Non-CME Webinar Series
designed with the trainee in mind

first Tuesday of the month

Brought to you by ASRA | ASRA Pain Medicine Education Research & THE ASSOCIATION OF PAIN PROGRAM DIRECTORS
ADVANCING EDUCATION IN MULTIDISCIPLINARY PAIN MEDICINE

The Basics – Epidural Injections – Radiofrequency Ablations:

Peripheral Joints

Max Eckmann, M.D.

Ramamurthy Endowed Professor and Vice Chair of Clinical Research

UT Health San Antonio, Department of Anesthesiology

President, Texas Pain Society

Tuesday, November 2, 2021

7-8:30 pm ET

Faculty Disclosure

	Nothing to disclose
	Yes, as follows: X

Honoraria/Expenses	
Consulting/Advisory Board	AVANOS, Abbot
Speakers Bureau	
Funded Research (Individual)	
Funded Research (Institution)	SPR Therapeutics, Medtronic, Abbot, Boston Scientific
Royalties/Patent	
Stock Options	
Ownership/Equity Position	iKare MTRC, Ellipsas
Employee	UT Health San Antonio
Other	Co-Chair ASRA CME Committee, Chair ASA Pain Education Track, President Texas Pain Society

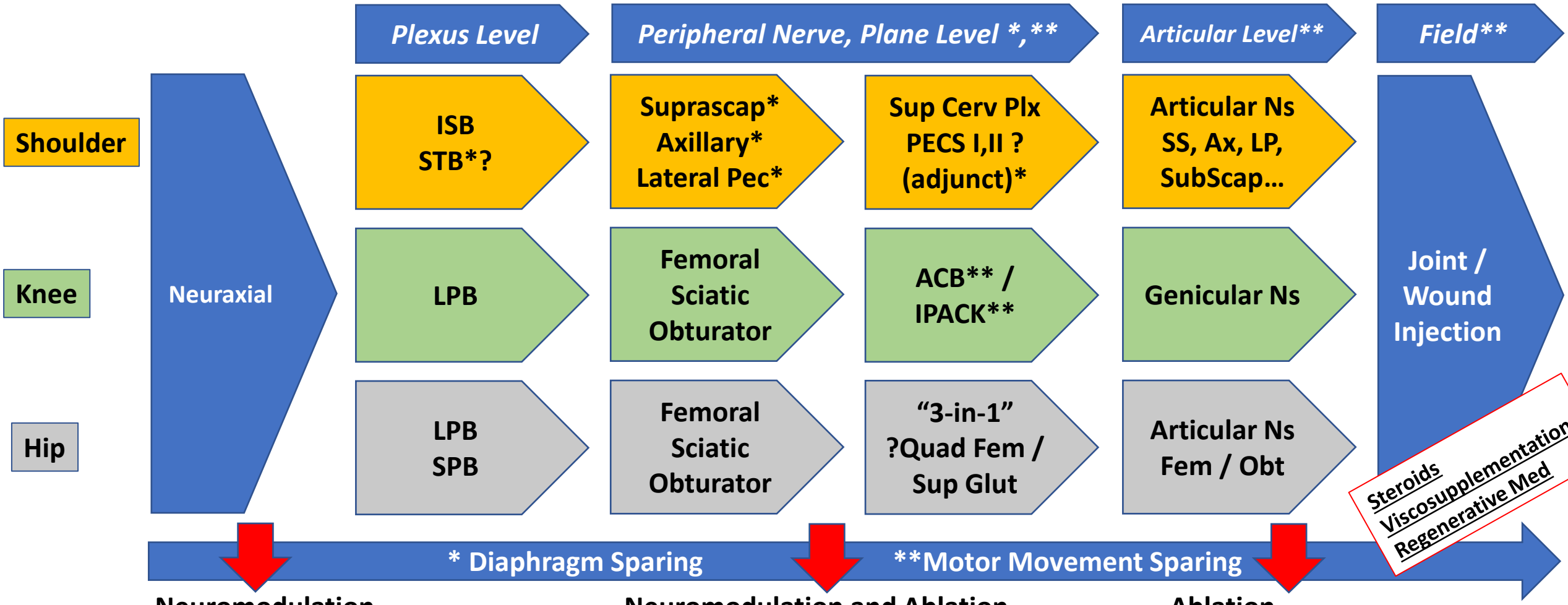
Objectives

- Evaluate available quantitative neuroanatomy of the shoulder, knee, hip.

- Highlight the importance of preclinical and translational research in the development of peripheral nerve ablation and stimulation.

Chronic Pain Applications

ISB (interscalene block); STB (superior trunk block);
LPB (lumbar plexus block); ACB (adductor canal block);
LFCN (lateral femoral cutaneous nerve); IPACK (infiltration between popliteal artery and capsule of knee); PECS (pectoralis block)



Neuromodulation

- *Spinal Cord Stimulation*
- *Dorsal Root Ganglion Stimulation*
- *Intrathecal Drug Delivery*
- *Deep Brain Stimulation*

Neuromodulation and Ablation

- *Pulsed Radiofrequency Ablation (RFA)*
- *Standard and Cooled RFA (SRFA, CRFA)*
- *Cryoablation, Chemoneurolysis*
- *Peripheral Nerve Stimulation*

Ablation

- *Genicular*
- *Fem/Obt*
- *? Shoulder articular*
- **Field/ Cutaneous Stimulation**

Non-CME Webinar Series
designed with the trainee in mind

first Tuesday of the month

Brought to you by ASRA & THE ASSOCIATION OF PAIN PROGRAM DIRECTORS
ADVANCING EDUCATION IN MULTIDISCIPLINARY PAIN MEDICINE

Genicular Nerve Ablation for Chronic Knee Pain

Genicular Ablation Evolution

2011

Radiofrequency treatment relieves chronic knee osteoarthritis pain: A double-blind randomized controlled trial

Woo-Jong Choi [a], Seung-Jun Hwang [b], Jun-Gol Song [a], Jeong-Gil Leem [a], Yong-Up Kang [c], Pyong-Jin-Woo Shin [a,*]

Pain Medicine 2011; 12: 546–551
Wiley Periodicals, Inc.

Percutaneous Radiofrequency Treatment for Refractory Anteromedial Pain of Osteoarthritic Knees

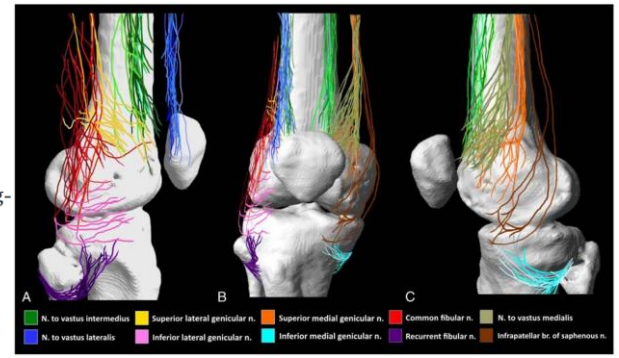
Masahiko Ikeuchi, MD, PhD,* Takahiro Ushida, MD, PhD,*† Masashi Izumi, MD,* and Toshikazu Tani, MD, PhD*

Anatomical Study of the Innervation of Anterior Knee Joint Capsule

Implication for Image-Guided Intervention

John Tran, HBSc, Philip W.H. Peng, MBBS,† Karen Lam, MD,† Ehtesham Baig, MD,† Anne M.R. Agur, PhD,* and Michael Gofeld, MD†*

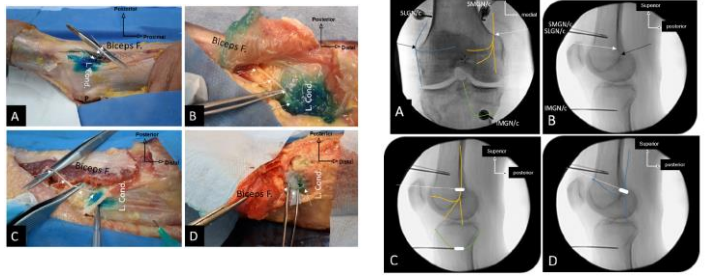
2018



Accuracy of fluoroscopic-guided genicular nerve blockade: a need for revisiting anatomical landmarks

Loïc Fonkoue,[1,2] Catherine Wydemans Behets,[1] Arnaud Steyaert,[3,4] Jean-Eric Kouame Kouassi,[2] Christine Detrembleur,[2] Bernard Le Polain De Waroux,[3] Olivier Cornu[2,5]

2019

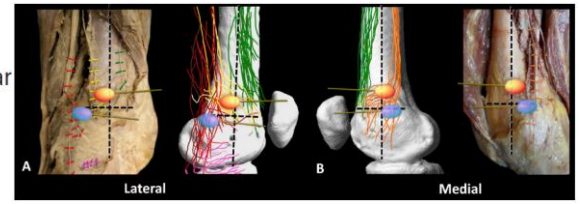


2020

Revisiting the anatomical evidence supporting the classical landmark of genicular

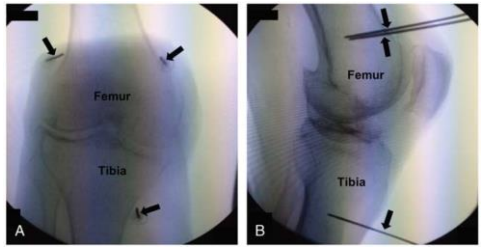
John Tran,[1] Anne Agur,[1] Philip Peng[2]

To the Editor



Prospective, Multicenter, Randomized, Crossover Clinical Trial Comparing the Safety and Effectiveness of Cooled Radiofrequency Ablation With Corticosteroid Injection in the Management of Knee Pain From Osteoarthritis

Tim Davis, MD, Eric Loudermilk, MD,† Michael DePalma, MD,‡ Corey Hunter, MD,§ David Lindley, DO,|| Nilesh Patel, MD,** Daniel Choi, MD,†† Marc Soloman, MD,‡‡ Anita Gupta, DO, PharmD,§§ Mehul Desai, MD,|||| Asokumar Buvanendran, MD,*** and Leonardo Kapural, MD, PhD†††*



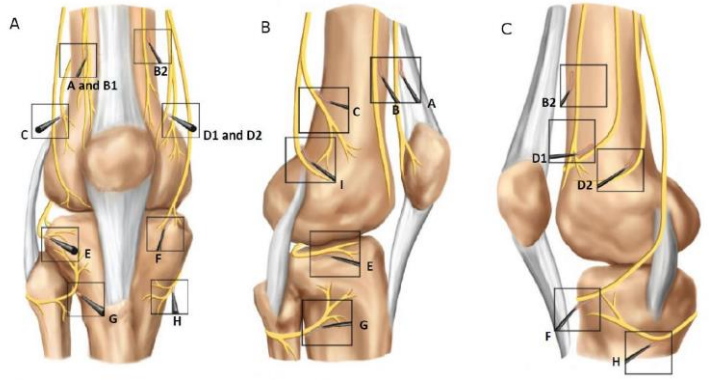
Cooled Radiofrequency Ablation Treatment of the Genicular Nerves in the Treatment of Osteoarthritic Knee Pain: 18- and 24-Month Results

2021

Corey Hunter, MD*; Tim Davis, MD†; Eric Loudermilk, MD‡; Leonardo Kapural, MD§; Michael DePalma, MD¶

Technical considerations for genicular nerve radiofrequency ablation: optimizing outcomes

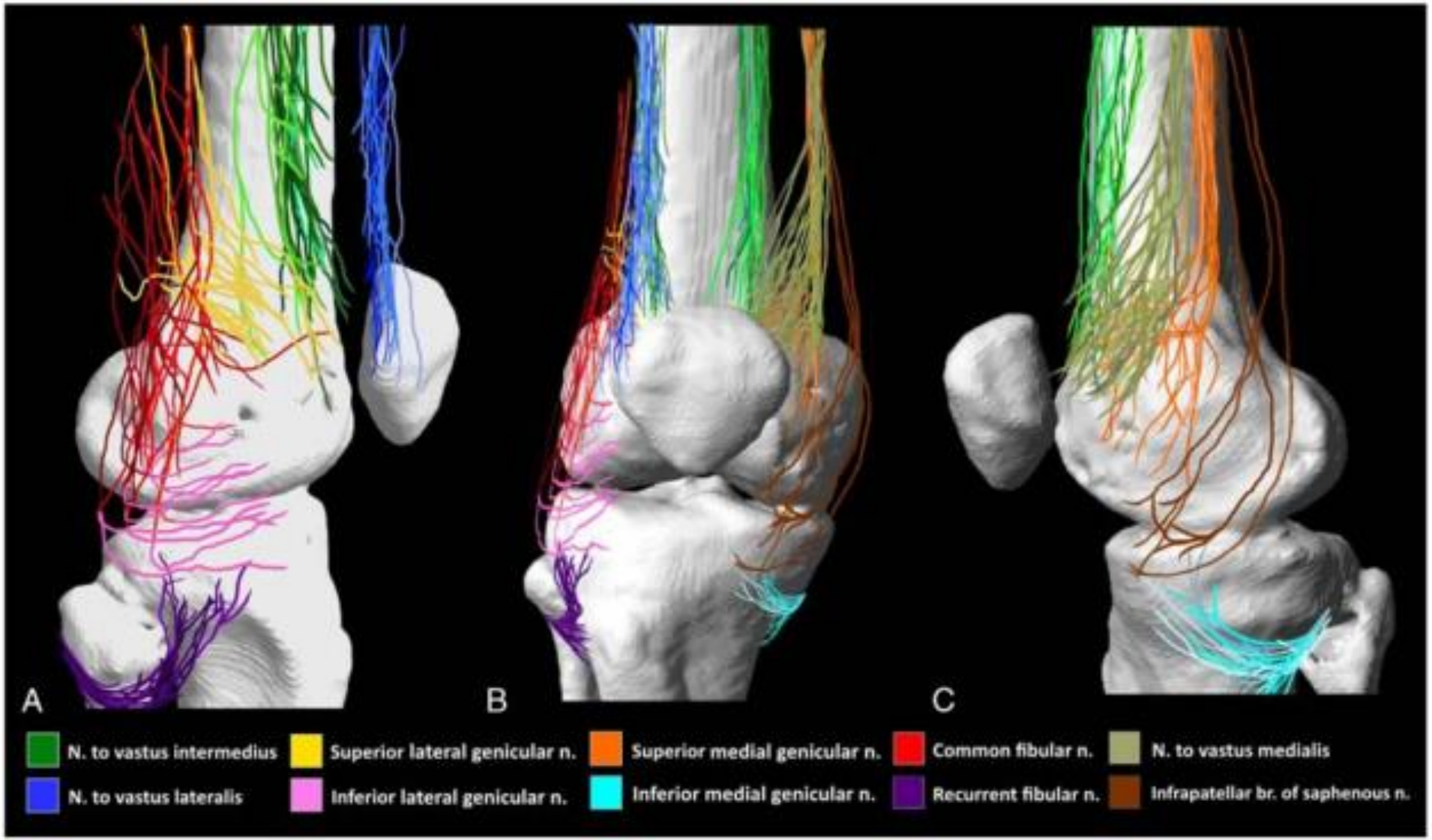
Zachary L McCormick,[1] Steven P Cohen,[2] David R Walega,[3] Lynn Kohan[4]



Anatomical Study of the Innervation of Anterior Knee Joint Capsule

Implication for Image-Guided Intervention

John Tran, HBSc, Philip W.H. Peng, MBBS,† Karen Lam, MD,† Ehtesham Baig, MD,† Anne M.R. Agur, PhD,* and Michael Gofeld, MD†*

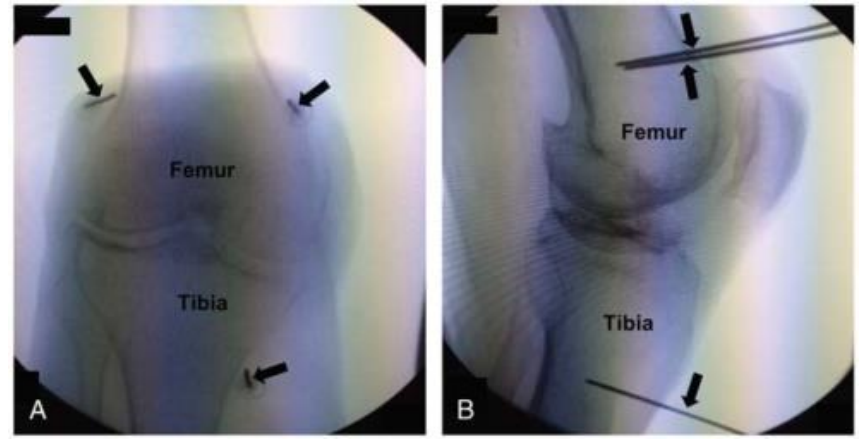


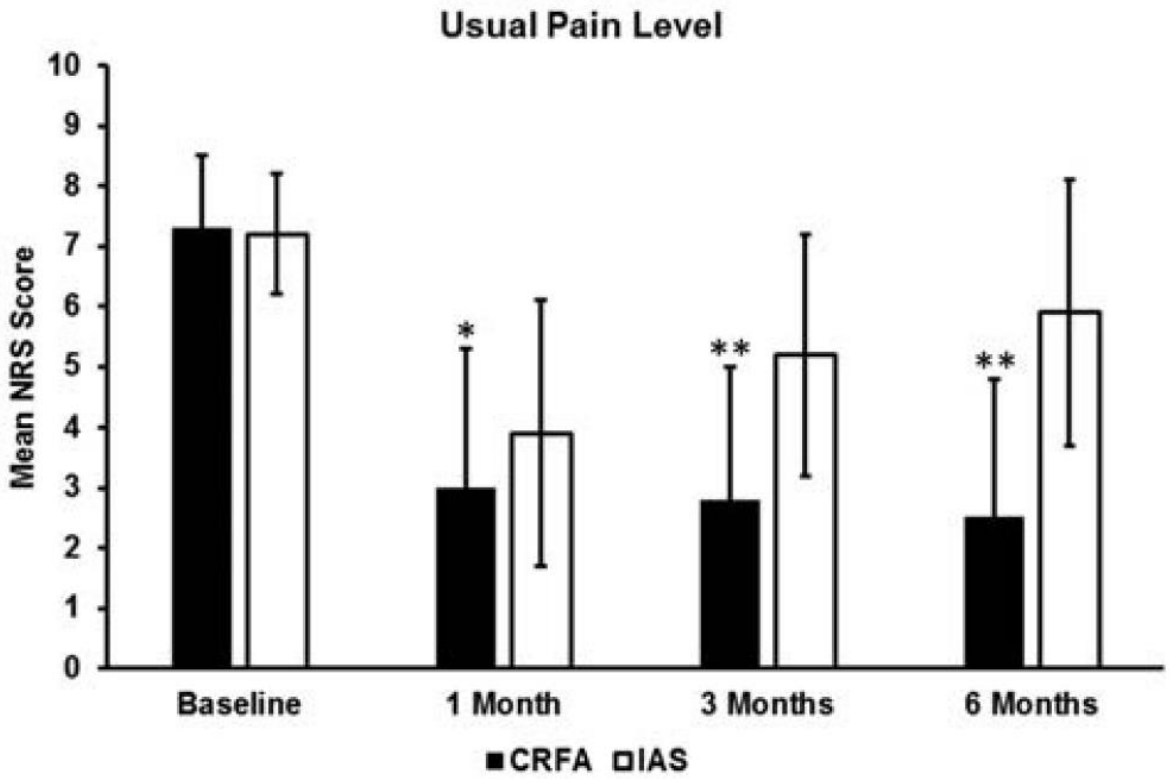
Response:

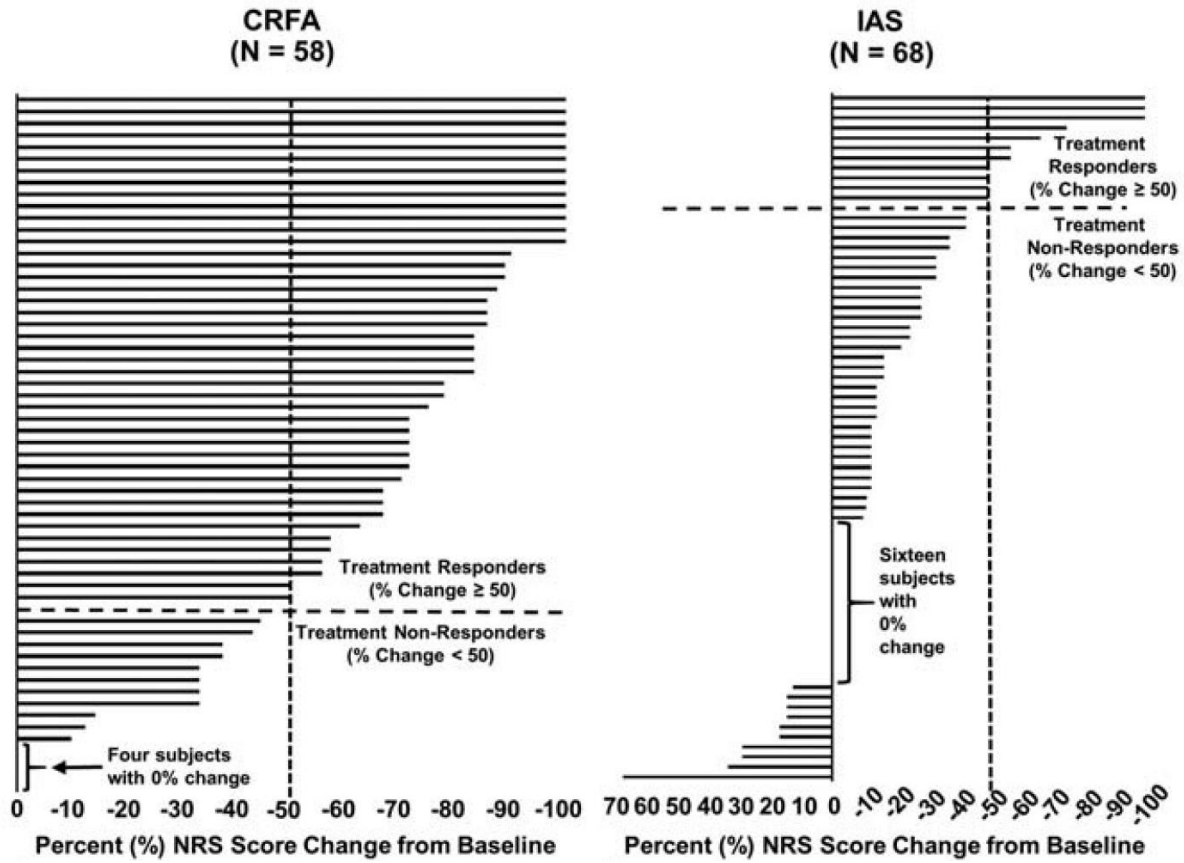
Conger A, Cushman DM, Walker K, Petersen R, Walega DR, Kendall R, McCormick ZL. A Novel Technical Protocol for Improved Capture of the Genicular Nerves by Radiofrequency Ablation. Pain Med. 2019 Nov 1;20(11):2208-2212.

Prospective, Multicenter, Randomized, Crossover Clinical Trial Comparing the Safety and Effectiveness of Cooled Radiofrequency Ablation With Corticosteroid Injection in the Management of Knee Pain From Osteoarthritis

Tim Davis, MD, Eric Loudermilk, MD,† Michael DePalma, MD,‡ Corey Hunter, MD,§ David Lindley, DO,|| Nilesh Patel, MD,** Daniel Choi, MD,†† Marc Soloman, MD,‡‡ Anita Gupta, DO, PharmD,§§ Mehul Desai, MD,|||| Asokumar Buvanendran, MD,*** and Leonardo Kapural, MD, PhD†††*







Radiofrequency techniques to treat chronic knee pain: a comprehensive review of anatomy, effectiveness, treatment parameters, and patient selection

David E Jamison[1,2]
Steven P Cohen[1–6]

Predictors of success
Medial compartment osteoarthritis and concordant pain
Large and/or multiple lesions
Controlled prognostic blocks

Predictors of failure
Greater disease burden (eg, longer duration of symptoms, greater disability)
Previous surgery
Opioid use
Psychopathology
Diffuse pain symptomatology (fibromyalgianess)

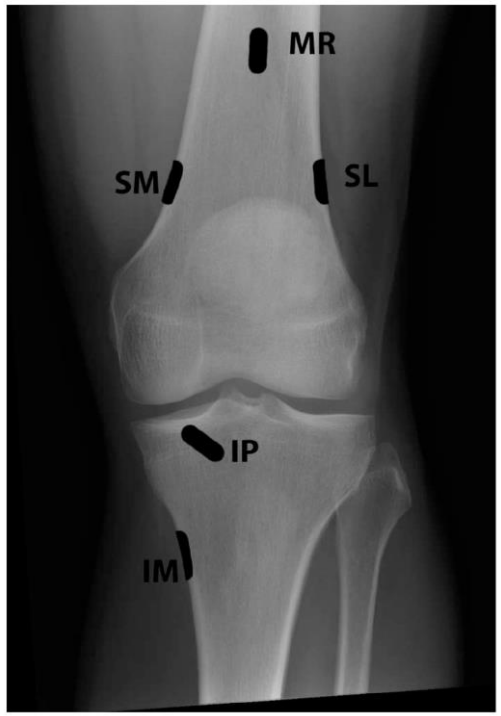


Figure 1 Anterior-posterior radiograph of the knee depicting locations for genicular nerve targeting.
Abbreviations: IM, inferomedial; IP, infrapatellar; MR, medial retinacular; SL, superolateral; SM, superomedial.

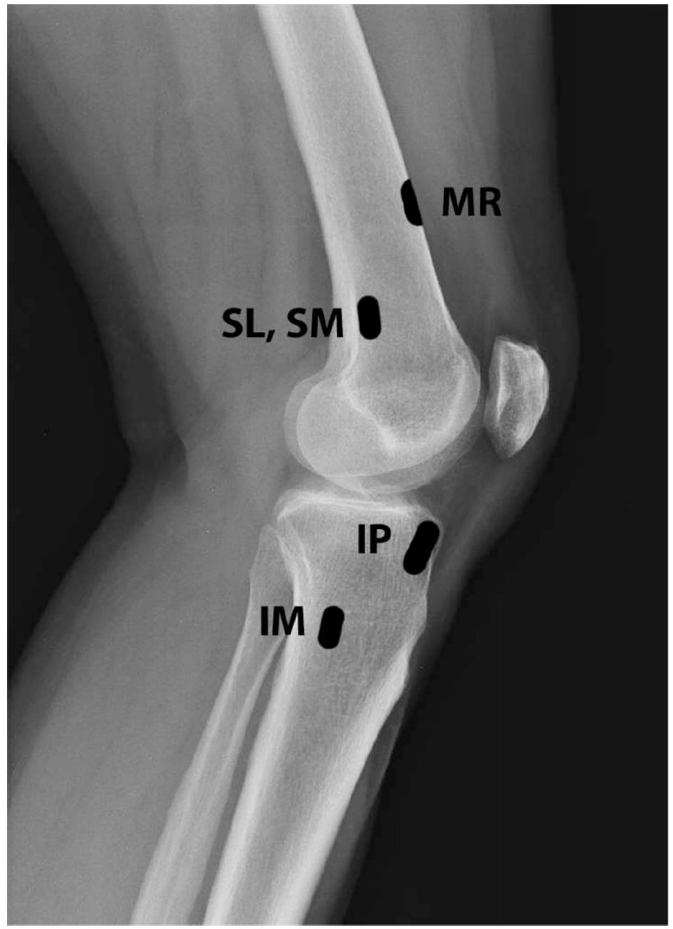


Figure 2 Lateral radiograph of the knee depicting locations for genicular nerve targeting.
Abbreviations: IM, inferomedial; IP, infrapatellar; MR, medial retinacular; SL, superolateral; SM, superomedial.

Prognostic Blocks?

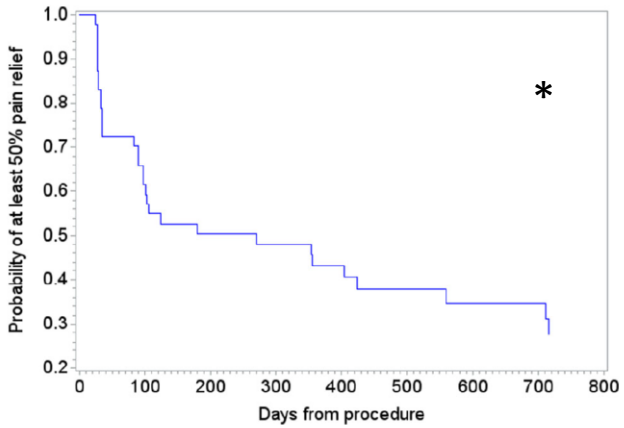
- **A Prospective Randomized Trial of Prognostic Genicular Nerve Blocks to Determine the Predictive Value for the Outcome of Cooled Radiofrequency Ablation for Chronic Knee Pain Due to Osteoarthritis.**
- McCormick ZL[1], Reddy R[2], Korn M[3], Dayanim D[4], Syed RH[5], Bhave M[6], Zhukalin M[7], Choxi S[8], Ebrahimi A[9], Kendall MC[10], McCarthy RJ[3], Khan D[3], Nagpal G[3], Bouffard K[4], Walega DR[3].

29 subjects -> Prognostic Block* -> CRFA	=	58.6% pain responders**
25 subjects -> NO BLOCK -> CRFA	=	64.0% pain responders

* Block volume 1 ml

**Responder Rate - ≥ 50% pain relief at 6 months; WOMAC Osteoarthritis Index responders also 55 and 60% respectively

- Articular sensory nerves emerge from several branches the femoral, sciatic obturator N[1,2,3].
- Two early randomized, sham controlled RCT's of RFA showed responders of up to 12 weeks.
- CRFA has been studied; a prospective study demonstrated 19% chance of complete pain relief, as well as a 35% chance of minimum clinically important difference:
  - "improved" global perceived effect, >= 50% NRS pain improvement, and avoidance of surgery[4].
- Genicular CRFA compares favorably to corticosteroid injection in providing a higher responder rate at 6 and 12 months with better functional improvement from OA[5,6].
  - CRFA – 74% response at 1 yr; IAS 16% at 1 yr
- Cryoneurolysis may also out-perform sham control for up to 90 days[7].
- PRP may outperform viscosupplementation with Hyaluronic Acid[8].
- Pre-operative ablation did not appear to improve pain outcomes after TKA[9].
- Long term outcomes of CRFA in extended study reported to 24 months[10*].
  - Reflects 33 included, of 83 screened subjects.



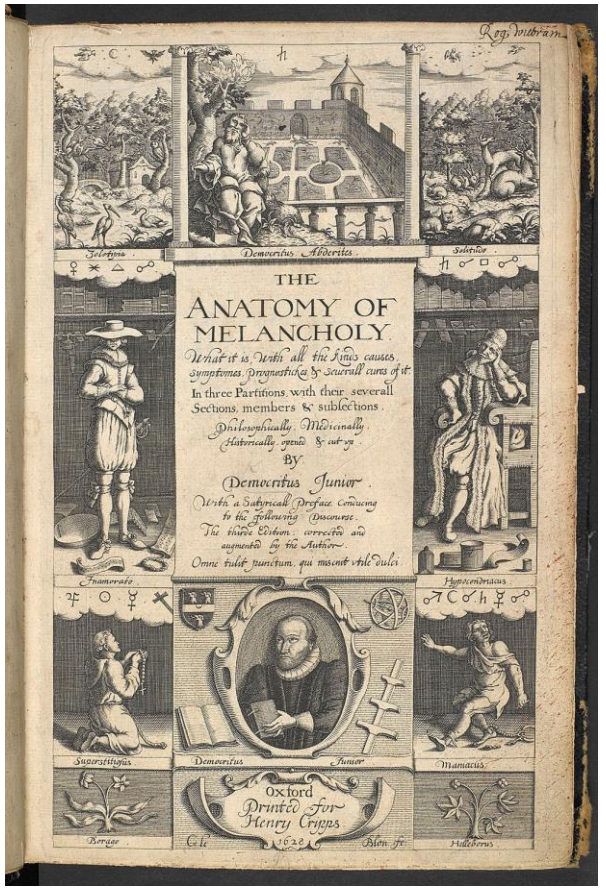
1. Burckett-St Laurant D, et. al. The Nerves of the Adductor Canal and the Innervation of the Knee: An Anatomic Study. Reg Anesth Pain Med. 2016 May-Jun;41(3):321-7.
2. Tran J, et al. Anatomical Study of the Innervation of Anterior Knee Joint Capsule: Implication for Image-Guided Intervention. Reg Anesth Pain Med. 2018 May;43(4):407-414.
3. Franco CD, et. al. Innervation of the Anterior Capsule of the Human Knee: Implications for Radiofrequency Ablation. Reg Anesth Pain Med. 2015 Jul-Aug;40(4):363-8.
4. McCormick ZL, et. al. Cooled Radiofrequency Ablation of the Genicular Nerves for Chronic Pain due to Knee Osteoarthritis: Six-Month Outcomes. Pain Med. 2017 Sep 1;18(9):1631-1641.
5. Davis T, et. al. Prospective, Multicenter, Randomized, Crossover Clinical Trial Comparing the Safety and Effectiveness of Cooled Radiofrequency Ablation With Corticosteroid Injection in the Management of Knee Pain From Osteoarthritis. Reg Anesth Pain Med. 2018 Jan;43(1):84-91.
6. Davis T, et. al. Twelve-month analgesia and rescue, by cooled radiofrequency ablation treatment of osteoarthritic knee pain: results from a prospective, multicenter, randomized, cross-over trial. Reg Anesth Pain Med. 2019 Feb 16.
7. Radnovich R, Scott D, Patel AT, Olson R, Dasa V, Segal N, Lane NE, Shrock K, Naranjo J, Darr K, Surowitz R, Choo J, Valadie A, Harrell R, Wei N, Metyas S. Cryoneurolysis to treat the pain and symptoms of knee osteoarthritis: a multicenter, randomized, double-blind, sham-controlled trial. Osteoarthritis Cartilage. 2017 Aug;25(8):1247-1256.
8. Han Y, Huang H, Pan J, Lin J, Zeng L, Liang G, Yang W, Liu J. Meta-analysis Comparing Platelet-Rich Plasma vs Hyaluronic Acid Injection in Patients with Knee Osteoarthritis. Pain Med. 2019 Mar 7.
9. Walega D, et. al. Radiofrequency ablation of genicular nerves prior to total knee replacement has no effect on postoperative pain outcomes: a prospective randomized sham-controlled trial with 6-month follow-up. Reg Anesth Pain Med. 2019 Apr 25.
10. Hunter C, Davis T, Loudermilk E, Kapural L, DePalma M. Cooled Radiofrequency Ablation Treatment of the Genicular Nerves in the Treatment of Osteoarthritic Knee Pain: 18- and 24-Month Results. Pain Pract. 2020 Mar;20(3):238-246.

Non-CME Webinar Series
designed with the trainee in mind

first Tuesday of the month

Brought to you by ASRA | ASRA Pain Medicine Education Research & THE ASSOCIATION OF PAIN PROGRAM DIRECTORS
ADVANCING EDUCATION IN MULTIDISCIPLINARY PAIN MEDICINE

"Put your shoulder to the wheel"



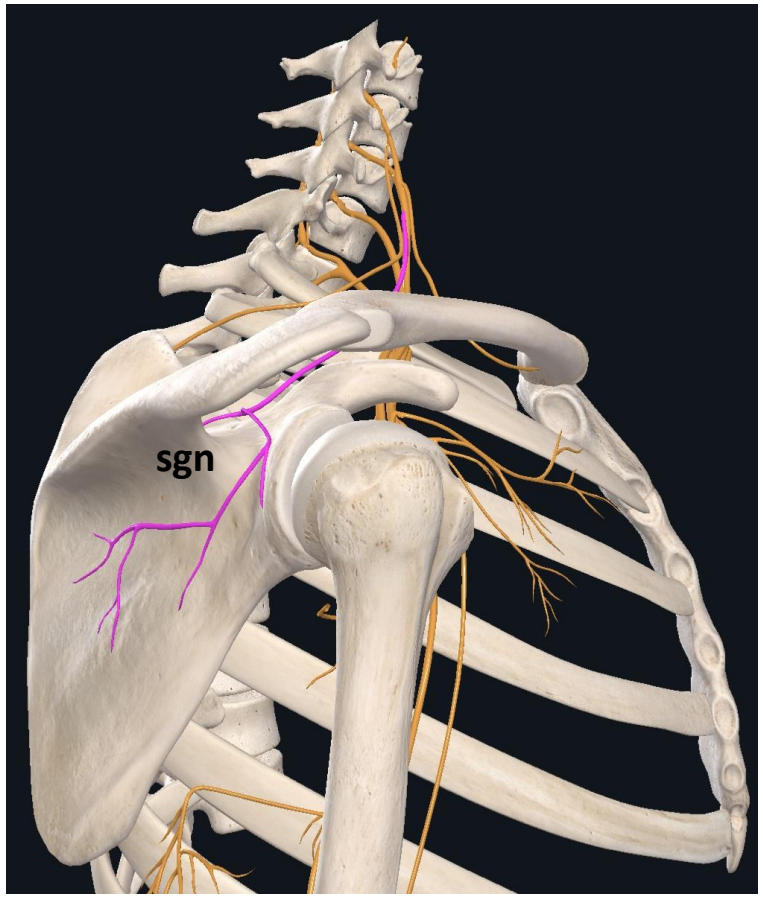
To pray alone and reject ordinary meanes, is to doe like him in Aesope, that when his cart was stalled, lay flat on his backe and cryed aloud helpe Hercules, but that was to little purpose, except as his friend advised him, rotis tute ipse annitaris, hee whipt his horses withall, and **put his shoulder to the wheel**. – **Robert Burton 1577-1640**

Gross Anatomical Review:

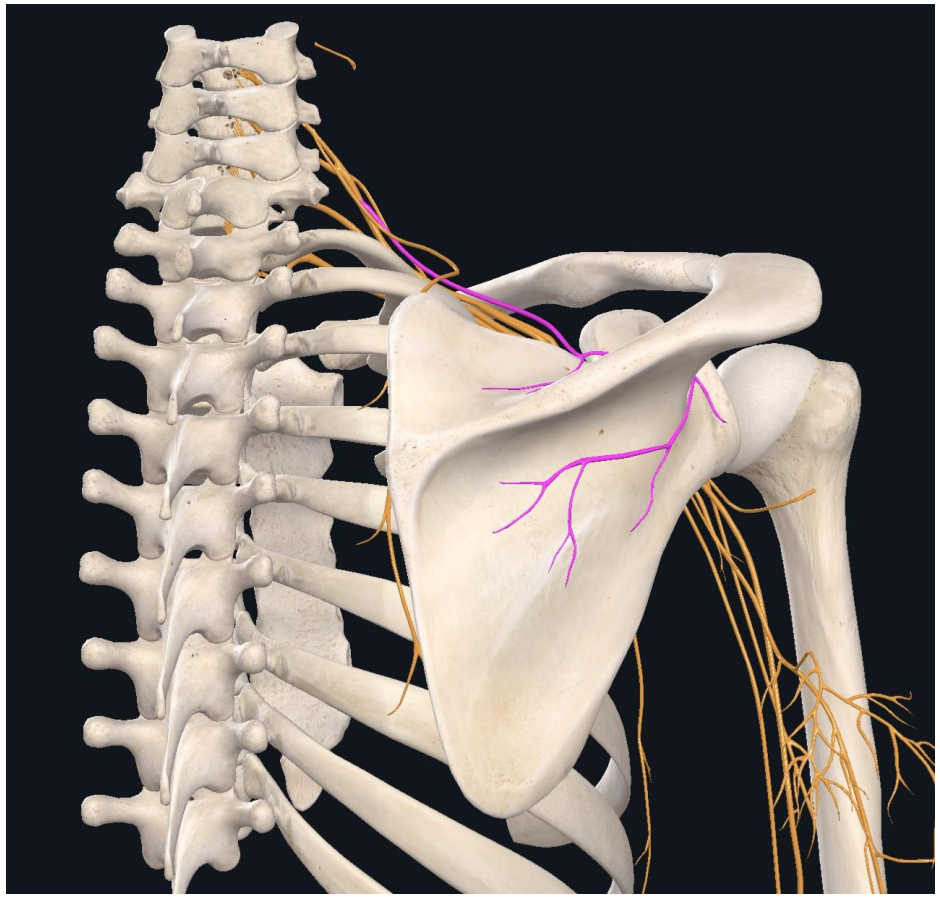
Suprascapular N
Axillary N
Lateral Pectoral N
Upper and Lower Subscapular N

Suprascapular Nerve, Gross Anatomy

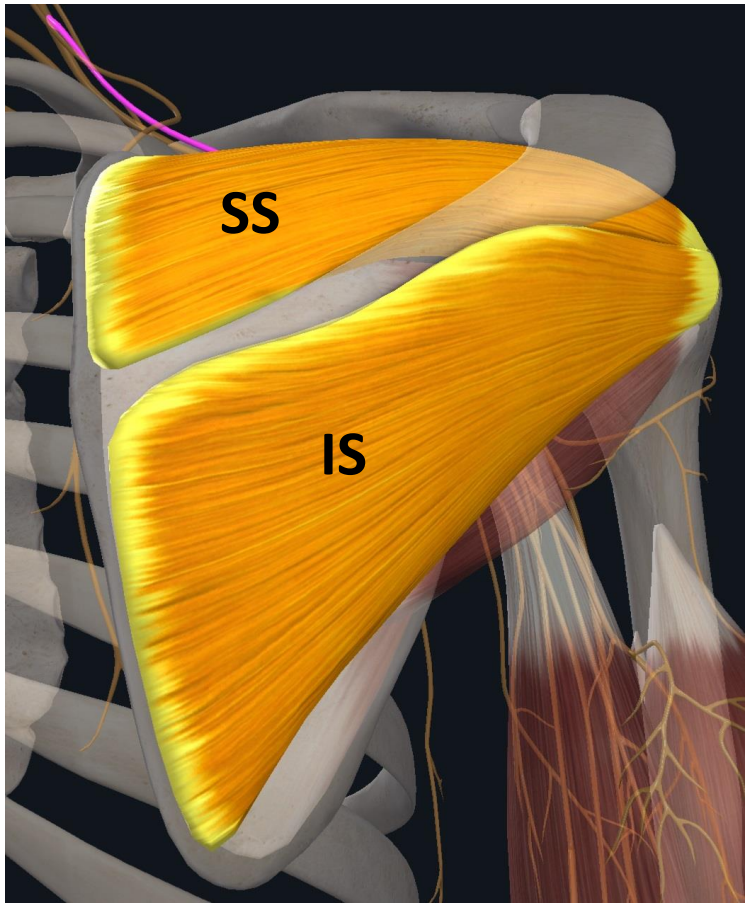
Lateral



Posterior

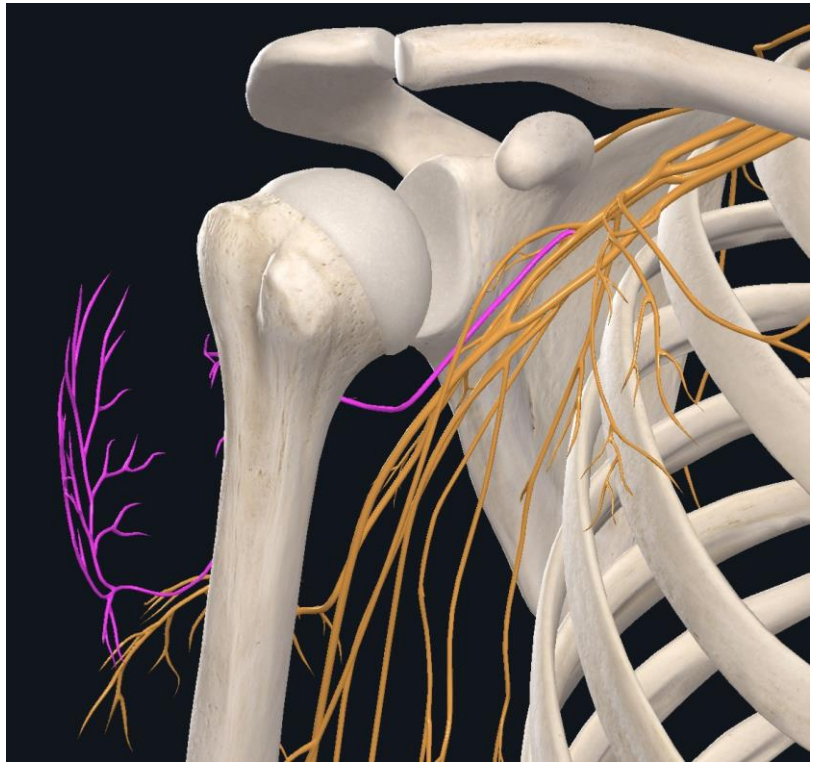


Motor

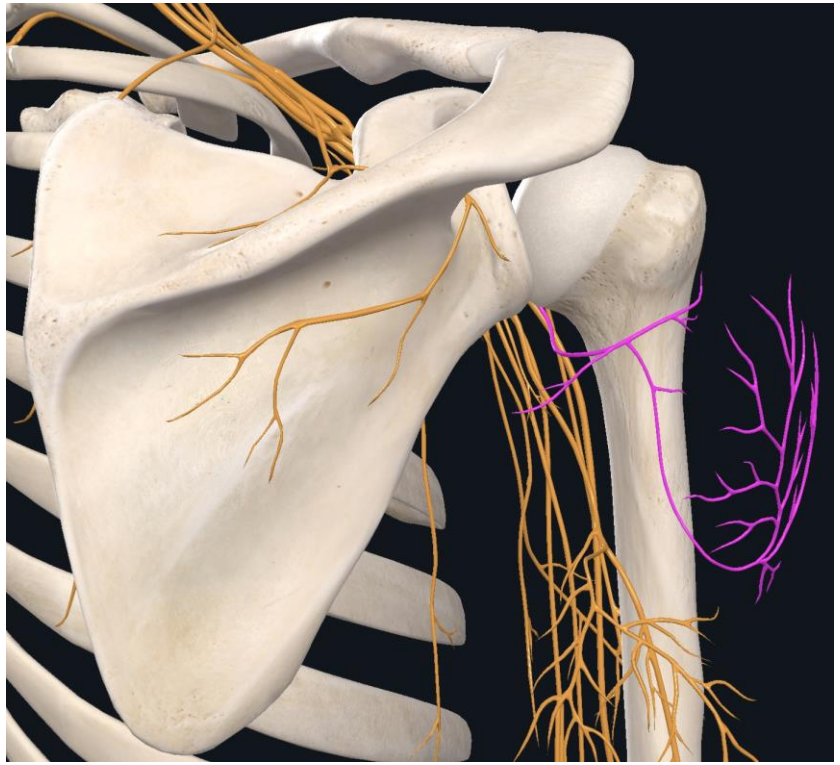


Axillary Nerve: Gross Anatomy

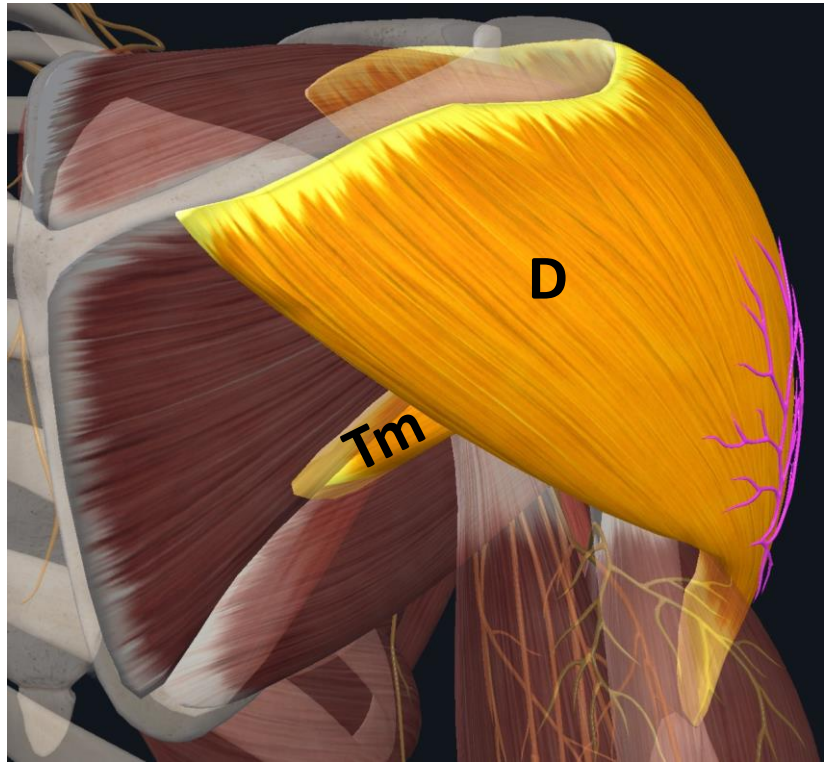
Anterior



Posterior

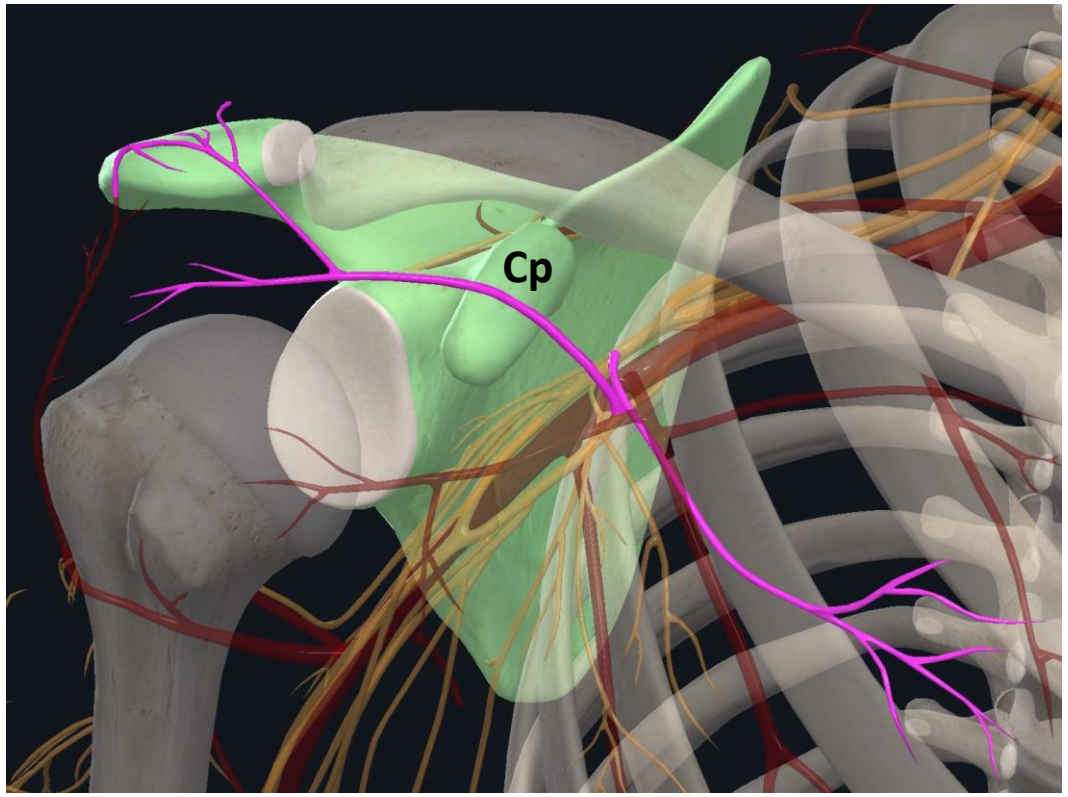


Motor

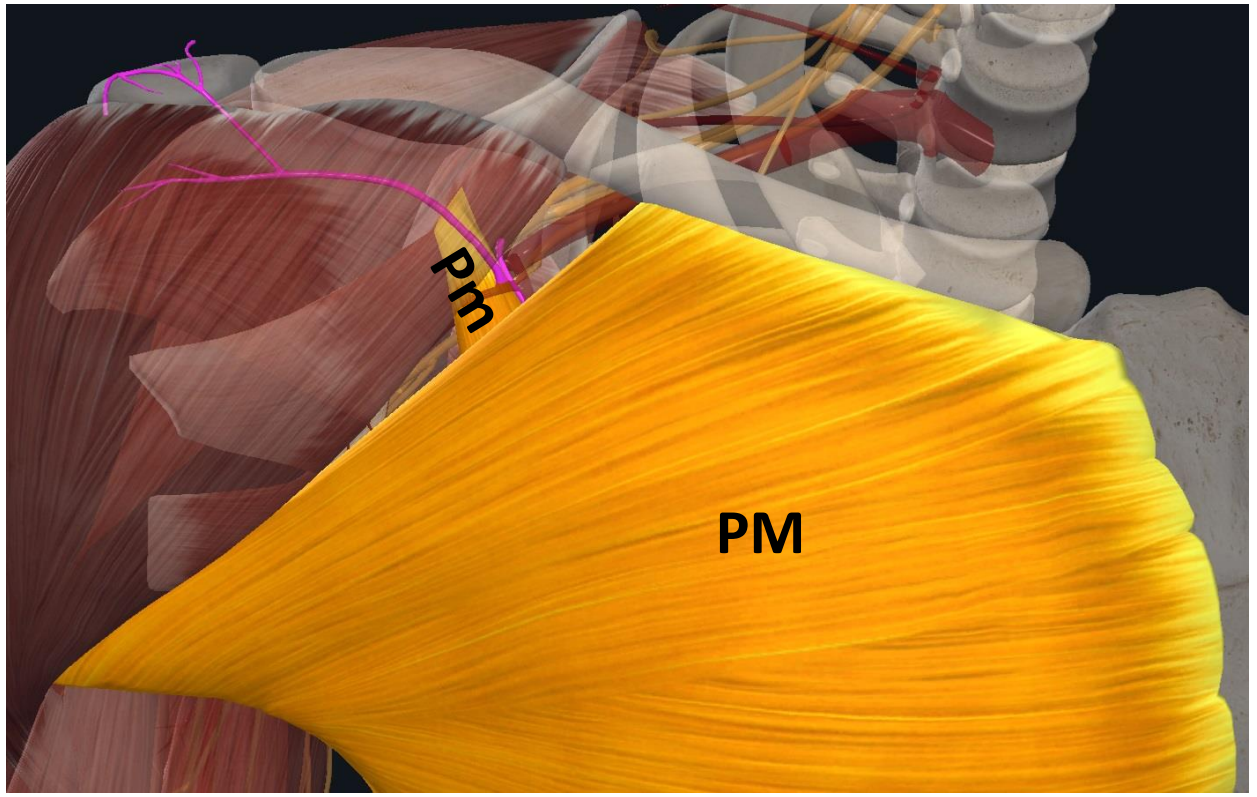


Lateral Pectoral Nerve: Gross Anatomy

Anterior

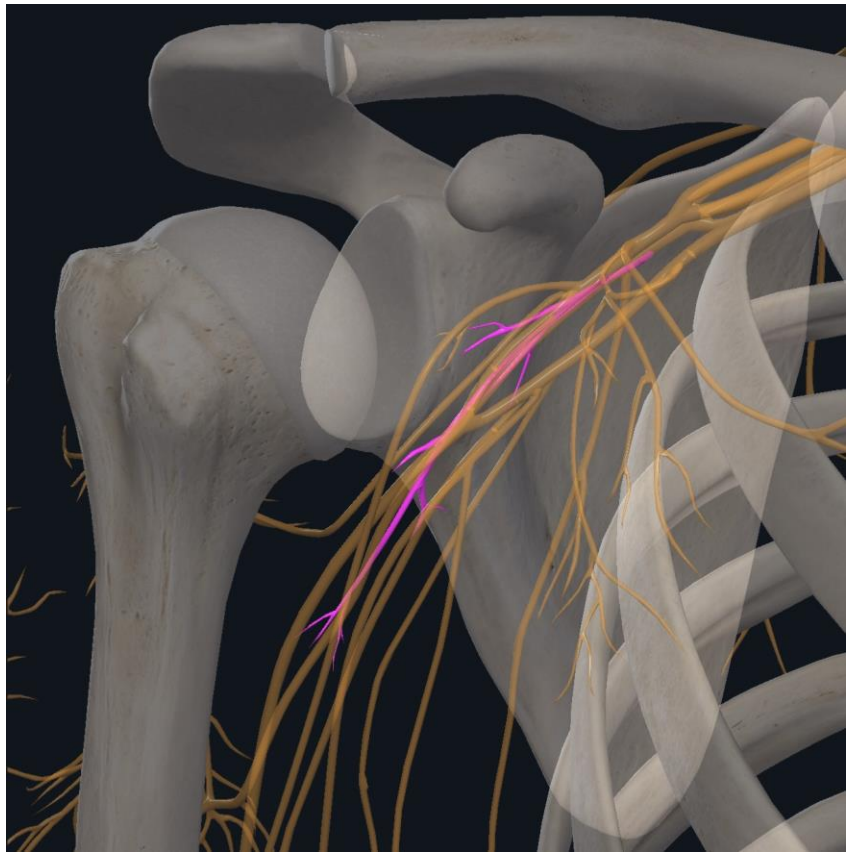


Motor

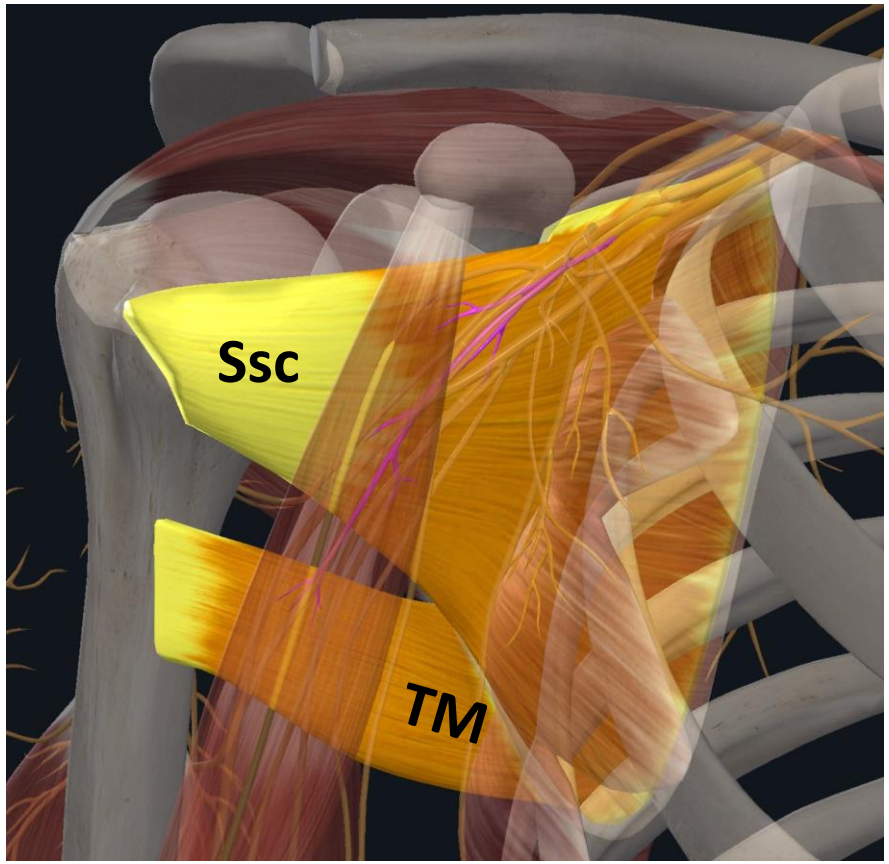


Upper and Lower Subscapular Nerves: Gross Anatomy

Anterior



Motor



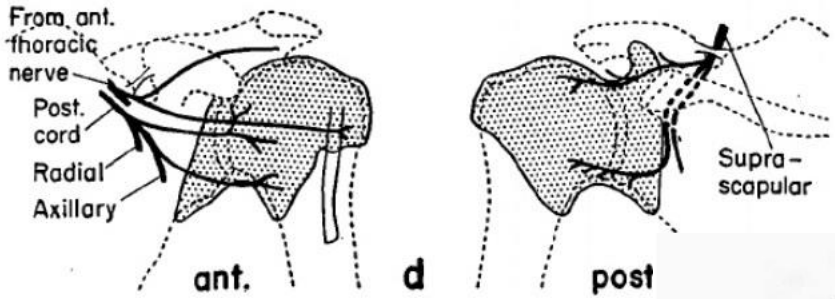
Relevant Shoulder Structure Innervation

Eckmann MS, McCormick ZL, Beal C, Julia J, Cheney CW, Nagpal AS. Putting Our Shoulder to the Wheel: Current Understanding and Gaps in Nerve Ablation for Chronic Shoulder Pain. Pain Med. 2021 Jul 25;22(Suppl 1):S2-S8.

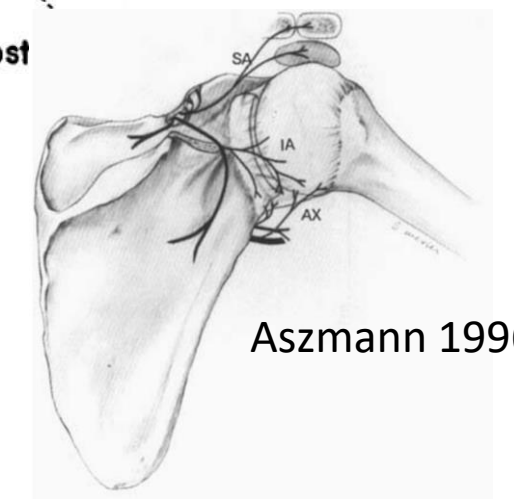
*

Structure	Suprascapular N	Axillary N	Lateral Pectoral N	Upper and/or Lower Subscapular N
Glenohumeral joint capsule	X (superior, posterior)	X (posterior, anterior inferior)	X (anterior, superior, inferior)	X (anterior, superior, inferior)
Subacromial bursa	X (medial, anterior, and posterior)	X (lateral)	X	
Coracoacromial and coracoclavicular ligaments	X		X	
Acromioclavicular joint	X (acromial branch)		X	
Transverse humeral ligament		X		
Long head of biceps tendon		X		X
Head/Neck of humerus fascia	X (posterior)	X (lateral)		

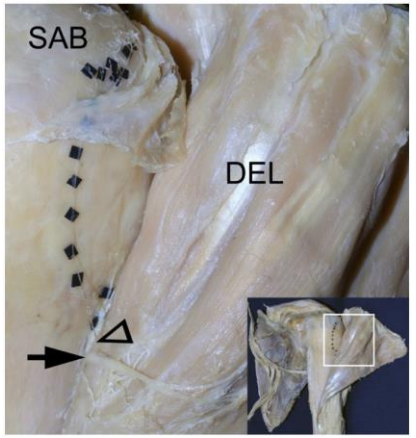
* -Aszmann OC, Dellon AL, Birely BT, McFarland EG. Innervation of the human shoulder joint and its implications for surgery. Clin Orthop Relat Res. 1996;330:202–207.
-Ebraheim NA, Whitehead JL, Alla SR, et al. The suprascapular nerve and its articular branch to the acromioclavicular joint: an anatomic study. J Shoulder Elbow Surg. 2011;20:e13–e17.
-Nasu H, Nimura A, Yamaguchi K, Akita K. Distribution of the axillary nerve to the subacromial bursa and the area around the long head of the biceps tendon. Knee Surg Sports Traumatol Arthrosc. 2015;23:2651–2657.
-Nam YS, Panchal K, Kim IB, Ji JH, Park MG, Park SR. Anatomical study of the articular branch of the lateral pectoral nerve to the shoulder joint. Knee Surg Sports Traumatol Arthrosc. 2016;24:3820–3827.
-Eckmann MS, Bickelhaupt B, Fehl J, Benfield JA, Curley J, Rahimi O, Nagpal AS. Cadaveric Study of the Articular Branches of the Shoulder Joint. Reg Anesth Pain Med. 2017 Sep/Oct;42(5):564-570.
-Sager B, Gates S, Collett G, Chhabra A, Khazzam M. Innervation of the subscapularis: an anatomic study. JSES Open Access. 2019 Apr 26;3(2):65-69.
-Laumonerie P, Blasco L, Tibbo ME, Bonnevialle N, Labrousse M, Chaynes P, et al. Sensory innervation of the subacromial bursa by the distal suprascapular nerve: a new description of its anatomic distribution. J Shoulder Elbow Surg 2019;28:1788-94.
-Tran J, Peng PWH, Agur AMR. Anatomical study of the innervation of glenohumeral and acromioclavicular joint capsules: implications for image-guided intervention. Reg Anesth Pain Med. 2019 Jan 11:rapm-2018-100152.
-Bickelhaupt B, Eckmann MS, Brennick C, Rahimi OB. Quantitative analysis of the distal, lateral, and posterior articular branches of the axillary nerve to the shoulder: implications for intervention. Reg Anesth Pain Med. 2019 Jul 8:rapm-2019-100560.
-Laumonerie P, Dalmas Y, Tibbo ME, Robert S, Faruch M, Chaynes P, Bonnevialle N, Mansat P. Sensory innervation of the human shoulder joint: the three bridges to break. J Shoulder Elbow Surg. 2020 Dec;29(12):e499-e507.



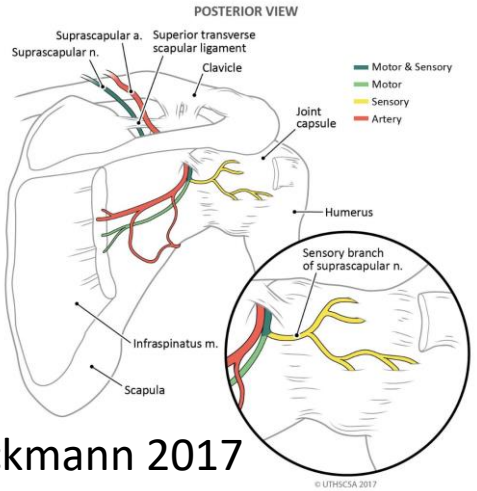
Gardner 1948



Aszmann 1996



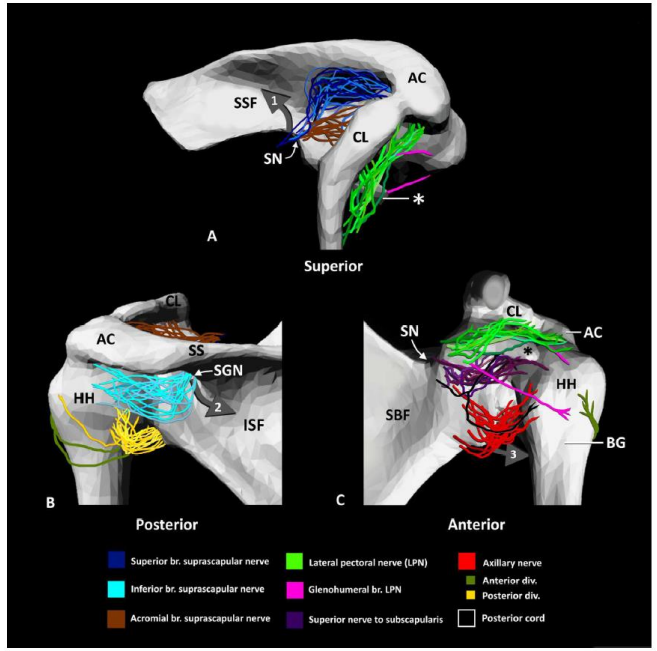
Nasu 2015



Eckmann 2017

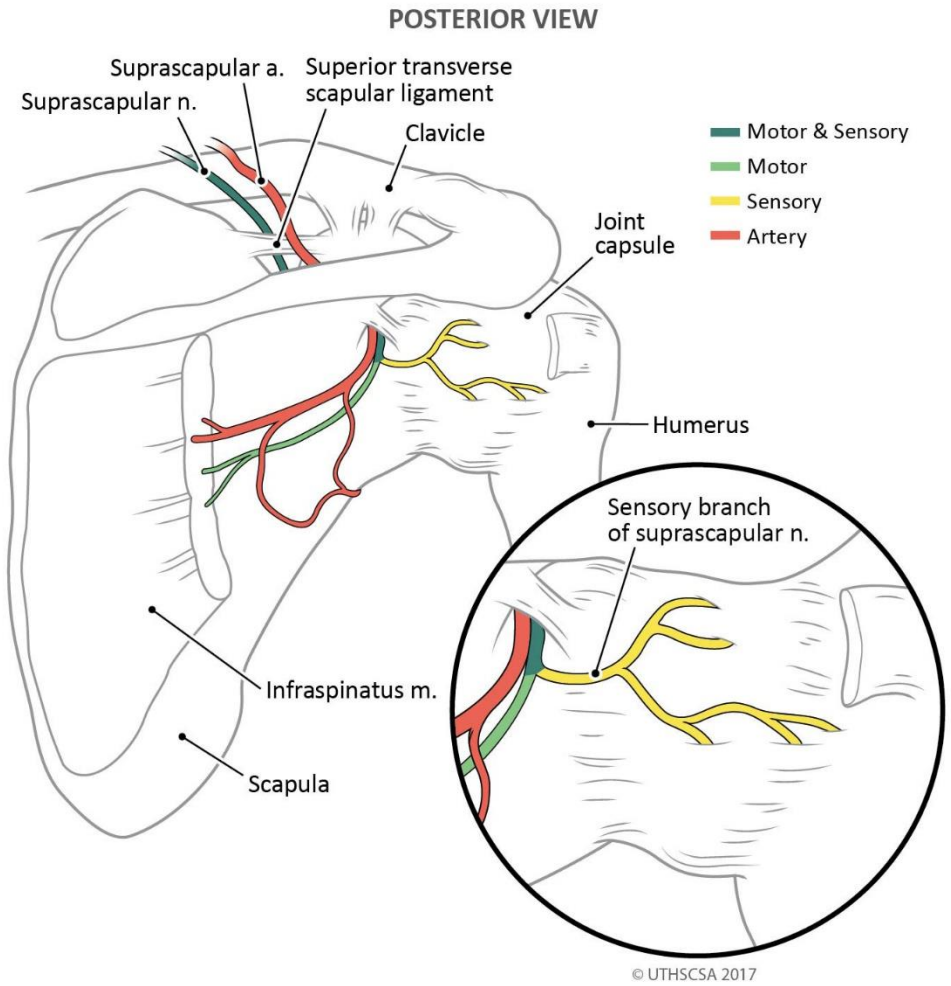
Articular Nerve Branches

Evolution of our Understanding

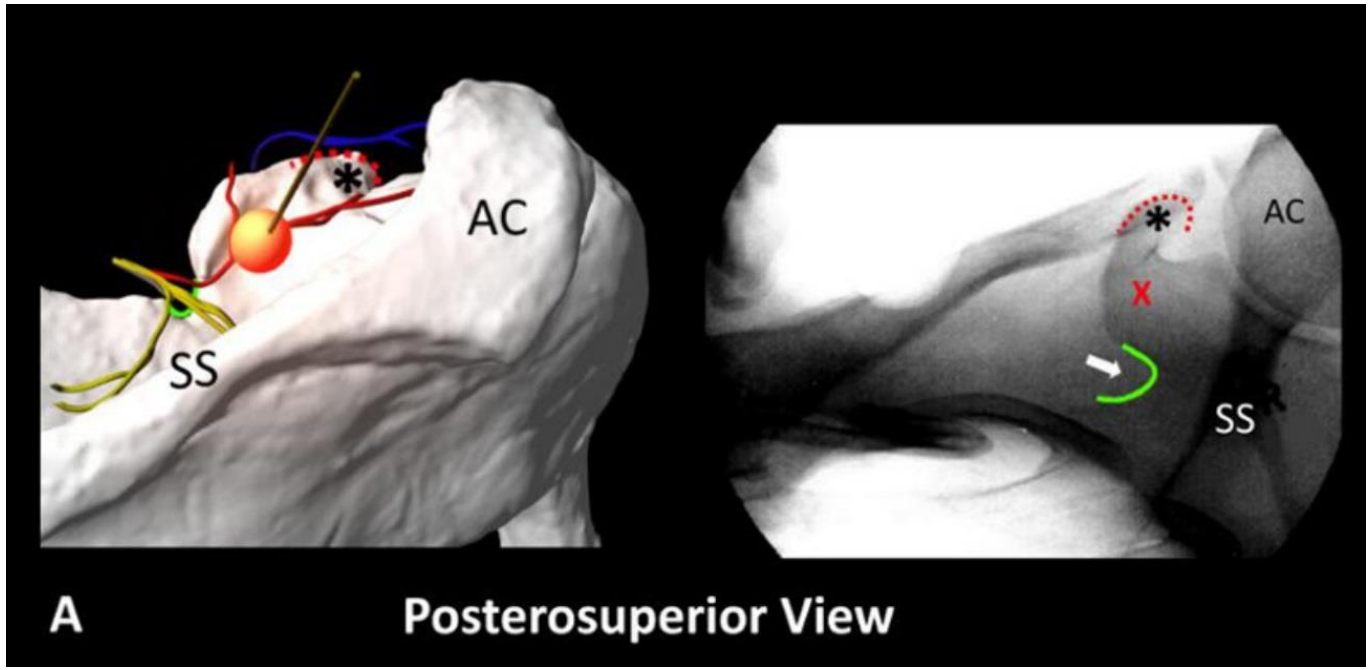


Tran 2019

Suprascapular Nerve

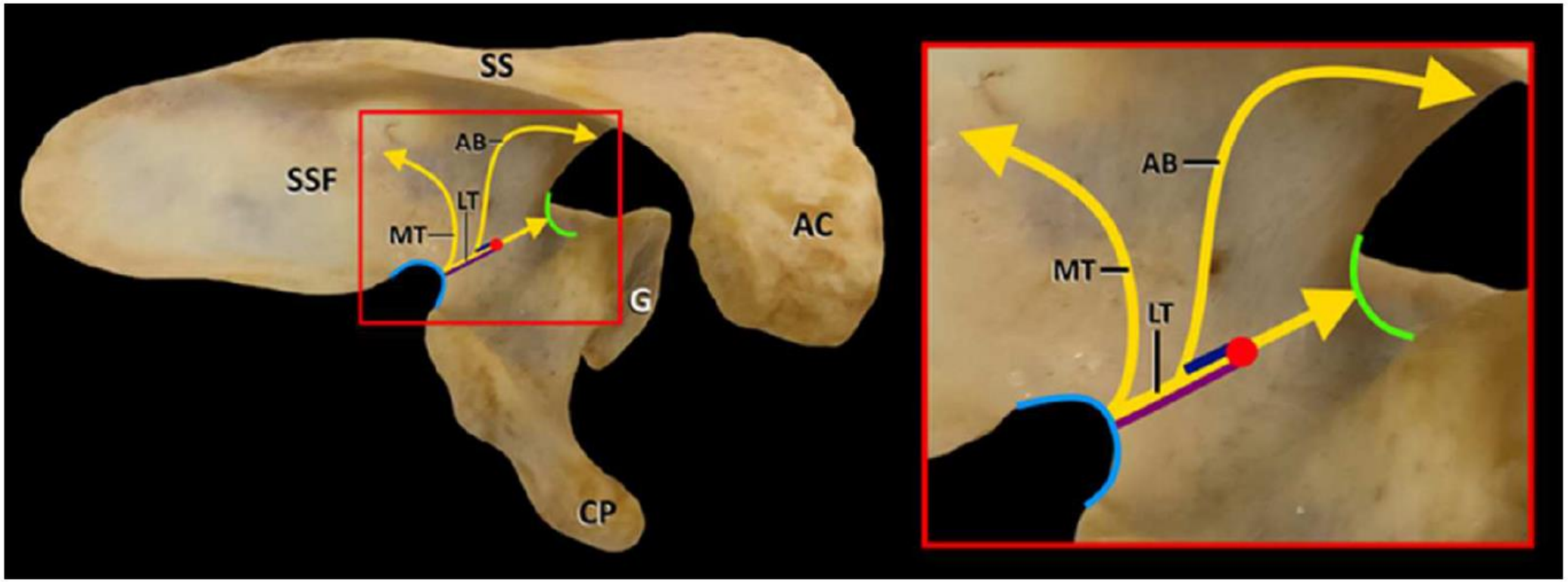


Eckmann MS, Bickelhaupt B, Fehl J, Benfield JA, Curley J, Rahimi O, Nagpal AS. Cadaveric Study of the Articular Branches of the Shoulder Joint. Reg Anesth Pain Med. 2017 Sep/Oct;42(5):564-570.



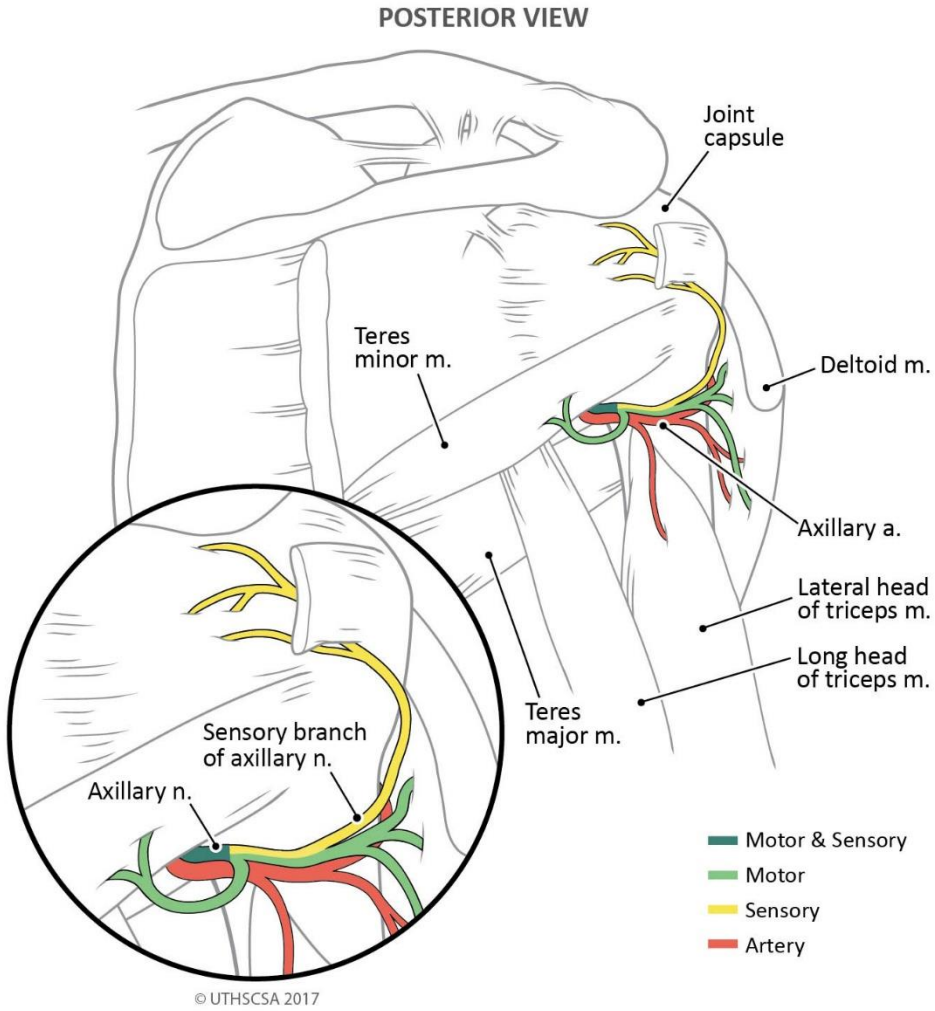
Tran J, Peng P, Agur A, Mittal N. Diagnostic block and radiofrequency ablation of the acromial branches of the lateral pectoral and suprascapular nerves for shoulder pain: a 3D cadaveric study. Reg Anesth Pain Med. 2021 Apr;46(4):305-312.

Suprascapular Nerve – Medial and Lateral Trunks – Superior View

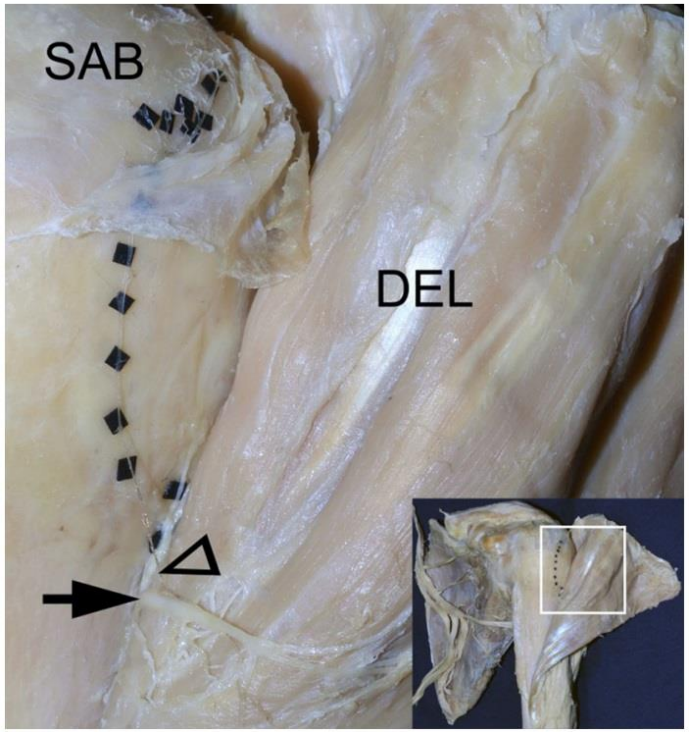


Tran J, Peng PWH, Agur AMR. Anatomical study of the innervation of glenohumeral and acromioclavicular joint capsules: implications for image-guided intervention. Reg Anesth Pain Med. 2019 Jan 11.

Axillary Nerve



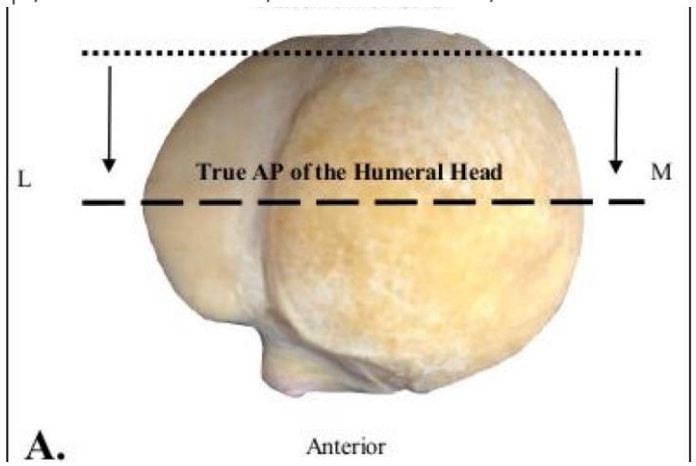
Eckmann MS, Bickelhaupt B, Fehl J, Benfield JA, Curley J, Rahimi O, Nagpal AS. Cadaveric Study of the Articular Branches of the Shoulder Joint. Reg Anesth Pain Med. 2017 Sep/Oct;42(5):564-570.

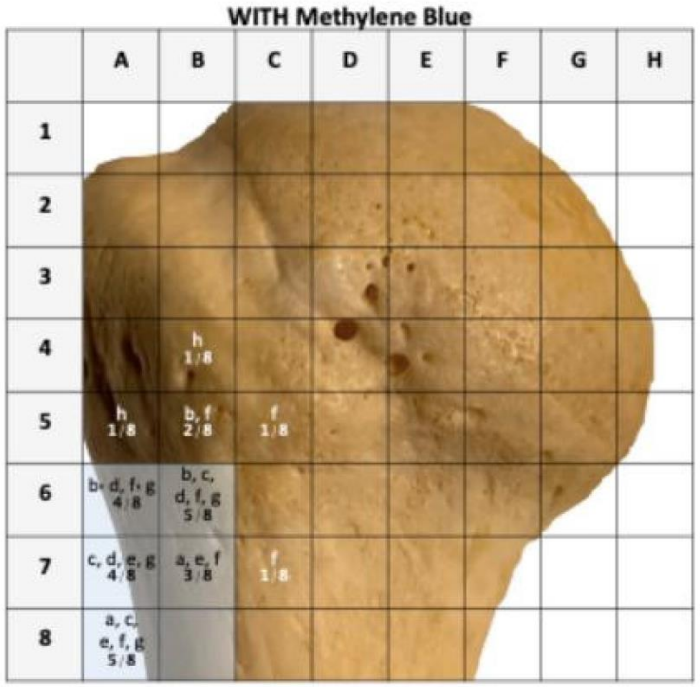


Nasu H, Nimura A, Yamaguchi K, Akita K. Distribution of the axillary nerve to the subacromial bursa and the area around the long head of the biceps tendon. Knee Surg Sports Traumatol Arthrosc. 2015 Sep;23(9):2651-7.

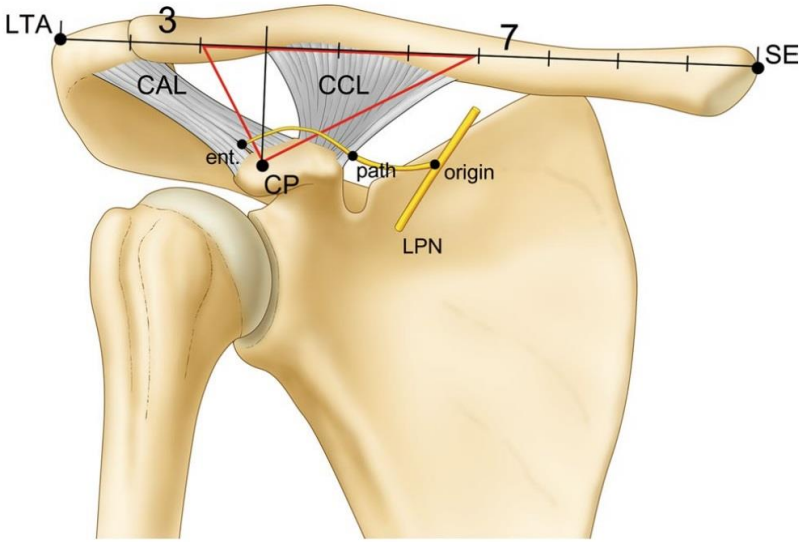
Quantitative analysis of the distal, lateral, and posterior articular branches of the axillary nerve to the shoulder: implications for intervention

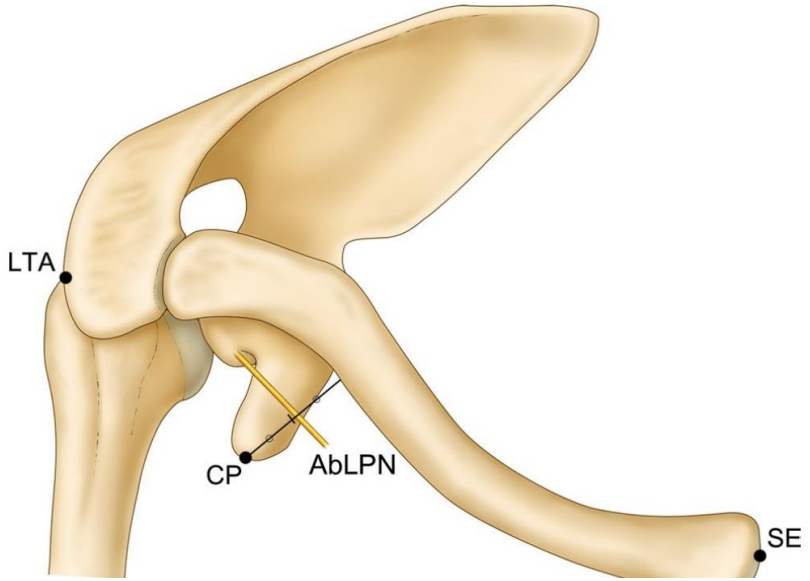
Brittany Bickelhaupt,[1] Maxim S Eckmann,[2] Caroline Brennick,[1] Omid B Rahimi[3]





Lateral Pectoral N

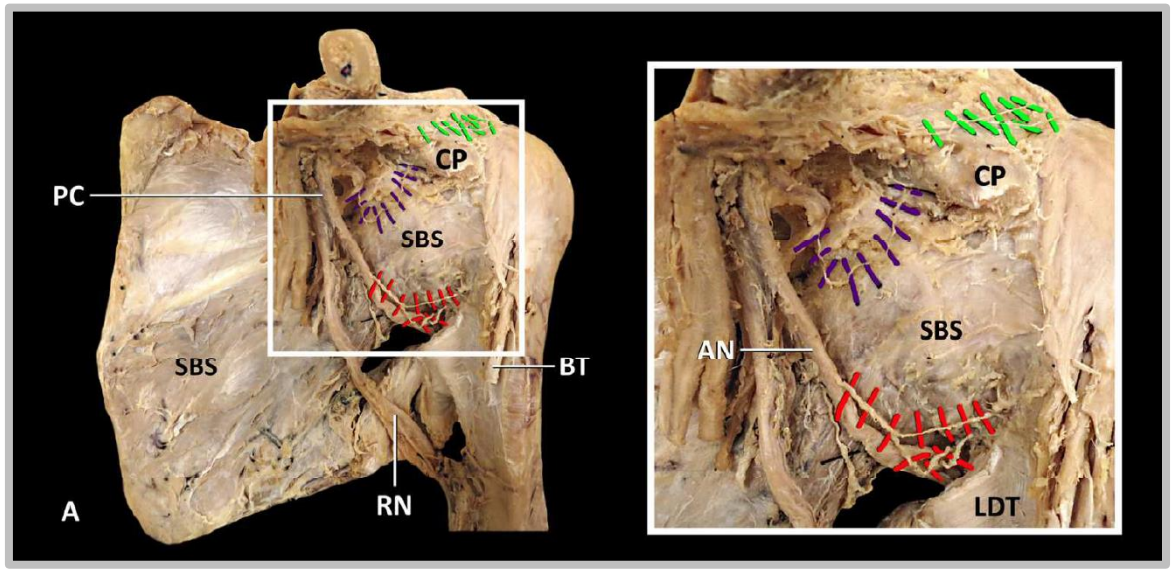




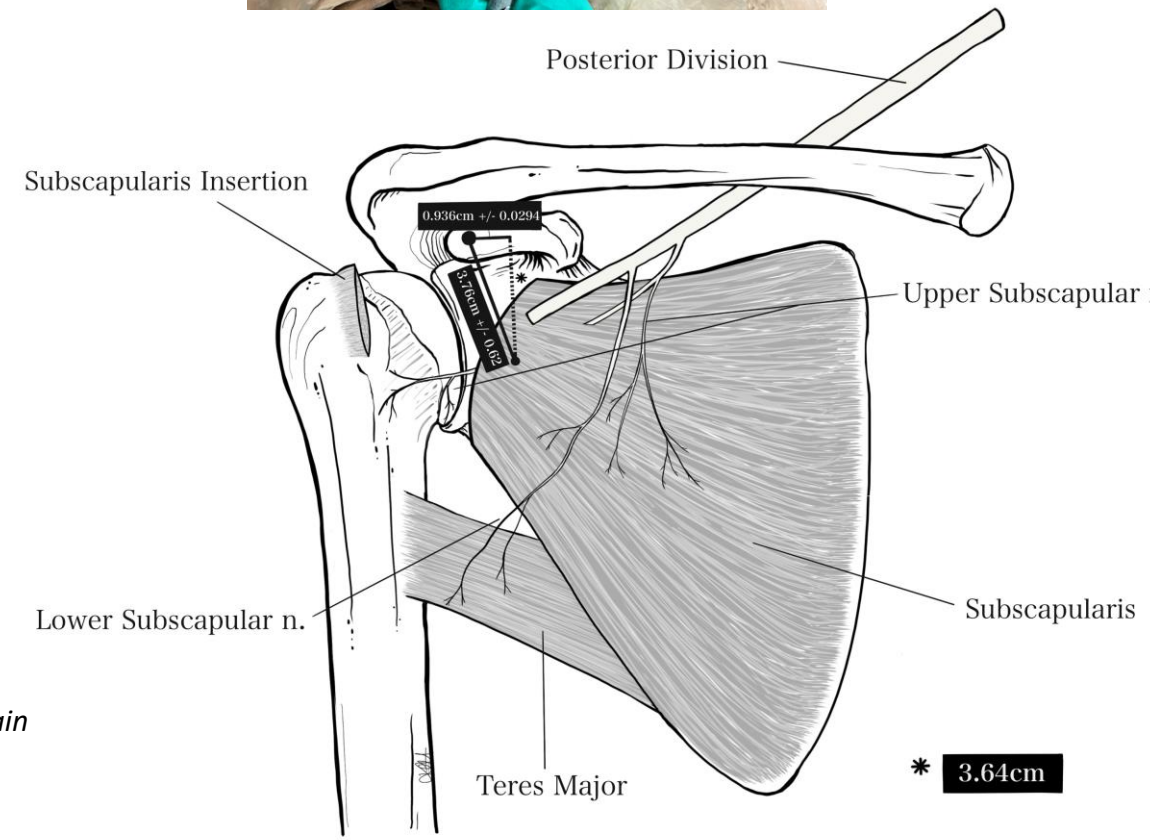
Nam YS, Panchal K, Kim IB, Ji JH, Park MG, Park SR. Anatomical study of the articular branch of the lateral pectoral nerve to the shoulder joint. Knee Surg Sports Traumatol Arthrosc. 2016 Dec;24(12):3820-3827.

Tran J, Peng P, Agur A, Mittal N. Diagnostic block and radiofrequency ablation of the acromial branches of the lateral pectoral and suprascapular nerves for shoulder pain: a 3D cadaveric study. Reg Anesth Pain Med. 2021 Apr;46(4):305-312.

Subscapular Nerves (Esp. Upper)



Tran J, Peng PWH, Agur AMR. Anatomical study of the innervation of glenohumeral and acromioclavicular joint capsules: implications for image-guided intervention. Reg Anesth Pain Med. 2019 Jan 11.



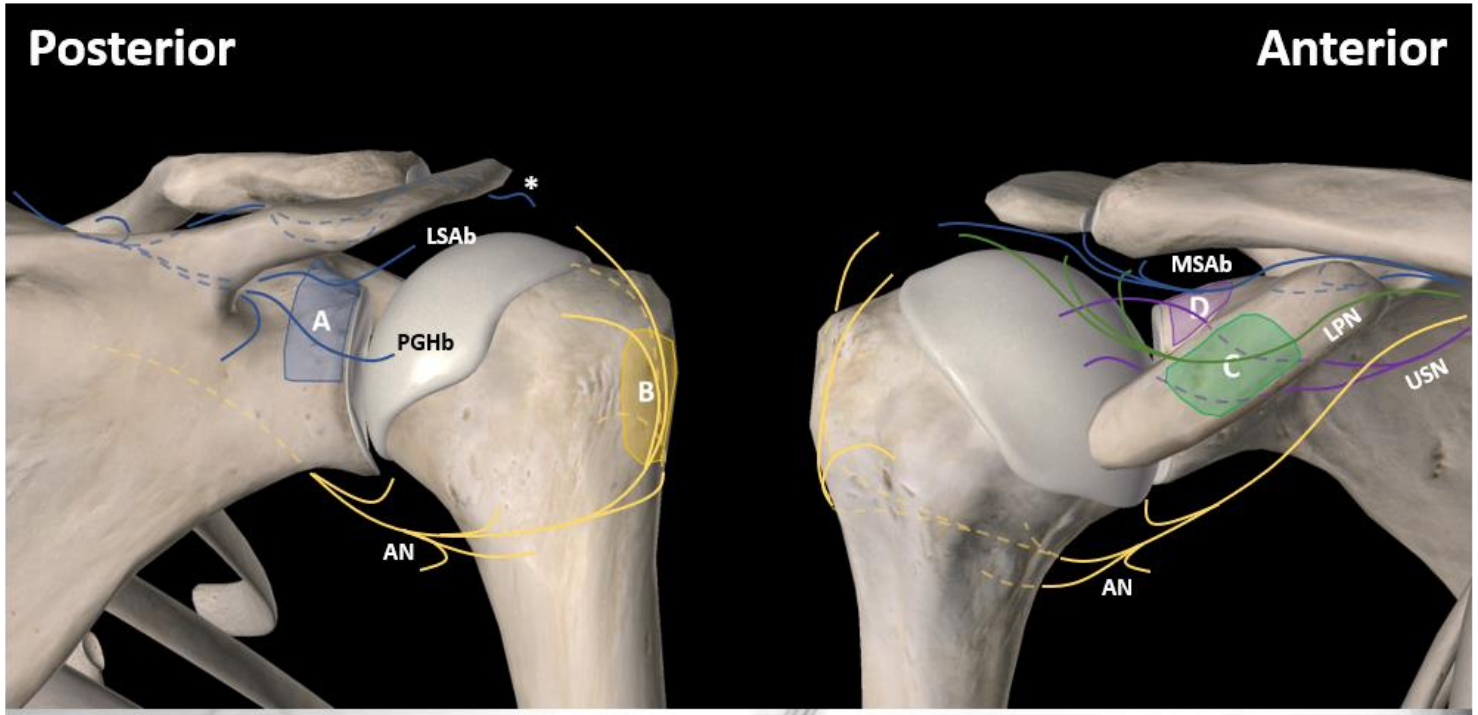
Current Project: Identifying the Upper Subscapular Nerve as a Target for Chronic Shoulder Pain

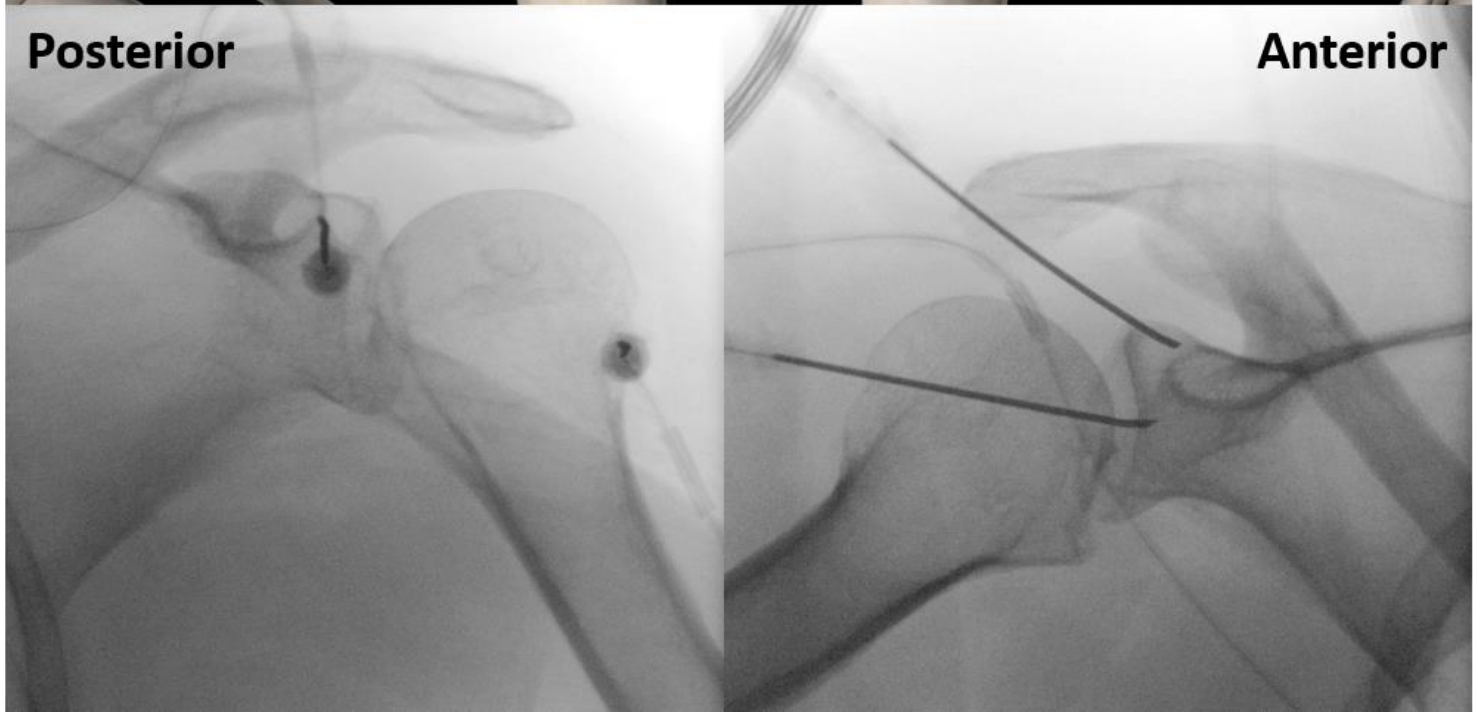
Kenneth Brooks MD, Jordan Farley DO, Seth Probert DO, Kendal Hulk DO, Omid Rahimi Phd, Maxim Eckmann MD.

Summary of Potential Shoulder Articular Ablation Zones

A – **Suprascapular** LSAb, PGHb
B – **Axillary** ascending br.
C – **Lateral Pectoral** N.
D – **Suprascapular** MSAb and Upper **Subscapular** br.

LSAb – Lateral Subacromial Branch;
PGHb – Posterior Glenohumeral Branch;
MSAb – Medial Subacromial Branch





Eckmann MS, McCormick ZL, Beal C, Julia J, Cheney CW, Nagpal AS. Putting Our Shoulder to the Wheel: Current Understanding and Gaps in Nerve Ablation for Chronic Shoulder Pain. Pain Med. 2021 Jul 25;22(Suppl 1):S2-S8.

Shoulder Nerve Ablation – Emerging Knowledge

- Chronic shoulder pain may stem from a variety of causes including rotator cuff disease, glenohumeral joint (GHJ) osteoarthritis, nerve injuries, and capsulitis.

- The **suprascapular, axillary, lateral pectoral, and subscapular nerves** are known to innervate the GHJ.
  - Other nerves may also contribute theoretically by Hiltons Law of joint innervation.
  - Articular branch nerves have been described and may be future clinical targets.

- Case series exist of main suprascapular nerve ablation (n=6) to palliate shoulder pain in patients with limited functional use of the shoulder (Simopoulos 2012).
  - *Patients can retain or improve function due to reduced pain and compensation.*

Simopoulos TT, Nagda J, Aner MM. Percutaneous radiofrequency lesioning of the suprascapular nerve for the management of chronic shoulder pain: a case series. J Pain Res. 2012;5:91-7.

- **2 Year Data**
- **Chronic Hemiplegic Shoulder Pain**
- **Axillary Motor Point Stimulation**
- **Sham Controlled Trial Step**
- **5 completers of 28 recruits**
- **Significant improvement in pain interference >50% at 12 months**
- **4/5 >50% pain improvement 24 mo.**
- **Improved Movement**

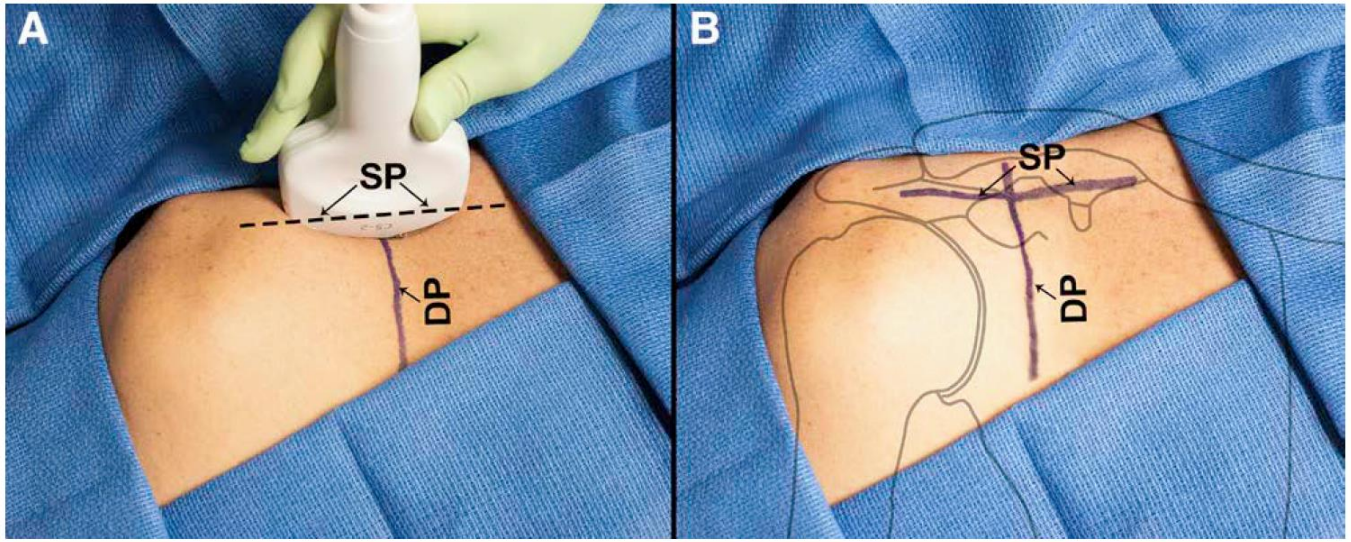
Table 2. Outcome Assessments for Implant Stage Participants, $N = 5$.

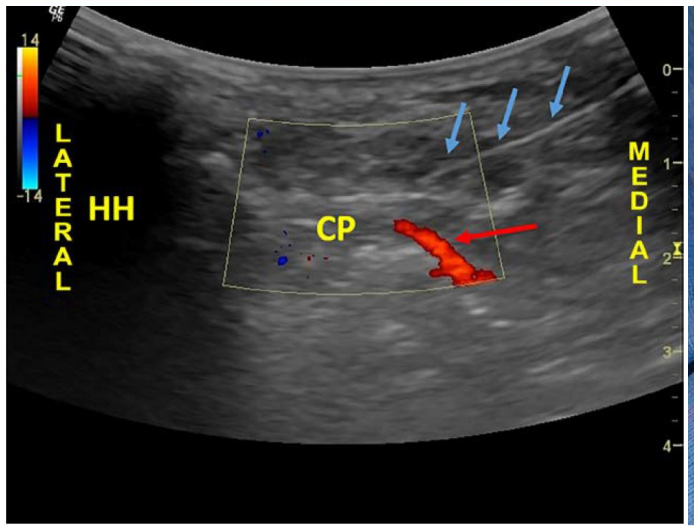
	Baseline	End of Sham	End of Trial	6 months	12 months	24 months
Worst pain 7 days (±SE)	8.2	5.2 (± 0.7)	2.4 (±0.7)	1.6 (±0.7)	0.8 (±0.7)	1.6 (±0.7)
Pain interference 7 days (±SE)	5.8	4.2 (±0.4)	1.4 (±0.4)	0.3 (±0.4)	0.1 (±0.4)	0.4 (±0.4)
External rotation ROM (degrees)	69.2	96.6 (±9.1)	134.2 (±9.1)	141.2 (±9.1)	151.4 (±9.1)	
SF-36v2 (±SE)						
Physical functioning	28.9	30.5 (±6.1)	33.4 (±6.1)	31.3 (±6.1)	31.3 (±6.1)	
Role-limitations physical	29.4	35.6 (±4.2)	38.3 (±4.2)	37.1 (±4.2)	30.6 (±4.2)	
Bodily pain	30.6	34.8 (±3.4)	42.0 (±3.4)	45.1 (±3.4)	50.1 (±3.4)	
General health	42.4	38.7 (±4.5)	38.7 (±4.5)	41.7 (±4.5)	38.0 (±4.5)	
Vitality	46.0	47.2 (±3.7)	44.8 (±3.7)	51.4 (±3.7)	50.2 (±3.7)	
Social functioning	39.2	42.4 (±4.2)	47.8 (±4.2)	47.8 (±4.2)	44.6 (±4.2)	
Role-emotional	35.2	34.5 (±7.0)	39.0 (±7.0)	47.4 (±7.0)	43.6 (±7.0)	
Mental health	39.6	46.3 (±4.6)	46.3 (±4.6)	50.7 (±4.6)	47.9 (±4.6)	

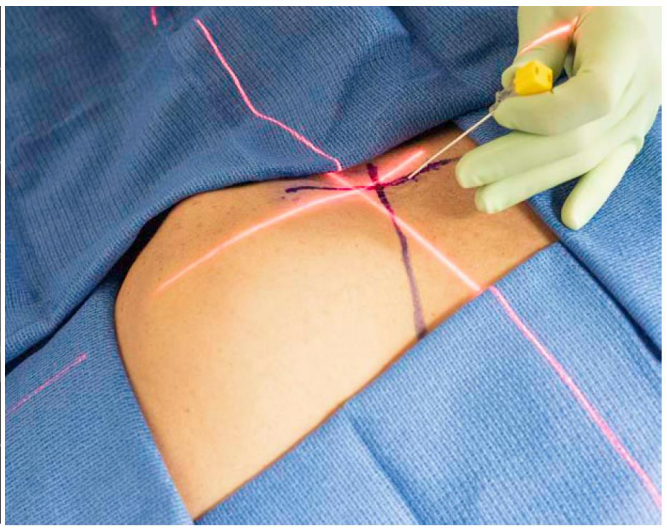
The trial stage consisted of a three-week blinded sham introductory period and a three-week active stimulation period.
SE, standard error; PNS, peripheral nerve stimulation; VGRS, Visual Graphic Rating Scales.

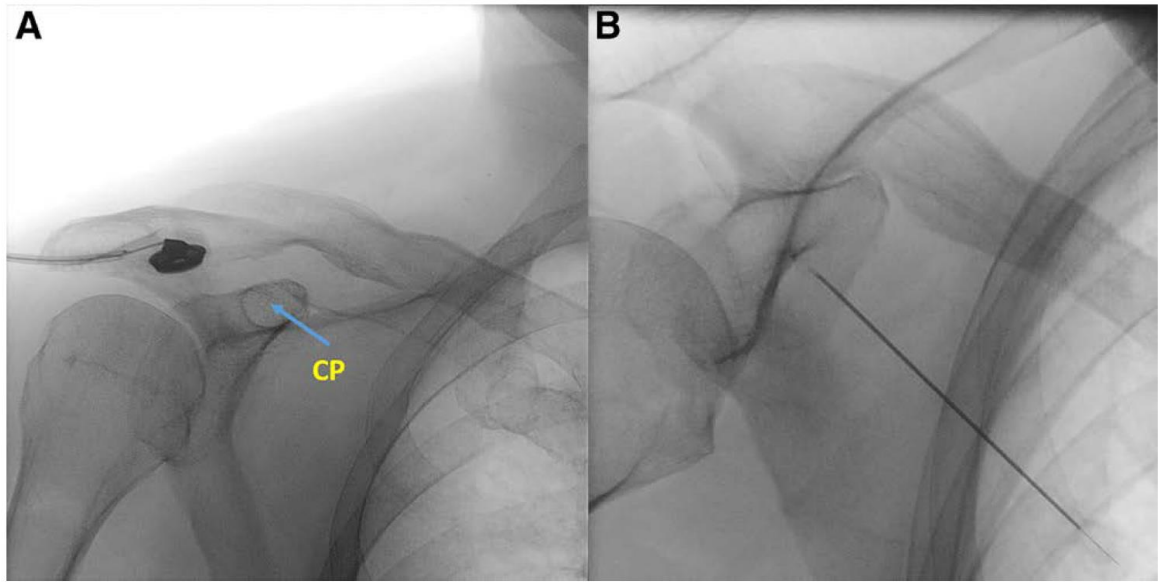
Wilson RD, Bennett ME, Nguyen VQC, Bock WC, O'Dell MW, Watanabe TK, Amundson RH, Hoyen HA, Chae J. Fully Implantable Peripheral Nerve Stimulation for Hemiplegic Shoulder Pain: A Multi-Site Case Series With Two-Year Follow-Up. Neuromodulation. 2018 Apr;21(3):290-295.

Thermal Radiofrequency Ablation of the Articular Branch of the Lateral Pectoral Nerve: A Case Report and Novel Technique









Eckmann MS, Lai BK, Uribe MA 3rd, Patel S, Benfield JA. Thermal Radiofrequency Ablation of the Articular Branch of the Lateral Pectoral Nerve: A Case Report and Novel Technique. A A Pract. 2019 Dec 1;13(11):415-419.

OXFORD UNIVERSITY PRESS

Pain Medicine

In press Oct 2019

Terminal Sensory Articular Nerve Radiofrequency Ablation for the Treatment of Chronic Intractable Shoulder Pain: A Novel Technique and Case Series

Eckmann, Maxim; UT Health Science Center, Anesthesiology
Johal, Justin; University of Texas Health Science Center at San Antonio
Bickelhaupt, Brittany; University of Texas Health Science Center at San Antonio
McCormick, Zachary; University of Utah Hospital, Physical Medicine and Rehabilitation
Abdallah, Rany; Lewis Katz School of Medicine at Temple University
Menzies, Robert; JPS Orthopedic and Sports Medicine
Soliman, Sameer; Sigma Pain Clinic
Nagpal, Ameet; University of Texas Health Science Center at San Antonio, Department of Anesthesiology

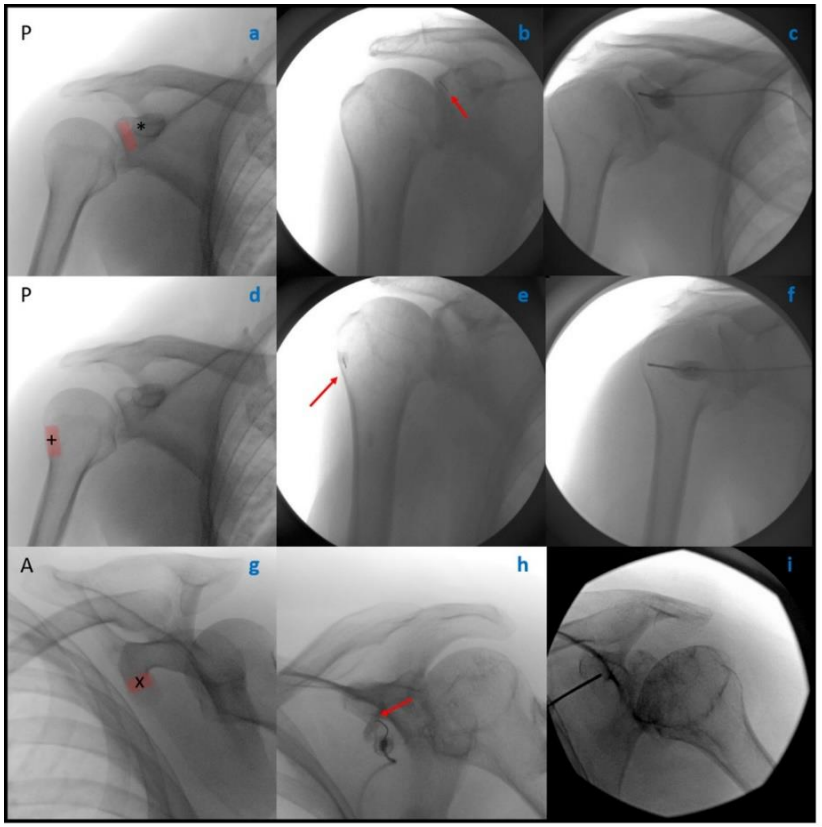


Figure 1. Fluoroscopically guided nerve blocks and ablations. *a:* Posterior (P) view of motor sparing ablation zone (red) for the articular branches of the Suprascapular nerve (abSN). Ablation zone is lateral to the Spinoglenoid Notch (*) on the neck of the glenoid for the abSN. Optimal AP view of the shoulder is a modified Grashey's (ipsilateral oblique) view with caudal tilt to expose this region. *b:* Position for diagnostic nerve block of the abSN (red arrow). *c:* Radiofrequency lesion targeting abSN after motor testing. *d:* Posterior (P) view of motor sparing ablation zone (red) for the articular branches of the Axillary nerve (abAN). Ablation zone is at the posterior-inferior portion of the greater tubercle (+) or epiphysis-diaphysis junction of the humerus for the abAN. *e:* Position for diagnostic nerve block of the abAN (red arrow). *f:* Radiofrequency lesion targeting abAN after motor testing. *g:* Anterior (A) view of motor sparing ablation zone (red) for the articular branches of the Lateral Pectoral Nerve (abLPN). Ablation zone is overlying the dorsal aspect of the coracoid process (X) proximal to the tip. *h:* Position for diagnostic nerve block of the abLPN. *i:* Radiofrequency lesion targeting the abLPN after motor testing.

- **Dual block, >50% relief threshold**
- **6/10 (60% [CI 29.7%-90.4%]) CRFA patients were responders, >50% pain relief of 6.6 [CI 4.6-8.6] mo**
- **3/9(33% [CI 2.3%-63.4%]) TRFA were responders, >50% pain relief for 5.3 [CI 0.9-9.7] mo**
- **Three CRFA responders and one TRFA responder still had significant pain relief at conclusion of retrospective review**
- **Shoulder osteoarthritis was the most common primary diagnosis in patients receiving RFA (11/19, 57.9% [CI 35.7%-80.1%]).**

Shoulder Nerves – Summary

- The shoulder is a complex major joint; emerging neuroanatomy
- Pathology includes: rotator cuff disease, osteoarthritis of the glenohumeral joint (GHJ), nerve injuries, capsulitis, and others.
- The suprascapular, axillary, lateral pectoral, subscapular nerves, are known to innervate the GHJ[1,2,3]. (and possibly others)
- Articular branch nerves are potential clinical targets[1,2,4,5].
- Case series exist of main suprascapular nerve ablation to palliate shoulder pain in patients with limited functional use of the shoulder[4].
  - While weakness of the shoulder is a logical complication, compensation possible.
- Case series of articular shoulder ablation suggests 5-6 months of >50% pain relief possible in patients with chronic shoulder pain from OA[5].
- Shoulder peripheral nerve stimulation possibly effective in well selected pts.[6]

1. Eckmann MS, Bickelhaupt B, Fehl J, Benfield JA, Curley J, Rahimi O, Nagpal AS. Cadaveric Study of the Articular Branches of the Shoulder Joint. Reg Anesth Pain Med. 2017 Sep/Oct;42(5):564-570.
2. Tran J, Peng PWH, Agur AMR. Anatomical study of the innervation of glenohumeral and acromioclavicular joint capsules: implications for image-guided intervention. Reg Anesth Pain Med. 2019 Jan 11.
3. Hébert-Blouin MN, et al. Clin Anat. 2014 May;27(4):548-55.
4. Simopoulos TT, Nagda J, Aner MM. Percutaneous radiofrequency lesioning of the suprascapular nerve for the management of chronic shoulder pain: a case series. J Pain Res. 2012;5:91-7.
5. Eckmann MS, Johal J, Bickelhaupt B, McCormick Z, Abdallah RT, Menzies R, Soliman S, Nagpal AS. Terminal Sensory Articular Nerve Radiofrequency Ablation for the Treatment of Chronic Intractable Shoulder Pain: A Novel Technique and Case Series. Pain Med. 2020 Apr 1;21(4):868-871.
6. Wilson RD, Bennett ME, Nguyen VQC, Bock WC, O'Dell MW, Watanabe TK, Amundson RH, Hoyen HA, Chae J. Fully Implantable Peripheral Nerve Stimulation for Hemiplegic Shoulder Pain: A Multi-Site Case Series With Two-Year Follow-Up. Neuromodulation. 2018 Apr;21(3):290-295.

Non-CME Webinar Series
designed with the trainee in mind

first Tuesday of the month

Brought to you by ASRA & THE ASSOCIATION OF PAIN PROGRAM DIRECTORS
ADVANCING EDUCATION IN MULTIDISCIPLINARY PAIN MEDICINE

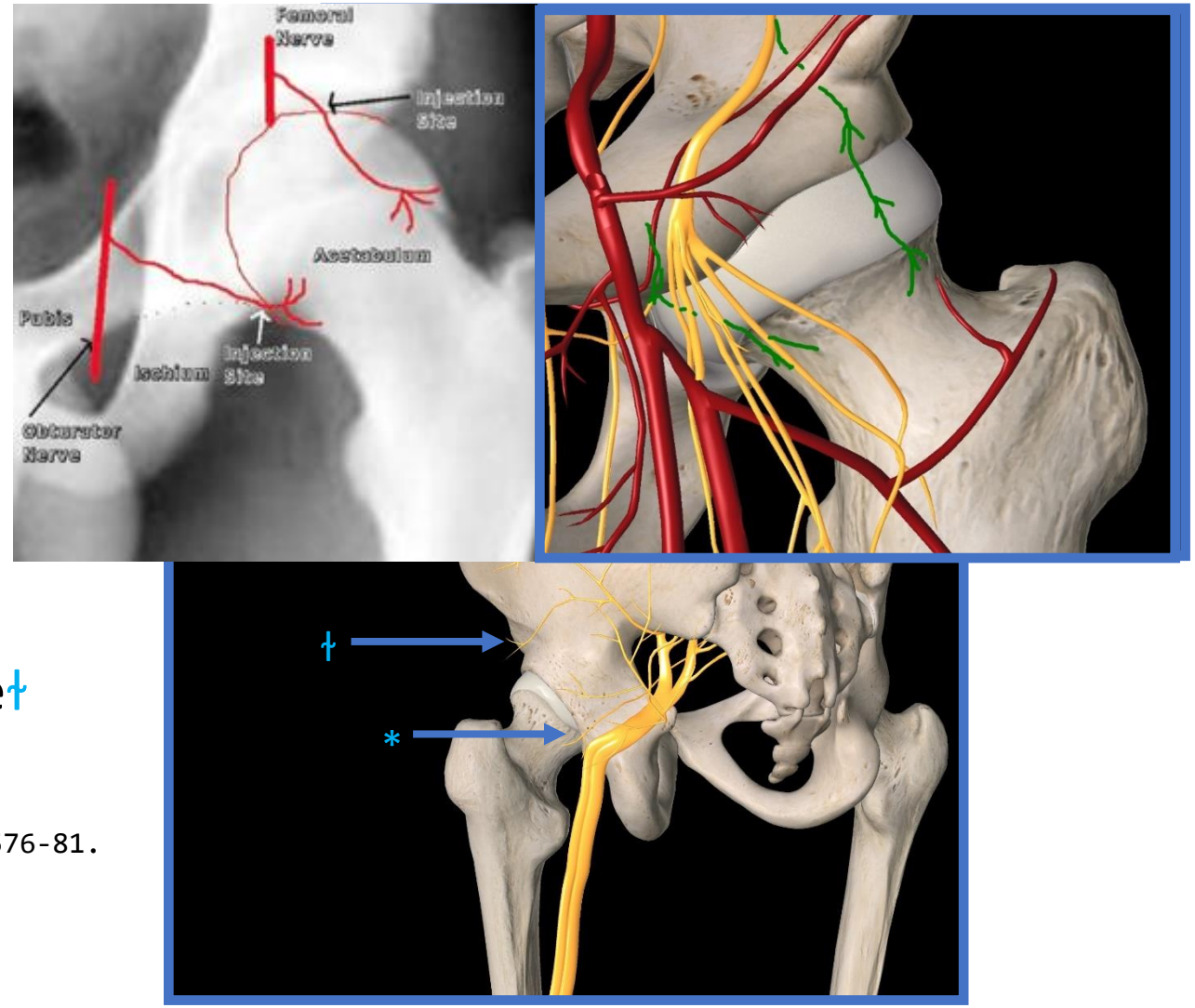
Obturator and Femoral Articular Nerve Ablation For Chronic Hip Pain

The sensory innervation of the hip joint - An anatomical study

K. Birnbaum[1], A. Prescher[2], S. Heßler[1] and K.-D. Heller[1]

Surg Radiol Anat (1997) 19: 371-375

- Anteromedial joint: obturator nerve
- Anterolateral joint: femoral nerve
- Posterosuperior joint: sciatic nerve
- Posteroinferior joint: nerves to quadratus femoris muscle*
- Posterolateral joint: superior gluteal nerve†



1. Binbaum K, et al. Surg Radiol Anat. 1997; 19:371-375.
2. Kawaguchi M, et. al. Reg Anesth Pain Med. 2001 Nov-Dec;26(6):576-81.
3. Malik A, et. al. Pain Physician. 2003 Oct;6(4):499-502.
4. Chye CL, et. al. Clin Interv Aging. 2015 Mar 16;10:569-74.
5. Wu H, Groner J. Pain Pract. 2007 Dec;7(4):341-4.

Case Series of Hip Denervation

Kawaguchi M, et. al. Reg Anesth Pain Med. 2001 Nov-Dec;26(6):576-81.

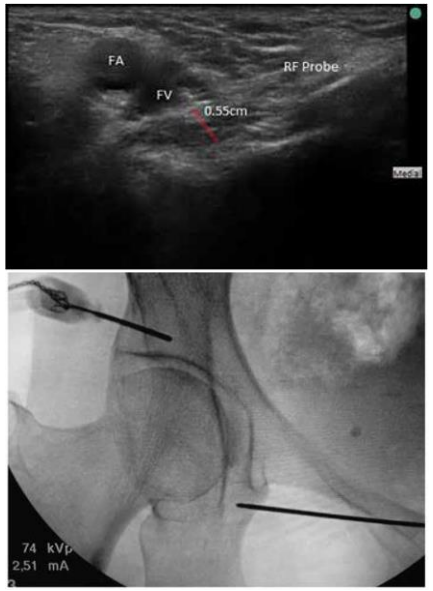
- N = 14 patients; Single diagnostic block: nerve/joint; RFA: obturator in 9, obturator and femoral in 5; mean VAS: 6.8 to 2.7
- 86% had 50% relief for 1-11 months

Rivera F[1], et al. Orthopedics. 2012 Mar 7;35(3):e302-5.

- N = 16 pts; 8 pts ≥ 50% pain relief at 6 months;
- Statistically significant improvement in WOMAC scores.

Kapural L, Jolly S, Mantoan J, Badhey H, Ptacek T. Pain Physician 2018; 21:279-284

- N: 62 screens w diagnostic blocks, 52 recommended to proceeded to RFA (>50% pain relief from block), 23 met inclusion (180 day f/u, completed RFA)
- 52 Hip denervations performed, no vascular complications, 1 case of neuritis/groin pain x1 week
- Ultrasound used in combination with fluoroscopy
- Mean VAS pain score 7.6 → 2.3 ($p < 0.01$); First RFA gave "pain relief" from 30-320 days.
- Mean ~ 150 d



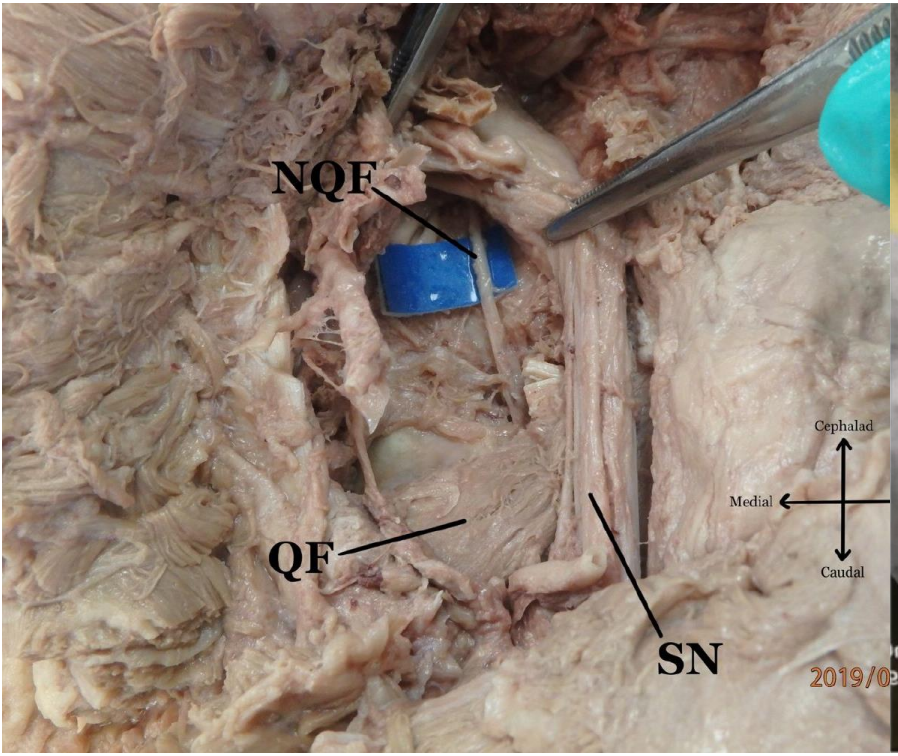
ACCEPTED MANUSCRIPT

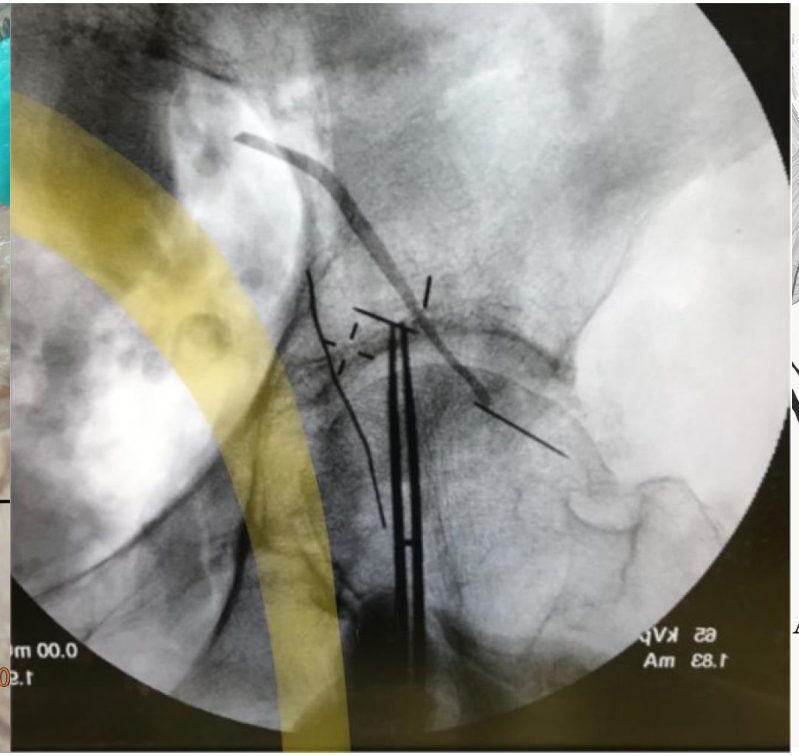
Innervation of the Posterior Hip Capsule: A Cadaveric Study

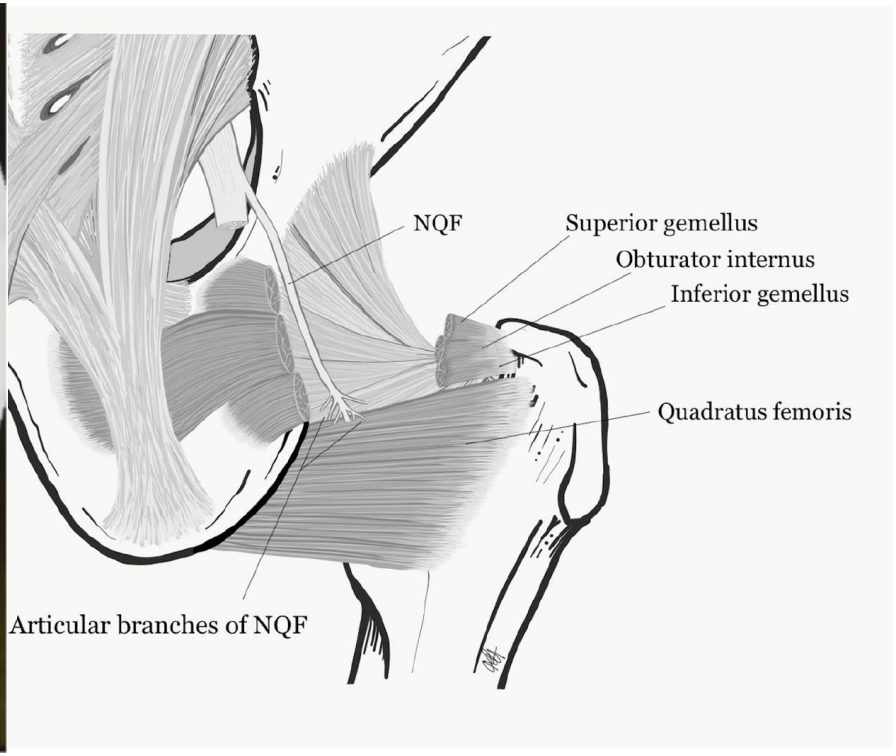
Ameet S Nagpal, MD, MS, MEd ✉, Caroline Brennick, DO, Annette P Occhialini, MD, Jennifer Gabrielle Leet, MD, Tyler Scott Clark, MD, Omid B Rahimi, PhD, Kendall Hulk, DO, Brittany Bickelhaupt, MD, Maxim S Eckmann, MD

Pain Medicine, pnab057, https://doi-org.libproxy.uthscsa.edu/10.1093/pm/pnab057

Published: 10 February 2021







Hip Articular Nerve Ablation and Outcomes

- The obturator and femoral nerve send articular nerve branches to the anterior hip joint[1]. The posterior hip is innervated at least by the nerve to quadratus femoris and the superior gluteal nerve but access may be limited.
- The anterior nerves have been ablation targets in an attempt to palliate severe, non-operable hip pain. Analogous diagnostic paradigms for diagnostic nerve blocks are applied.
- Several case series of SRFA suggest some promise for ablation over the superior portion of the acetabulum and inferomedial portion of the acetabulum.
- Femoral nerve and arterial injury have occurred[2].
- No RCTs are available as of the time of this review.
- CRFA has been developed for this procedure; case series of 23 patients showed mean “pain relief” duration ~150 days (30-320) and no major complications.[3]

1. Short AJ, Barnett JJG, Gofeld M, Baig E, Lam K, Agur AMR, Peng PWH. Anatomic Study of Innervation of the Anterior Hip Capsule: Implication for Image-Guided Intervention. Reg Anesth Pain Med. 2018 Feb;43(2):186-192.
2. Gooding I, et al. Femoral Nerve Injury Following Cooled Radiofrequency Lesioning For the Treatment of Hip Pain Despite Ultrasound Guidance and Motor Testing. Pain Pract. 2016;16(S1):147
3. Kapural L, Jolly S, Mantoan J, Badhey H, Ptacek T. Pain Physician 2018; 21:279-284

Priorities for Future Research

- Defining Clinical Success
  - Clinically important differences in pain
  - Functional assessment and reporting
- Discrete inclusion criteria
  - Disease specific (e.g. bursae, joint, soft tissue)
  - Prognostic block protocol
- Technical Improvements
  - Quantitative Neuroanatomy
  - Ultrasound
  - Lesion Augmentation
- Co-intervention