARC², Eachempati KK³, Jangale A¹, Gurava Reddy AV¹.

Table 1 The patient characteristics of both groups

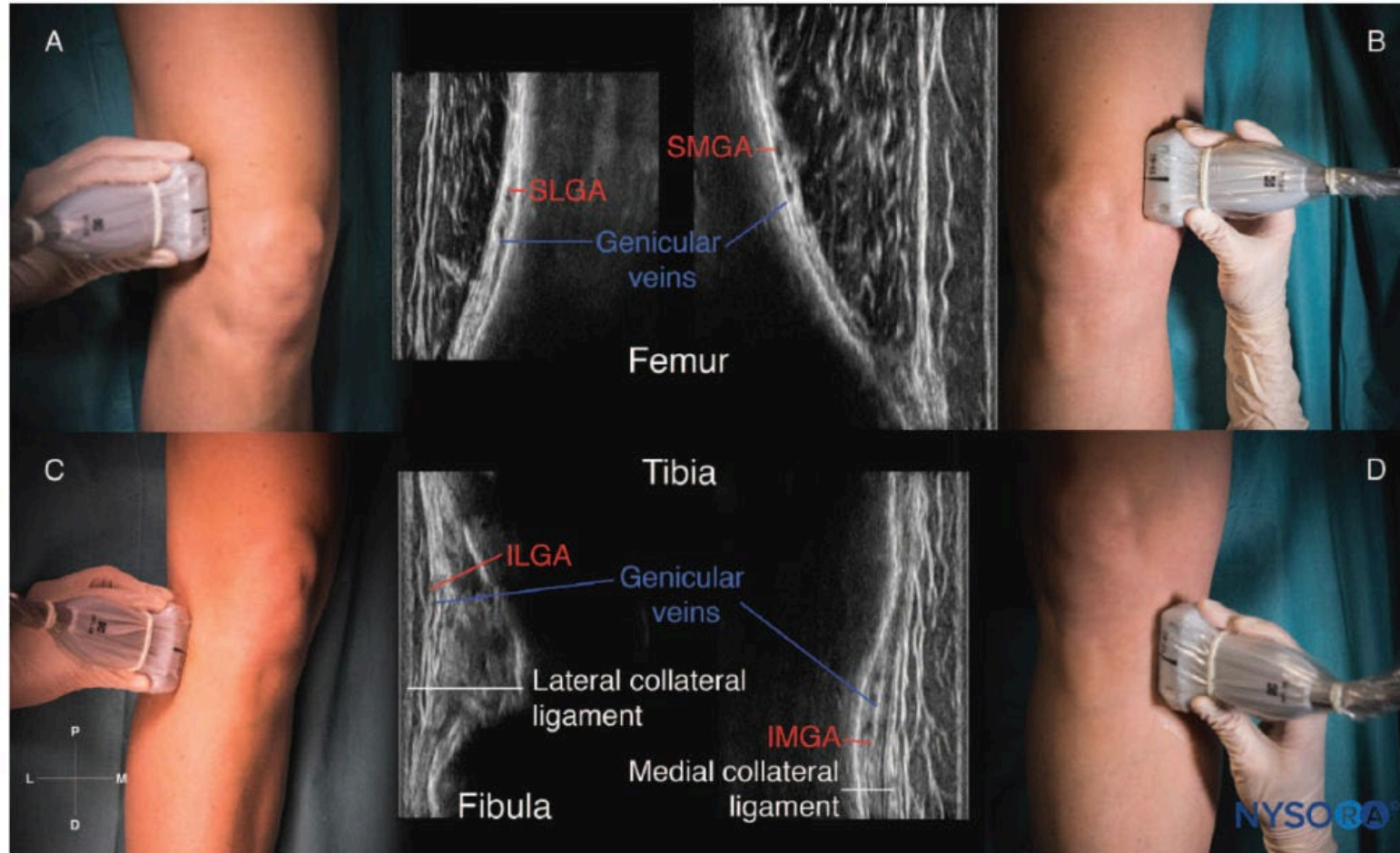
Patient characteristics	Group 1	Group 2
Age	60	61
Sex (male/female)	38/22	42/18
Height (cm)	163	159
Weight (Kg)	78	73
Duration of surgery (min)	68	66

In conclusion, ACB + IPACK is a promising technique that offers improved pain management in the immediate postoperative period without effecting the motor function around the knee joint resulting in better ROM and

Table 2 The comparison of postoperative VAS scores and distance walked between both the groups

Variable	Adductor canal block + IPACK (Group 1, n = 60)	Adductor canal (Group 2, n = 60)	P value
VAS 8 h PO	1.4333 ± 0.6474	2.9167 ± 0.64550	< 0.001
VAS POD 1	2.05 ± 0.4323	3.1833 ± 0.72467	< 0.001
VAS POD 2	2.55 ± 0.7274	3.4500 ± 0.67460	< 0.001
ROM (°)	71.8333 ± 9.52	62.2500 ± 8.25	< 0.001
Distance walked day 3 (no. of steps)	8.51 ± 1.85	7.1333 ± 1.434	< 0.001

GENICULAR NERVE BLOCKS



Randomized Controlled Trial > [Reg Anesth Pain Med](#). 2021 Oct;46(10):862-866.

doi: 10.1136/rapm-2021-102667. Epub 2021 Jul 14.

Ultrasound-guided genicular nerve blocks following total knee arthroplasty: a randomized, double-blind, placebo-controlled trial

Milly Rambhia ¹, An Chen ¹, Amanda H Kumar ², W Michael Bullock ², Michael Bolognesi ³, Jeffrey Gadsden ⁴

Affiliations + expand

PMID: 34261807 DOI: [10.1136/rapm-2021-102667](#)

Results: Forty (40) subjects were enrolled. Opioid consumption at 24 hours was significantly lower in the BLOCK group compared with the SHAM group (23 ± 20 vs 58 ± 35 , $p < 0.001$), and this difference remained significant at 48 hours (50 ± 40 vs 98 ± 56 , $p = 0.004$). Pain scores were reduced in the BLOCK group at time 6 hours (2.6 ± 1.9 vs 4.3 ± 2.2 , $p = 0.012$), but were otherwise similar at remaining time points. Patient satisfaction at 24 hours and 20 m walk test times were similar between groups.

GENICULAR NERVE BLOCKS

Randomized Controlled Trial

> [J Arthroplasty. 2023 Sep;38\(9\) 1734-1741.e2.](#)

doi: 10.1016/j.arth.2023.03.018. Epub 2023 Mar 15.

Comparison of Analgesic Efficacies of the iPACK (Interspace Between the Popliteal Artery and Capsule of the Posterior Knee) and Genicular Nerve Blocks Used in Combination With the Continuous Adductor Canal Block After Total Knee Arthroplasty: A Randomized Clinical Trial

[Wirinaree Kampitak](#)¹, [Wannida Kertkiatkachorn](#)¹, [Srihatach Ngarmukos](#)²,
[Aree Tanavalee](#)², [Chotetawan Tanavalee](#)², [Chonruethai Tangkittithaworn](#)¹

Affiliations + expand

PMID: 36931354

DOI: [10.1016/j.arth.2023.03.018](#)

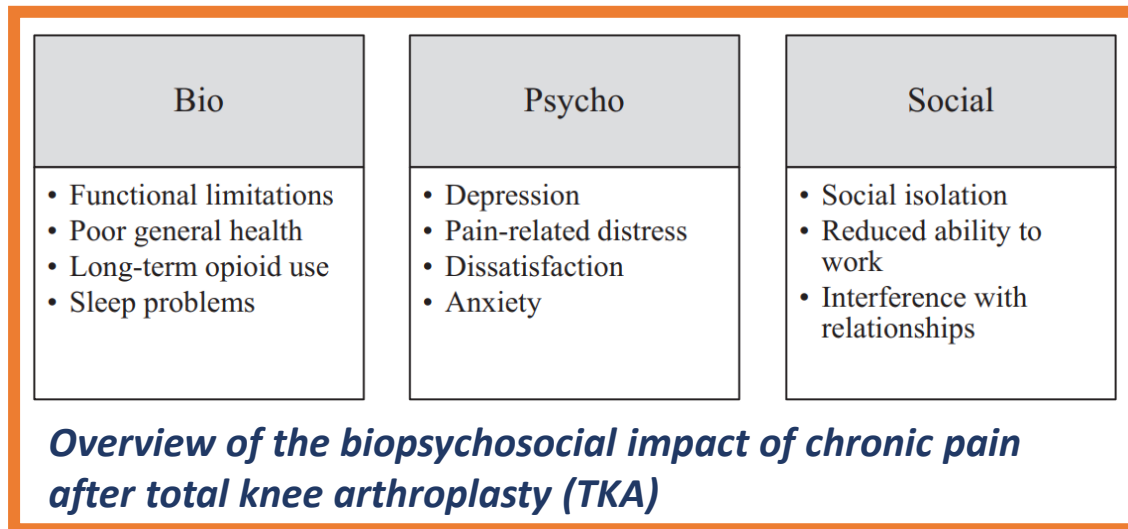
Conclusion: The iPACK-GNB combination relieved pain during movement better than the iPACK block alone during the 8 hours postoperatively after total knee arthroplasty in setting of multimodal analgesia such as adductor canal block.

UNHAPPY KNEE PROTESIS

Painful knee arthroplasties



Almost **20% Chronic pain**

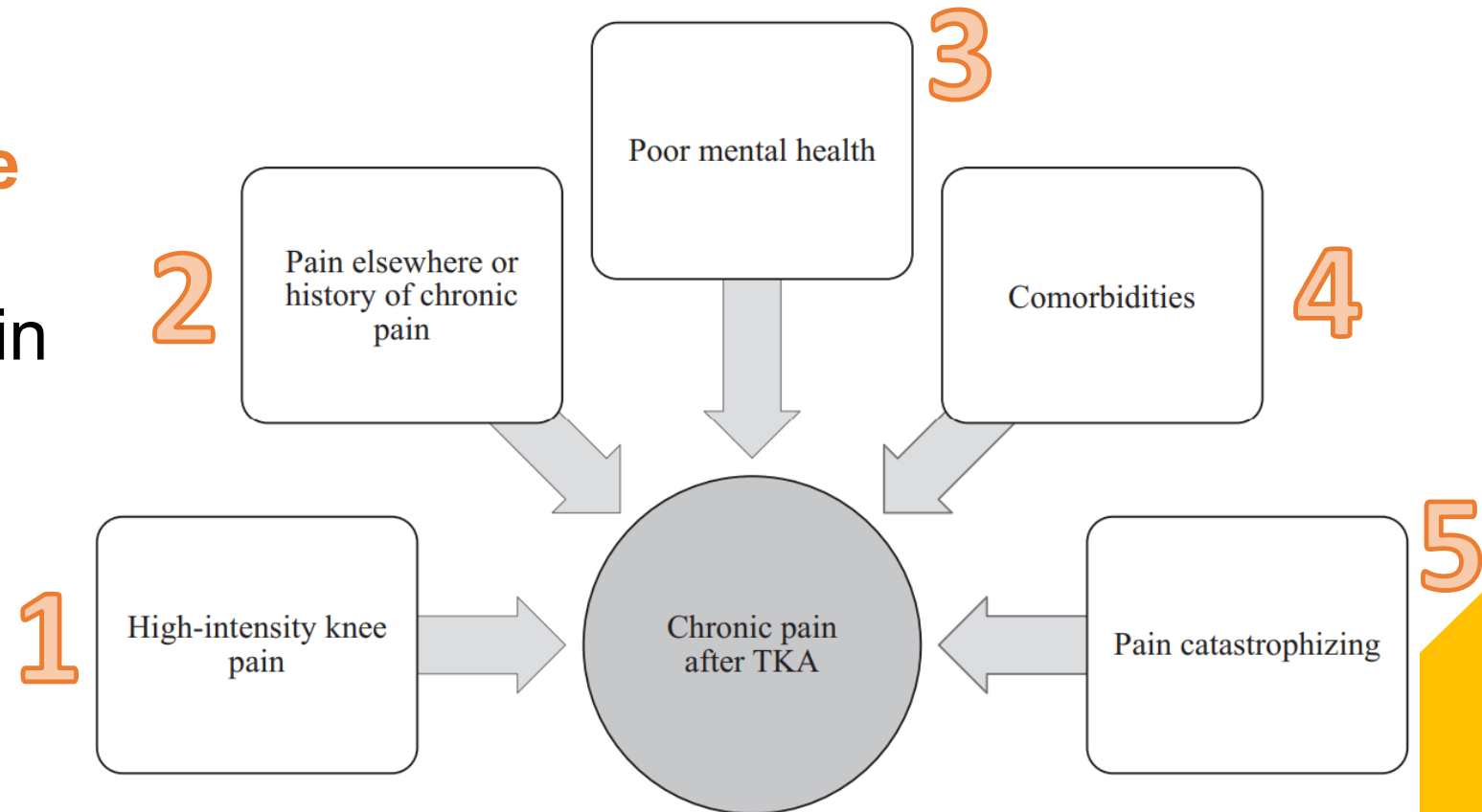


Biological and surgical factors contributing to chronic pain after total knee arthroplasty

Factor	Examples
Biological 67,68,83-89,112	Sensitizing impact of long-term pain from osteoarthritis Complex Regional Pain Syndrome Pain originating from the hip Patellofemoral pain Allergy-related problem Inflammatory response
Surgical 83-89	Infection Localized nerve injury Prosthetic loosening Malalignment Malrotation Incorrect sizing Instability Stiffness

UNHAPPY KNEE PROTESIS

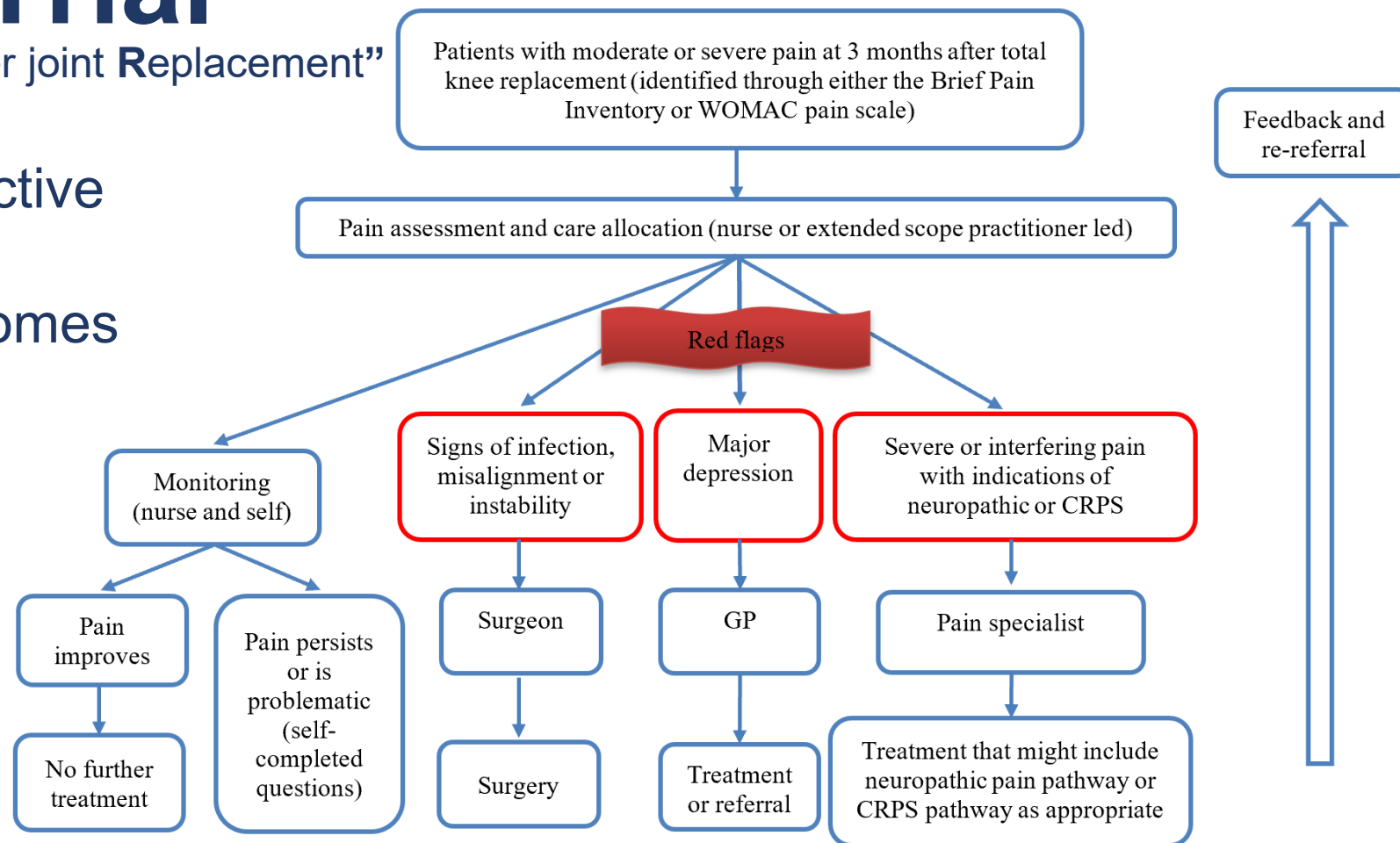
**Preoperative
risk factors
for chronic pain
after TKA**



«STAR» Trial

“Support and Treatment After joint Replacement”

Clinically/cost-effective
intervention to
improve pain outcomes



GENICULAR NERVE RF

Safety and Efficacy of Genicular Nerve Radiofrequency Ablation for Management of Painful Total Knee Replacement: A Systematic Review

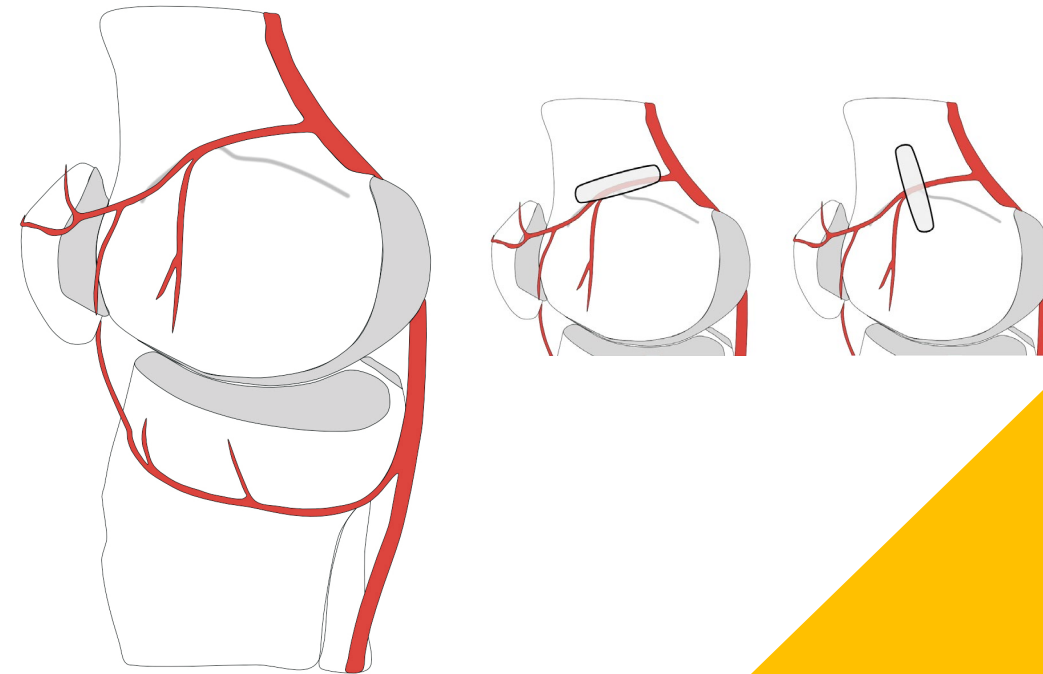
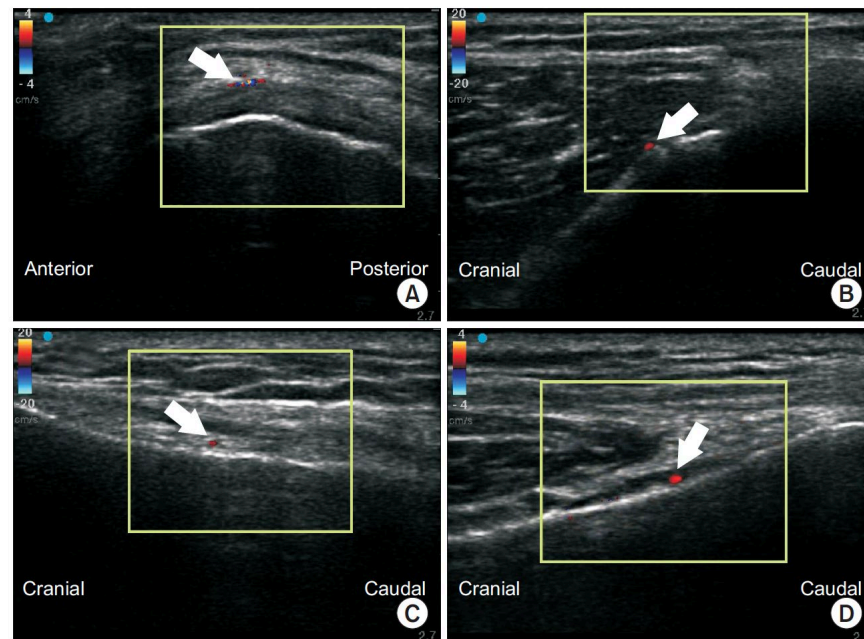
Naga Cheppalli ¹, Amit W Bhandarkar ², Senthil Sambandham ³, Solomon F Oloyede ¹

Affiliations + expand

PMID: 34912630 PMCID: [PMC8665972](https://pubmed.ncbi.nlm.nih.gov/34912630/) DOI: [10.7759/cureus.19489](https://doi.org/10.7759/cureus.19489)

RFA

- Temporary and partial pain relief (50%)
- Can last ≥ 3 months
- No significant complications



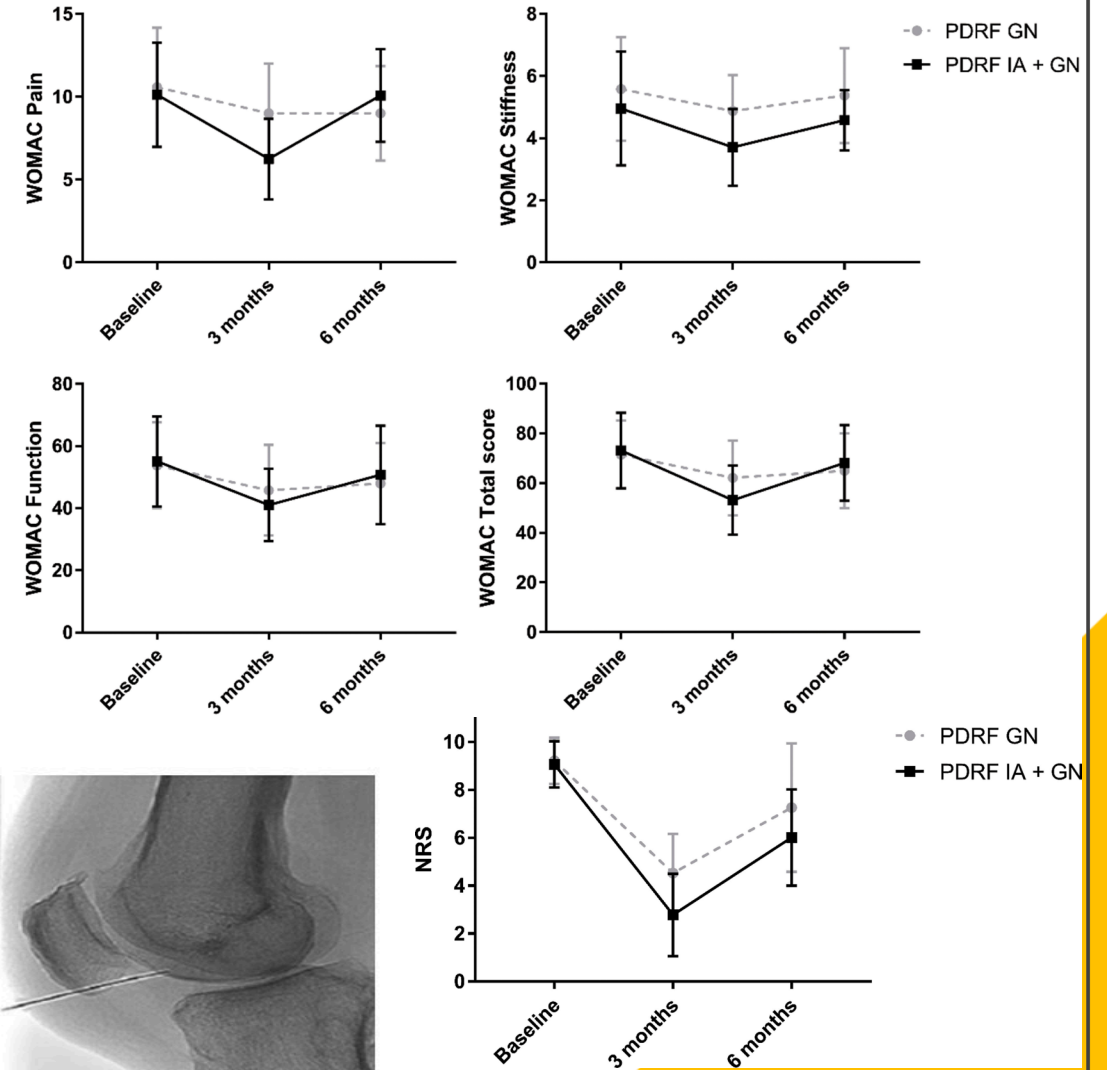
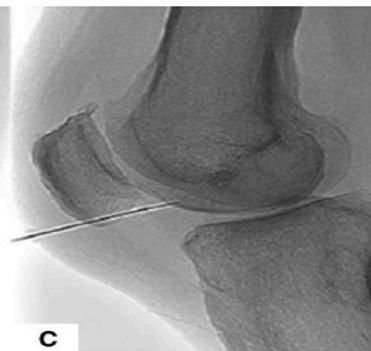
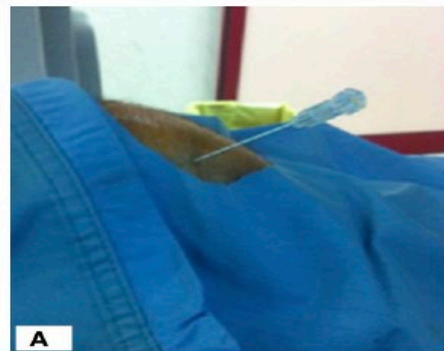
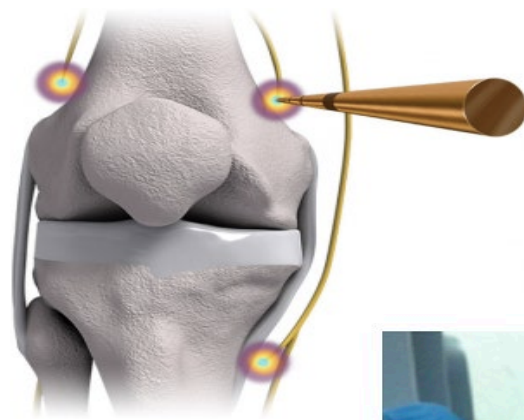
Pulsed Radiofrequency

Journal of Pain Research

Dove Press

Genicular Nerve Pulsed Dose Radiofrequency (PDRF) Compared to Intra-Articular and Genicular Nerve PDRF in Knee Osteoarthritis Pain: A Propensity Score-Matched Analysis

Matteo Luigi Giuseppe Leoni, Michael E Schatman, [...], and Gaetano Terranova



Neurostimulation for Postsurgical Analgesia: A novel system enabling USG pPNS

ORIGINAL ARTICLE

Neurostimulation for Postsurgical Analgesia: A Novel System Enabling Ultrasound-Guided Percutaneous Peripheral Nerve Stimulation

Brian M. Ilfeld, MD, MS (Clinical Investigation)*; Stuart A. Grant, MB, CH.B[†];
Christopher A. Gilmore, MD^{‡,§,¶}; John Chae, MD, ME^{*,†,‡,§,¶}; Richard D.
Wilson, MD, MS^{*,†,‡,§,¶}; Amorn Wongsarnpigoon, PhD[¶]; Joseph W. Boggs, PhD^{¶¶}

Pain Practice, Volume 17, Issue 7, 2017 892–901(Case Series)

- 5 pts TKA, Persistent Pain after Surgery, Femoral and Sciatic Nerves pPNS
- **50% immediate pain relief**
- At rest by **63%**
- During passive ROM by **14%**
- During active ROM by **50%**

Ilfeld et al. *Journal of Orthopaedic Surgery and Research* (2017) 12:4
DOI 10.1186/s13018-016-0506-7

Journal of Orthopaedic
Surgery and Research

TECHNICAL NOTE

Open Access

Ultrasound-guided percutaneous peripheral nerve stimulation for analgesia following total knee arthroplasty: a prospective feasibility study



Brian M. Ilfeld^{1*}, Christopher A. Gilmore^{2,3,4}, Stuart A. Grant⁵, Michael P. Bolognesi⁶, Daniel JJ Del Gaizo⁷,
Amorn Wongsarnpigoon⁸ and Joseph W. Boggs⁸

Journal of Orthopaedic Surgery and Research (2017) 12:4(Case Series)

- 5 pts TKA, 5-58 days postoperatively, Femoral and Sciatic Nerves pPNS
- PNS decreased rest pain of **93%** at rest
- **27%** at passive ROM
- **30%** at active ROM

Helically coiled monopolarinsulated electrical leads (MicroLead, SPR Therapeutics) connected to an external pulse stimulator used for 1–2 h

pfNS/PNS

in Chronic Pain after TKA

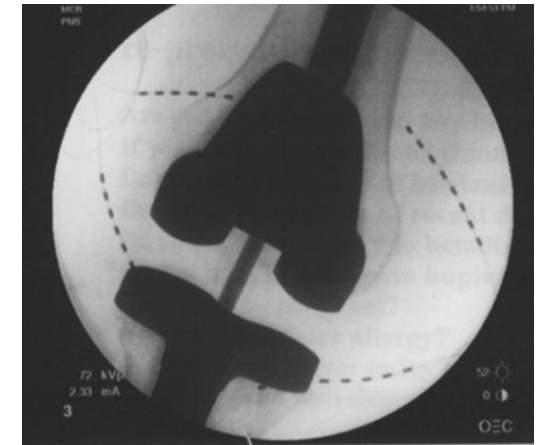
Received: February 25, 2009 First revision: June 1, 2009 Accepted: August 18, 2009.

(www.interscience.wiley.com) DOI: 10.1111/j.1525-1403.2009.00255.x

Novel approach for peripheral subcutaneous field stimulation for the treatment of severe, chronic knee joint pain after total knee arthroplasty

William Porter McRoberts, MD, Martin Roche, MD

- **subcutaneous stimulator** infrapatellar branch of the saphenous nerve
- **SUCCESSFUL** pain relief over a 2 years follow-up period



DRG Stimulation Post-Joint Surgery of the Knee

Neuromodulation of the Dorsal Root Ganglion for Chronic Postsurgical Pain

Pain Medicine, 20, 2019, S41–S48
doi: 10.1093/pm/pnz072
Review Article



Ajay B. Antony, MD,* B. Carsten Schultheis, MD, PhD,[†] Suneil M. Jolly, MD,[‡] Daniel Bates, MD,[§] Corey W. Hunter, MD,[¶] and Robert M. Levy, MD, PhD^{||}

*University of Florida College of Medicine, Gainesville, Florida, USA; [†]Krankenhaus Neuwerk “Maria von den Aposteln,” Mönchengladbach, Germany; [‡]Louisiana Pain Specialists, New Orleans, Louisiana, USA; [§]Metro Pain Group, Victoria, Australia; [¶]Ainsworth Institute of Pain Management, New York, New York; ^{||}Institute for Neuromodulation, Boca Raton, Florida, USA

Pain Physician 2018; 21:E377-E387 • ISSN 2150-1149

Prospective Study

Dorsal Root Ganglion Stimulation (DRGS) for the Treatment of Chronic Neuropathic Pain: A Single-Center Study with Long-Term Prospective Results in 62 Cases

Matthias H. Morgalla, MD, Marcos Fortunato, MD, Guilherme Lepski, MD, and Bankim S. Chander, MS



DRG stimulation for postoperative knee pain
→ reduction of VAS was

69%

Conservative Treatment-Unhappies Knee arthroplasties



EXERCISE

Strengthens knee and its surrounding muscles while increasing flexibility and mobility

WEIGHT LOSS

Reduces stress of bodyweight on the knee, decreasing pain and bone-on-bone contact

BIOMECHANICAL AIDS

Provide support and stability to the knee, allowing for increased activity levels



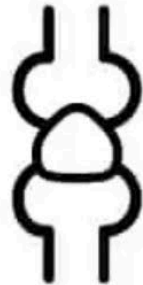
PHYSIOTHERAPY

After knee replacement

Recovery times depend on



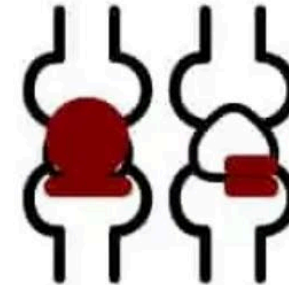
ETÀ



QUALITÀ
OSSEA



STATO DI SALUTE
GENERALE



TIPO DI PROTESI
USATA

PHASES OF FUNCTIONAL RECOVERY

Phase 1 Pain control

Phase 2 Recovery of range motion

Phase 3 Recovery of strength

Phase 4 Recovery of coordination

Phase 5 Recovery of the gesture



PHASES OF FUNCTIONAL RECOVERY

Phase 1 Recovery of range of motion

Modality: interventional physiatry and physical therapies

Phase 2 Recovery of range motion

Phase 3 Recovery of strength

Phase 4 Recovery of coordination

Phase 5 Recovery of the gesture



Setting: medical clinic and gym

PHASES OF FUNCTIONAL RECOVERY

Phase 1 Pain control

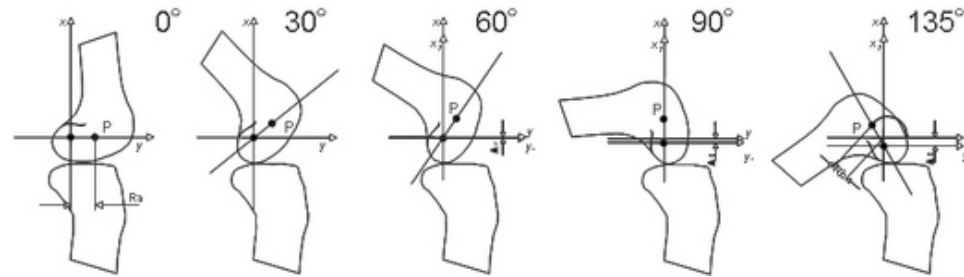
Phase 2 Recovery of range motion

Phase 3 Recovery of strength

Phase 4 Recovery of coordination

Phase 5 Recovery of the gesture

Modalities: joint mobilizations and physiotherapy



Setting: medical clinic and rehabilitation gym

PHASES OF FUNCTIONAL RECOVERY

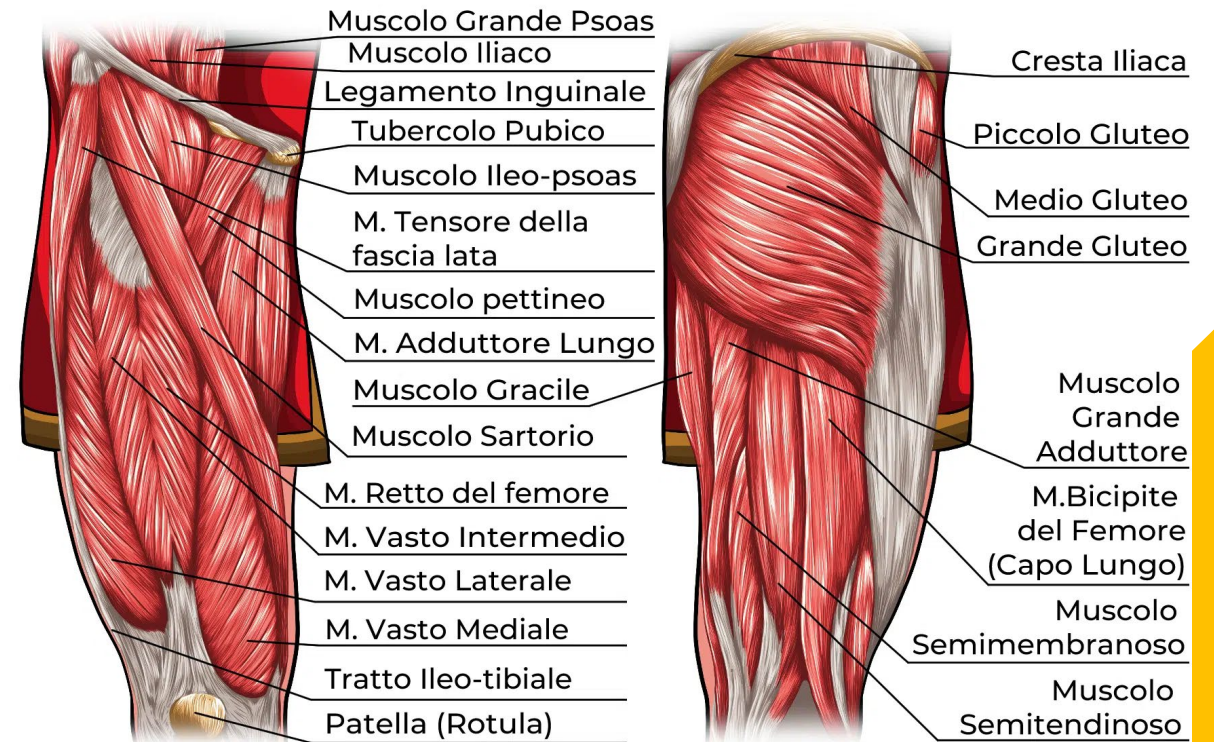
Phase 1 Pain control

Phase 2 Recovery of range motion

Phase 3 Recovery of strength

Phase 4 Recovery of coordination

Phase 5 Recovery of the gesture



PHASES OF FUNCTIONAL RECOVERY

Phase 1 Pain control

Phase 2 Recovery of range motion

Phase 3 Recovery of strength

Phase 4 Recovery of coordination

Phase 5 Recovery of the gesture

Method: rehabilitation techniques



Setting: gym and rehabilitation pool

PHASES OF FUNCTIONAL RECOVERY

Phase 1 Pain control

Phase 2 Recovery of range motion

Phase 3 Recovery of strength

Phase 4 Recovery of coordination

Phase 5 Recovery of the gesture

Method: rehabilitation and occupational techniques



Setting: gym and rehabilitation pool

Vi ringrazio per l'attenzione

- Paolo Grossi MD
- Director
- Dept of Anesthesia,
Intensive Care and Pain Treatment



Centro Specialistico Ortopedico Traumatologico
Gaetano Pini-CTO

Sistema Socio Sanitario



Regione
Lombardia

ASST Gaetano Pini



State of the Art Safety Standards in RA
THE EUROPEAN SOCIETY OF REGIONAL
ANAESTHESIA & PAIN THERAPY



European Society of
Regional Anaesthesia
& Pain Therapy

ESRA ITALIA

