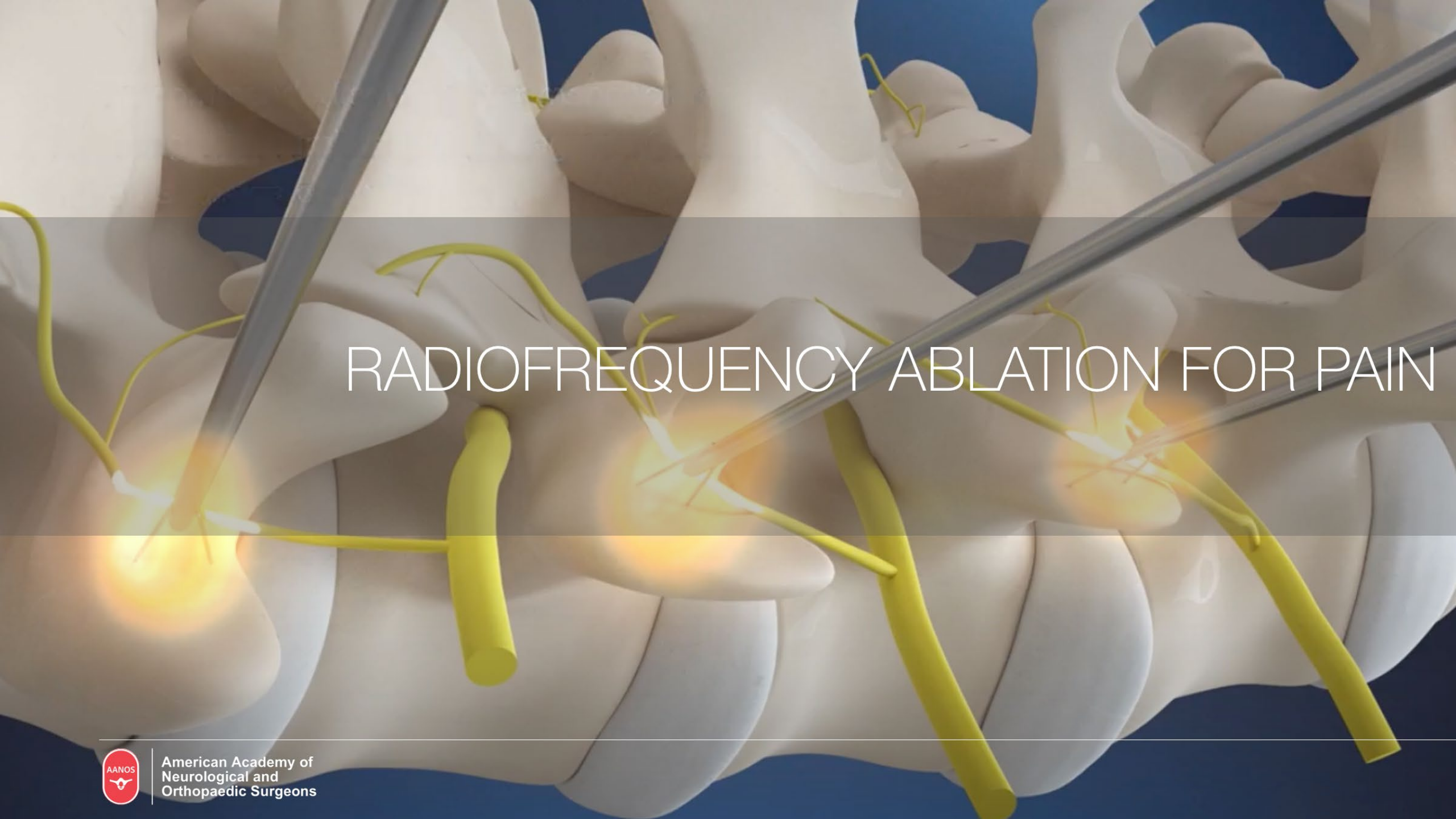


RADIOFREQUENCY ABLATION FOR PAIN

American Academy of
Neurological and
Orthopaedic Surgeons

SAQIB SIDDIQUI, MD, FICS, FAANOS

- Founder of The Spine Center
- Orthopedic Surgeon in private practice with over 33 years of experience in the medical field
- Diplomate of the American Board of Physician Specialists
- Diplomate of the American Academy of Neurological and Orthopedic Surgeons

OBJECTIVES

NIMBUS OVERVIEW

- History of RFA
- RFA Coverage
- Nimbus Design & Rationale
- Lesion Geometry
- Value of Large Volume Lesion

NIMBUS TECHNIQUE

- Cervical
- Lumbar

THE HISTORY OF RF ABLATION

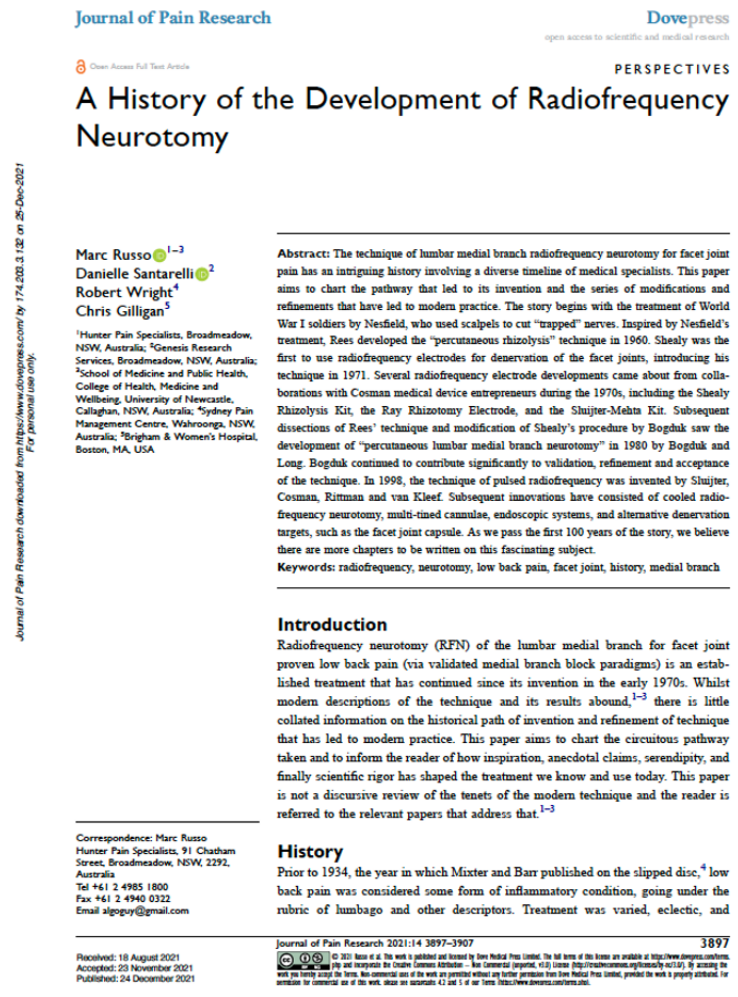
Prior to 1934: low back pain was considered a form of inflammatory condition, going under the rubric of lumbago and other descriptors.

- Treatment was varied, eclectic, and essentially unsuccessful.
- The natural history of the condition played out with various therapies applied.

1918: Nesfield develops treatment for “Trench Back” a low back affliction suffered by World War I soldiers.

- Nesfield, who was a general surgeon specializing in ophthalmics, used ophthalmic scalpels to cut “trapped” nerves.

1934: Mixter and Barr were the first to recognize true root causes of low back pain, publishing a paper on “The Slipped Disc”.



Journal of Pain Research

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PERSPECTIVES

A History of the Development of Radiofrequency Neurotomy

Marc Russo[1–3]
Danielle Santarelli[2]
Robert Wright[4]
Chris Gilligan[5]

[1]Hunter Pain Specialists, Broadmeadow, NSW, Australia; [2]Genesis Research Services, Broadmeadow, NSW, Australia; [3]School of Medicine and Public Health, College of Health, Medicine and Wellbeing, University of Newcastle, Callaghan, NSW, Australia; [4]Sydney Pain Management Centre, Wahroonga, NSW, Australia; [5]Brigham & Women's Hospital, Boston, MA, USA

Abstract: The technique of lumbar medial branch radiofrequency neurotomy for facet joint pain has an intriguing history involving a diverse timeline of medical specialists. This paper aims to chart the pathway that led to its invention and the series of modifications and refinements that have led to modern practice. The story begins with the treatment of World War I soldiers by Nesfield, who used scalpels to cut “trapped” nerves. Inspired by Nesfield’s treatment, Rees developed the “percutaneous rhizolysis” technique in 1960. Shealy was the first to use radiofrequency electrodes for denervation of the facet joints, introducing his technique in 1971. Several radiofrequency electrode developments came about from collaborations with Cosman medical device entrepreneurs during the 1970s, including the Shealy Rhizolysis Kit, the Ray Rhizotomy Electrode, and the Sluijter-Mehta Kit. Subsequent dissections of Rees’ technique and modification of Shealy’s procedure by Bogduk saw the development of “percutaneous lumbar medial branch neurotomy” in 1980 by Bogduk and Long. Bogduk continued to contribute significantly to validation, refinement and acceptance of the technique. In 1998, the technique of pulsed radiofrequency was invented by Sluijter, Cosman, Rittman and van Kleef. Subsequent innovations have consisted of cooled radiofrequency neurotomy, multi-tined cannulae, endoscopic systems, and alternative denervation targets, such as the facet joint capsule. As we pass the first 100 years of the story, we believe there are more chapters to be written on this fascinating subject.

Keywords: radiofrequency, neurotomy, low back pain, facet joint, history, medial branch

Introduction

Radiofrequency neurotomy (RFN) of the lumbar medial branch for facet joint proven low back pain (via validated medial branch block paradigms) is an established treatment that has continued since its invention in the early 1970s. Whilst modern descriptions of the technique and its results abound,[1–3] there is little collated information on the historical path of invention and refinement of technique that has led to modern practice. This paper aims to chart the circuitous pathway taken and to inform the reader of how inspiration, anecdotal claims, serendipity, and finally scientific rigor has shaped the treatment we know and use today. This paper is not a discursive review of the tenets of the modern technique and the reader is referred to the relevant papers that address that.[1–3]

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History

Prior to 1934, the year in which Mixter and Barr published on the slipped disc,[4] low back pain was considered some form of inflammatory condition, going under the rubric of lumbago and other descriptors. Treatment was varied, eclectic, and

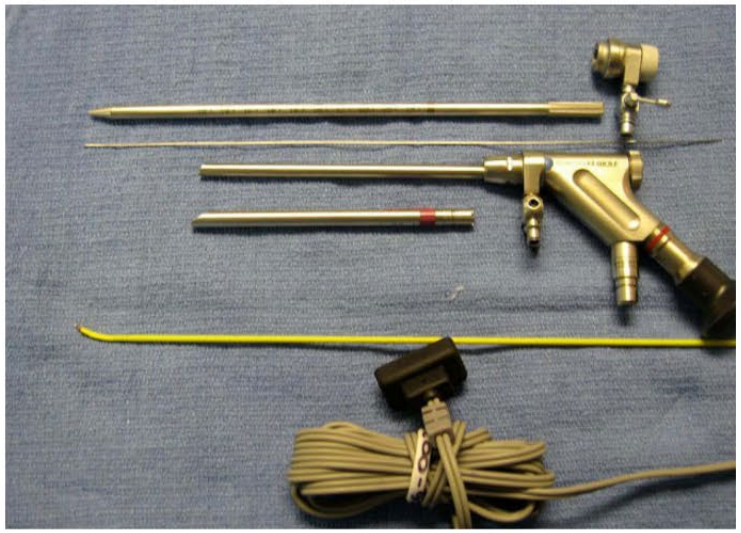
Received: 18 August 2021
Accepted: 23 November 2021
Published: 24 December 2021

THE HISTORY OF RF ABLATION

1960: Rees inspired by Nesfield's treatment, developed the "percutaneous rhizolysis" technique.

1971: Shealy the first to use radiofrequency electrodes for denervation of the facet joints.

- Shealy was the first to introduce fluoroscopic guidance.
- RF electrode development came from collaborations with Cosman medical device entrepreneurs during the 1970s, including the Shealy Rhizolysis Kit and the Ray Rhizotomy Electrode.
- These electrodes were early versions of the generic cannulas we see today. However, the first versions were 14 gauge.



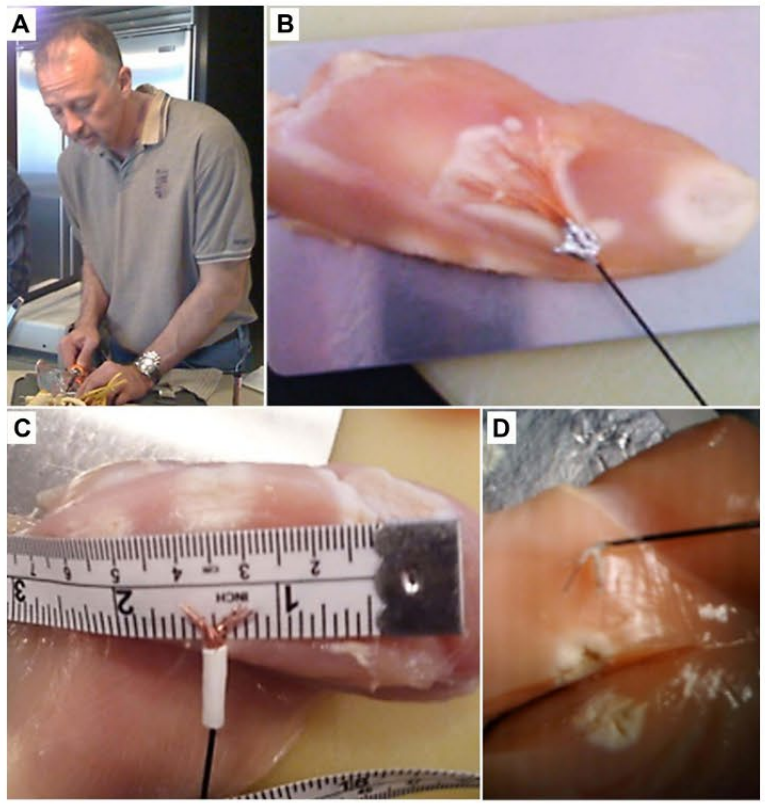
THE HISTORY OF RF ABLATION

1980: Modification of Shealy's procedure by Bogduk saw the development of "percutaneous lumbar medial branch neurotomy" by Bogduk and Long.

1998: "pulsed radiofrequency" was invented by Sluijter, Cosman, Rittman and van Kleef.

Subsequent innovations have consisted of:

- Protruding electrodes such as Venom and Sidekick
- Cooled radiofrequency neurotomy
- Multi-tined cannula
- Endoscopic systems
- Alternative denervation targets, such as the facet joint capsule



CODING & COVERAGE

ANATOMICAL AREA	LEVEL NERVE	CPT CODE
KNEE	3 or More Nerves	64624
SIJ	All Levels	64625
CERVICAL/THORACIC	1st Level	64633
	2nd Level	+64634
	3rd Level*	+64634
LUMBAR	1st Level	64635
	2nd Level	+64636
	3rd Level*	+64636

CONSENSUS GUIDELINES

Large Lesion RFA Device Improves Efficacy

LARGE LESION REDUCES FAILURES

"…decreasing the technical failure rate by increasing lesion size should be a relatively non-controversial endeavor that most people can agree on."

STANDARD CANNULA LIMITATIONS

"Based on the current limitations of traditional thermal RFA and the small size of the targeted structures, creating larger lesions with reduced lesion variability may increase the likelihood of capturing the targeted structure."

Special article

OPEN ACCESS

Consensus practice guidelines on interventions for lumbar facet joint pain from a multispecialty, international working group

Steven P Cohen [1], Arun Bhaskar,[2] Anuj Bhatia,[3] Asokumar Buvanendran,[4] Tim Deer,[5] Shuchita Garg,[6] W Michael Hooten [7], Robert W Hurley,[8] David J Kennedy,[9] Brian C McLean,[10] Jee Youn Moon,[11] Samer Narouze,[12] Sanjog Pangarkar,[13] David Anthony Provenzano,[14] Richard Rauck,[15] B Todd Sitzman,[16] Matthew Smuck,[17] Jan van Zundert [18,19] Kevin Vorenkamp,[20] Mark S Wallace,[21] Zirong Zhao[22]

► Additional material is published online only. To view, please visit the journal online (http://dx.doi.org/10.1136/rapm-2019-101243).

For numbered affiliations see end of article.

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Received 21 December 2019
Revised 7 February 2020
Accepted 11 February 2020
Published Online First 3 April 2020

To cite: Cohen SP, Bhaskar A, Bhatia A, *et al*. *Reg Anesth Pain Med* 2020;**45**:424–467.

ABSTRACT

Background The past two decades have witnessed a surge in the use of lumbar facet blocks and radiofrequency ablation (RFA) to treat low back pain (LBP), yet nearly all aspects of the procedures remain controversial.

Methods After approval by the Board of Directors of the American Society of Regional Anesthesia and Pain Medicine, letters were sent to a dozen pain societies, as well as representatives from the US Departments of Veterans Affairs and Defense. A steering committee was convened to select preliminary questions, which were revised by the full committee. Questions were assigned to 4–5 person modules, who worked with the Subcommittee Lead and Committee Chair on preliminary versions, which were sent to the full committee. We used a modified Delphi method, whereby the questions were sent to the committee en bloc and comments were returned in a non-blinded fashion to the Chair, who incorporated the comments and sent out revised versions until consensus was reached.

Results 17 questions were selected for guideline development, with 100% consensus achieved by committee members on all topics. All societies except for one approved every recommendation, with one society dissenting on two questions (number of blocks and cut-off for a positive block before RFA), but approving the document. Specific questions that were addressed included the value of history and physical examination in selecting patients for blocks, the value of imaging in patient selection, whether conservative treatment should be used before injections, whether imaging is necessary for block performance, the diagnostic and prognostic value of medial branch blocks (MBB) and intra-articular (IA) injections, the effects of sedation and injectate volume on validity, whether facet blocks have therapeutic value, what the ideal cut-off value is for a prognostic block, how many blocks should be performed before RFA, how electrodes should be oriented, the evidence for larger lesions, whether stimulation should be used before RFA, ways to mitigate complications, if different standards should be applied to clinical practice and clinical trials and the evidence for repeating RFA (see table 12 for summary).

Conclusions Lumbar medial branch RFA may provide benefit to well-selected individuals, with MBB being more predictive than IA injections. More stringent selection criteria are likely to improve denervation outcomes, but at the expense of more false-negatives. Clinical trials should be tailored based on objectives, and selection criteria for some may be more stringent than what is ideal in clinical practice.

INTRODUCTION

There are few conditions in interventional pain medicine as controversial as lumbar facet joint pain. Everything from incidence, to diagnostic criteria, patient selection for interventions and the effectiveness of treatment is a source of contention and scientific debate. Regarding prevalence, the cited frequency of lumbar facet joint pain ranges from as low as 4.8% in the multicenter National Low Back Pain Survey evaluating final diagnoses of 2374 patients with low back pain (LBP) referred to an orthopedic or neurosurgical spine surgeon, to over 50% in systematic reviews on prevalence studies using varying criteria for diagnostic blocks performed by interventional pain physicians.[1–4] The wide disparity in reported prevalence raises questions regarding the accuracy of diagnostic testing in the absence of any non-interventional diagnostic reference standard. The poor correlation between facet joint pathology on imaging and LBP further fuels debate.[5] For diagnostic criteria, research and review articles abound on the ideal cut-off for designating a block as positive, and the optimal number of blocks that should be performed before lumbar facet radiofrequency ablation (RFA) treatment, with no consensus emerging.[6–11]

Lumbar facet interventions comprise the second most common procedure performed in interventional pain practices, with millions per year being performed in the USA alone.[12] For lumbar RFA, a recent review of the Marketscan commercial claims and encounters databases from 2007 to 2016 demonstrated a 130.6% overall increase in utilization (9.7% annually).[13] Along with increasing utilization, there was also a reciprocal increase in cost,

Consensus Practice Guidelines on Interventions for Lumbar Facet Joint Pain from a Multispecialty, International Working Group
S. Cohen, MD, A. Bhaskar, MD, A. Bhatia, MD, A. Buvanendran, MD, Tim Deer, MD, S. Garg, MD, W.M. Hooten, MD, R.W. Hurley, MD, D.J. Kennedy, MD, B.C. McLean, J. Youn Moon, MD, S. Naro
Pain Practice Volume 21, Issue 7, 2021, page 747-758

CONSENSUS GUIDELINES

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STANDARD CANNULA LIMITATIONS

"Based on the current limitations of traditional thermal RFA and the small size of the targeted structures, creating larger lesions with reduced lesion variability may increase the likelihood of capturing the targeted structure."

Special article

et al[214] reported a 55% success rate when evaluating a new approach for cervical medial branch RFA without the use of a screening block. In a randomized study evaluating the utility of a single prognostic block before RFA for knee osteoarthritis in 54 individuals, McCormick *et al*[215] reported 6-month success rates of 64% in the no-block group and 59% in the single-block group. Yet, the lower relative prevalence rate of facetogenic pain in individuals with LBP compared with those with neck pain, and arthritis in those with knee pain, suggests there is a higher likelihood for false-positive diagnostic blocks in the lumbar spine compared with the cervical spine or knee.

Weighing false-positives versus false-negatives

There is evidence in the form of observational studies that the success rate for medial branch RFA will increase with the number of blocks, but this will inevitably occur at the expense of patients who are deprived of treatment. The proportion of the higher success rate that is attributable to a higher placebo response rate with multiple blocks is unclear; the only way to obviate this dilemma would be to perform placebo-controlled blocks, which are difficult to justify for a relatively safe procedure. Two observational studies illustrate the high success rates that can be achieved with stringent selection. As noted above, the prospective cohort study by Dreyfuss *et al*[23] reported that 87% of 15 patients who experienced at least 80% relief with dual-comparative LA MBB obtained at least 60% pain relief maintained at 1 year after RFA, with 60% obtaining at least 90% relief. However, along with double blocks, the authors screened 460 patients for the study, with 138 presenting for full physical examinations, suggesting a low prevalence of isolated facetogenic pain, a high false-negative rate or a combination of the two. In a more recent study using similar selection criteria and RF parameters, MacVicar *et al*[216] reported that 56% of 106 patients obtained complete pain relief and functional restoration lasting a median of 15 months. Whereas the authors were not able to determine the exact number of patients screened, they estimated it to be around 575. In a meta-analysis performed by Lee *et al*[217] evaluating five randomized controlled studies and 423 patients with 6-month follow-up data who underwent either lumbar medial branch RFA or a control procedure (sham or epidural steroid injection), the authors found a statistically and clinically significant 1.5-point difference in back pain scores favoring denervation. Notably, all studies in this review used either 1 or 0 (n=1) block, and one included patients with 'equivocal' relief. In a prospective, observational study, McCormick *et al*[205] performed double blocks in individuals who experienced between 50% and 75% relief (n=28), but proceeded to RFA following single blocks if the pain relief obtained was ≥75% (n=27), and found no significant differences in outcomes.

Clinical prediction tools

It is possible that in the future, predictive modeling programs based on large-scale registries or complex trial designs may find that different people require different RFA selection paradigms (personalized medicine). Proceeding straight to RFA without blocks is preferred in situations where costs and number of procedures are the primary concerns. Potential examples include an elderly person who is on anticoagulation therapy and presents with paraspinal tenderness, marked facet arthropathy on MRI and no psychopathology or those in whom blocks could pose significant risks or hardships (eg, a person with extreme needle phobia who might require sedation that could undermine the accuracy of a block, or a service member deployed at a forward operating base). Double MBBs provide an advantage and are preferred when maximizing the success rate of medial branch RFA is the primary concern. Examples include a person with minimal imaging pathology, an equivocal physical examination or multiple risk factors for treatment failure; a young athlete in whom denervating spinal muscles could affect performance and someone with spondylolisthesis or other risk factors for spinal instability in whom denervation could theoretically worsen their clinical condition.

Recommendation

The committee recommends a single block. We found moderate evidence that dual blocks result in a higher subsequent success rate for medial branch RF, but that the use of a zero-block paradigm results in the highest overall number of patients with a positive response to the RFA. This has led some, including this committee, to a clinical compromise of accepting the results of a single MBB for identifying denervation candidates, with some data suggesting that higher RF treatment response rates occur in those reporting a higher degree of relief with a single block. In an era of personalized medicine, the committee believes that known variables should be used to tailor care to the needs of the individual patient and to the goals of the practice environment; grade C recommendation, low-to-moderate level of certainty.

QUESTION 12: IS THERE EVIDENCE FOR LARGER LESIONS TO IMPROVE OUTCOME MEASURES FOR RADIOFREQUENCY ABLATION? IF SO, HOW CAN LESION SIZE BE INCREASED?

Rationale for lesion size for lumbar facet denervation

In order to effectively perform RFA of the medial branches and dorsal rami innervating the lumbar facet joints, it critically important that physicians understand the electrophysiological principles, technical and anatomic aspects of RFA.[14 218–220] Procedural challenges exist for lumbar RFA based on the need to balance limiting the size of thermal lesions to avoid lesioning non-targeted tissues and enhancing lesion size to increase the likelihood of capturing the targeted small-diameter nerve fibers. The diameter of lumbar medial branches is <2 mm and the L5 dorsal ramus transverse diameter has been measured at 0.5 mm.[221 222]

The main rationale for expanding lesion size is to increase the maximal tolerable margin of error for coagulating the targeted medial branch or dorsal rami, which can vary in location and in the number of branches that innervate the facet joint.[223] The margin of error is the maximum distance that an RF cannula can be placed from a targeted structure and still create a lesion that envelops the structure.[224] With limited-sized lesions and small diameter nerves, the tolerable margin of error is small.

It is important to emphasize that whereas patient selection is the most effective way to improve RFA success rate, because withholding treatment from individuals who are at high risk for failure but could greatly benefit from ablation may severely curtail access (ie, high-risk, high reward category such as those on opioids or who are unable to work because of back pain), decreasing the technical failure rate by increasing lesion size should be a relatively non-controversial endeavor that most people can agree on.

The physics of radiofrequency ablation

Traditional thermal RFA involves the use of high-frequency alternating current (300 000–500 000 Hz), which results in ionic agitation and friction generating focal heating in tissue (ie, the tissue surrounding the electrode becomes the primary source

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Pain Practice Volume 21, Issue 7, 2021, page 747-758

CLINICAL VALIDATION

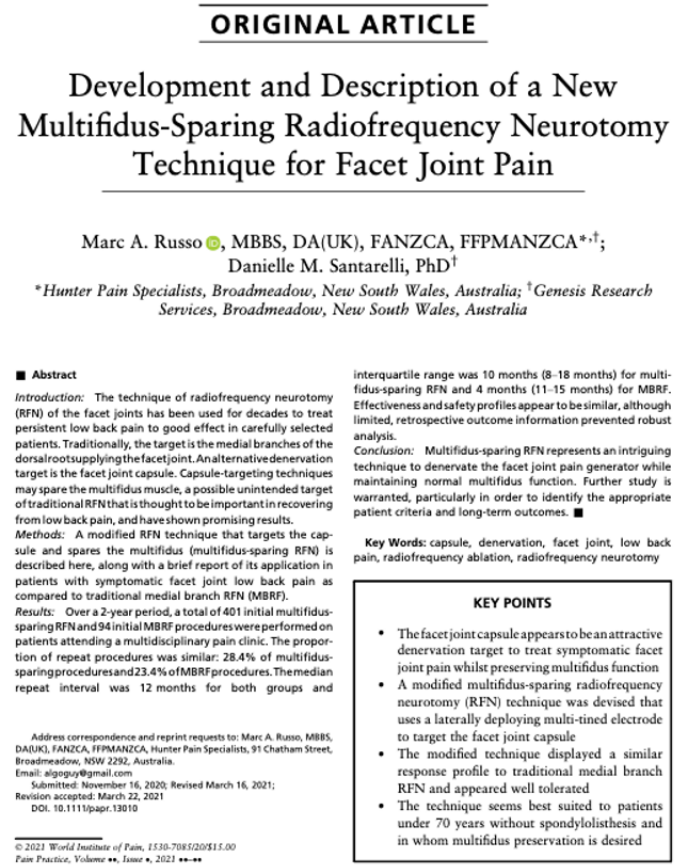
~57% of 495 of patients report positive outcome with Nimbus for Lumbar RFA at 12 months

12 MONTH LUMBAR RFA

"58.5% of MBRF procedures and 56.1% of multifidus-sparing RFN procedures having a positive outcome" at 12 months.

REPEAT 12 MONTH LUMBAR OUTCOME

"The majority of repeat procedures were performed after an initial positive result (86.4% of MBRF repeats and 82.5% of multifidus-sparing RFN repeats)."



ORIGINAL ARTICLE

Development and Description of a New Multifidus-Sparing Radiofrequency Neurotomy Technique for Facet Joint Pain

Marc A. Russo, MBBS, DA(UK), FANZCA, FFPMANZCA*,†; Danielle M. Santarelli, PhD†

*Hunter Pain Specialists, Broadmeadow, New South Wales, Australia; †Genesis Research Services, Broadmeadow, New South Wales, Australia

■ Abstract

Introduction: The technique of radiofrequency neurotomy (RFN) of the facet joints has been used for decades to treat persistent low back pain to good effect in carefully selected patients. Traditionally, the target is the medial branches of the dorsal root supplying the facet joint. An alternative denervation target is the facet joint capsule. Capsule-targeting techniques may spare the multifidus muscle, a possible unintended target of traditional RFN that is thought to be important in recovering from low back pain, and have shown promising results.

Methods: A modified RFN technique that targets the capsule and spares the multifidus (multifidus-sparing RFN) is described here, along with a brief report of its application in patients with symptomatic facet joint low back pain as compared to traditional medial branch RFN (MBRF).

Results: Over a 2-year period, a total of 401 initial multifidus-sparing RFN and 94 initial MBRF procedures were performed on patients attending a multidisciplinary pain clinic. The proportion of repeat procedures was similar: 28.4% of multifidus-sparing procedures and 23.4% of MBRF procedures. The median repeat interval was 12 months for both groups and interquartile range was 10 months (8–18 months) for multifidus-sparing RFN and 4 months (11–15 months) for MBRF. Effectiveness and safety profiles appear to be similar, although limited, retrospective outcome information prevented robust analysis.

Conclusion: Multifidus-sparing RFN represents an intriguing technique to denervate the facet joint pain generator while maintaining normal multifidus function. Further study is warranted, particularly in order to identify the appropriate patient criteria and long-term outcomes. ■

Key Words: capsule, denervation, facet joint, low back pain, radiofrequency ablation, radiofrequency neurotomy

KEY POINTS

- The facet joint capsule appears to be an attractive denervation target to treat symptomatic facet joint pain whilst preserving multifidus function
- A modified multifidus-sparing radiofrequency neurotomy (RFN) technique was devised that uses a laterally deploying multi-tined electrode to target the facet joint capsule
- The modified technique displayed a similar response profile to traditional medial branch RFN and appeared well tolerated
- The technique seems best suited to patients under 70 years without spondylolisthesis and in whom multifidus preservation is desired

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Email: algoguy@gmail.com

Submitted: November 16, 2020; Revised March 16, 2021; Revision accepted: March 22, 2021
DOI. 10.1111/papr.13010

Pain Practice, Volume ••, Issue •, 2021 ••–••

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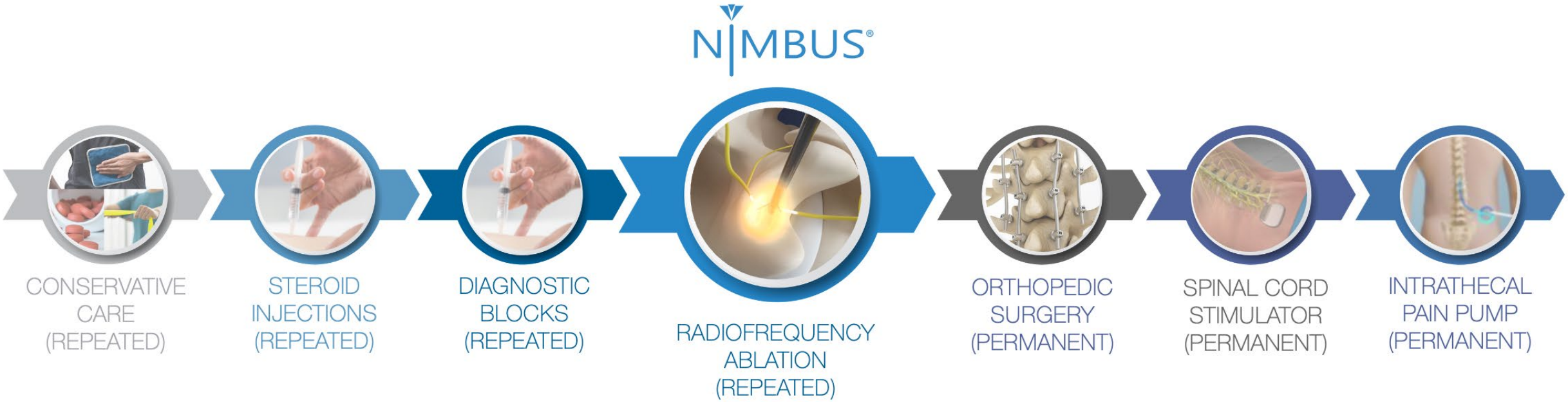
Pain Practice Volume 21, Issue 7, 2021, page 747-758

CHRONIC PAIN PATIENT JOURNEY

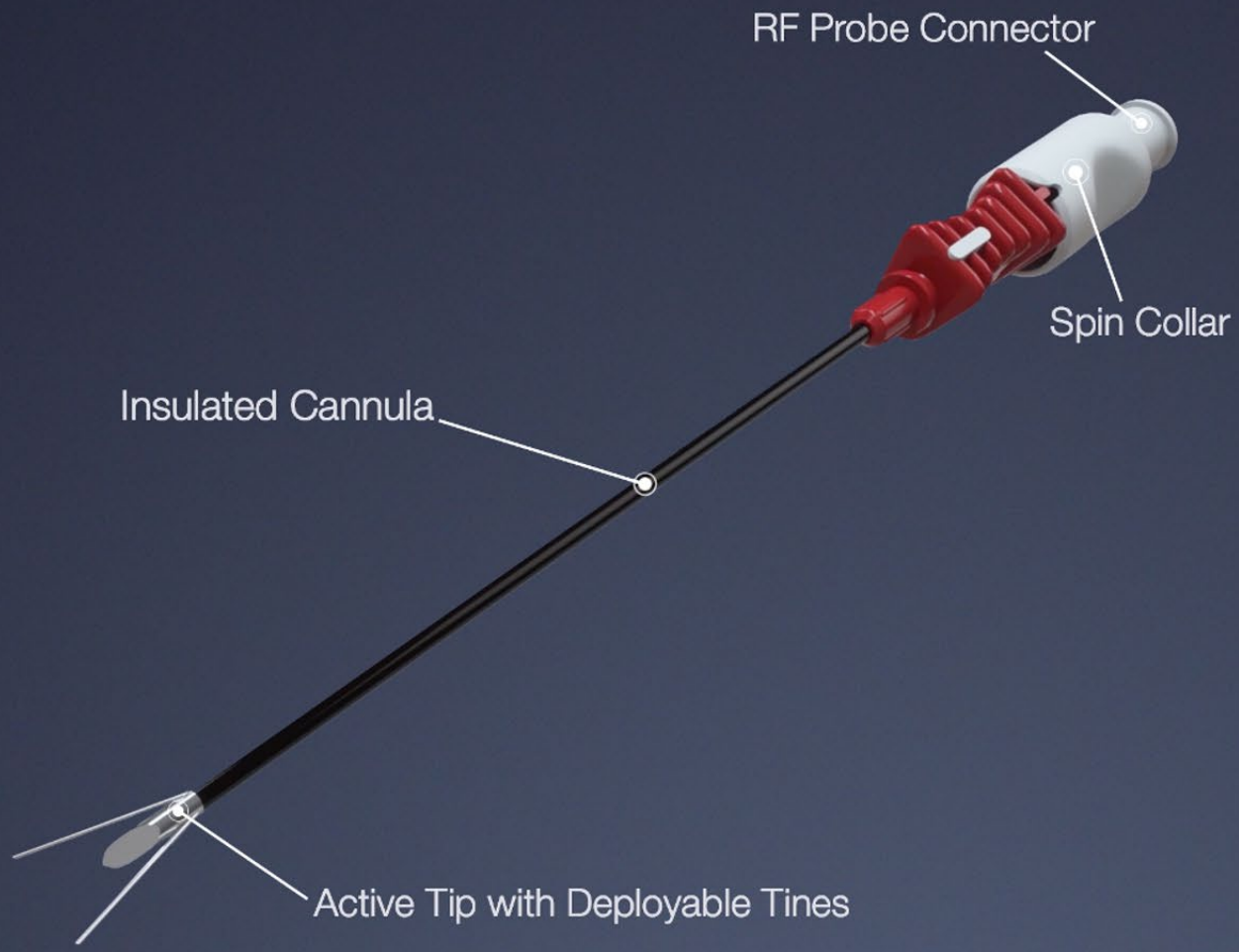


RFA FOR PAIN

Standard of care RFA Needle – 40 years with minimal innovation

50% of patients	3-6 months	1,100,000+	3,300,000+
50% Pain Relief	Duration of Pain Relief	US Procedures per Year	RF needles used annually

MULTI-TINED RFA

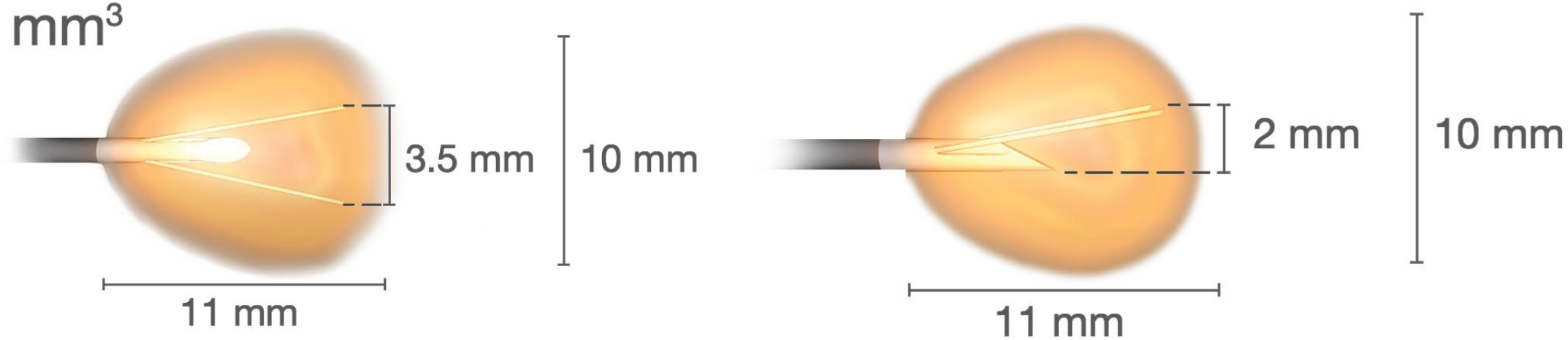


NIMBUS LESION

Volume & Geometry

Volume:

601 mm^3

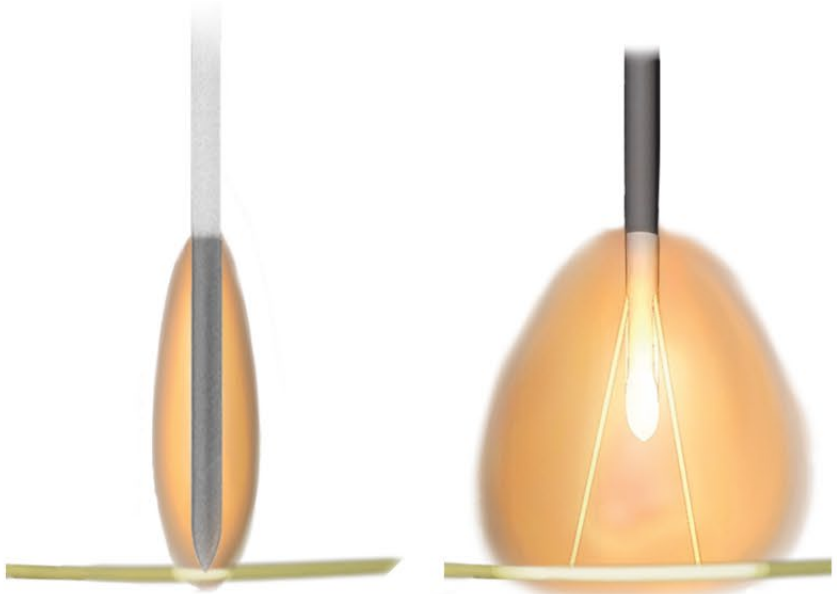


Bulk of lesion is contained near distal tip and ideal for perpendicular or *down the beam* placement

WHY NIMBUS WORKS

Large Volume Lesion to Address Anatomical Variation

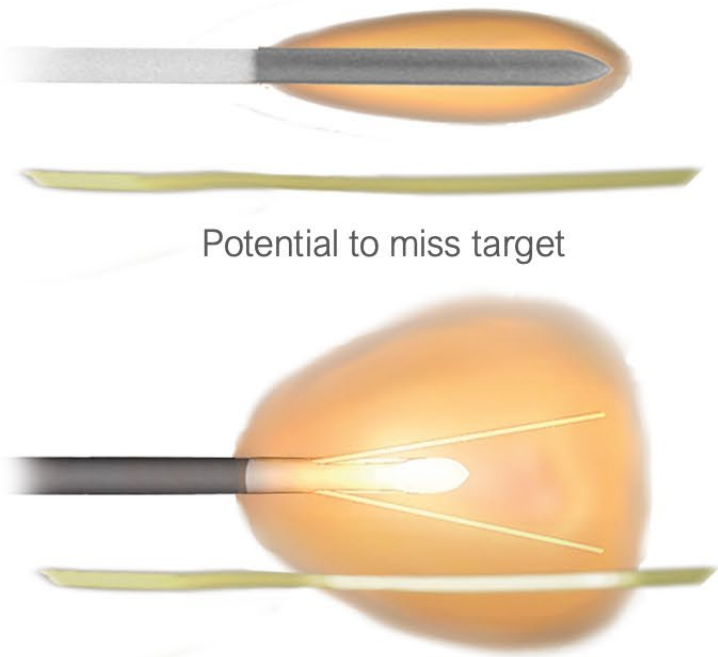
Perpendicular Approach



3mm Spot Lesion

10mm Neurotomy

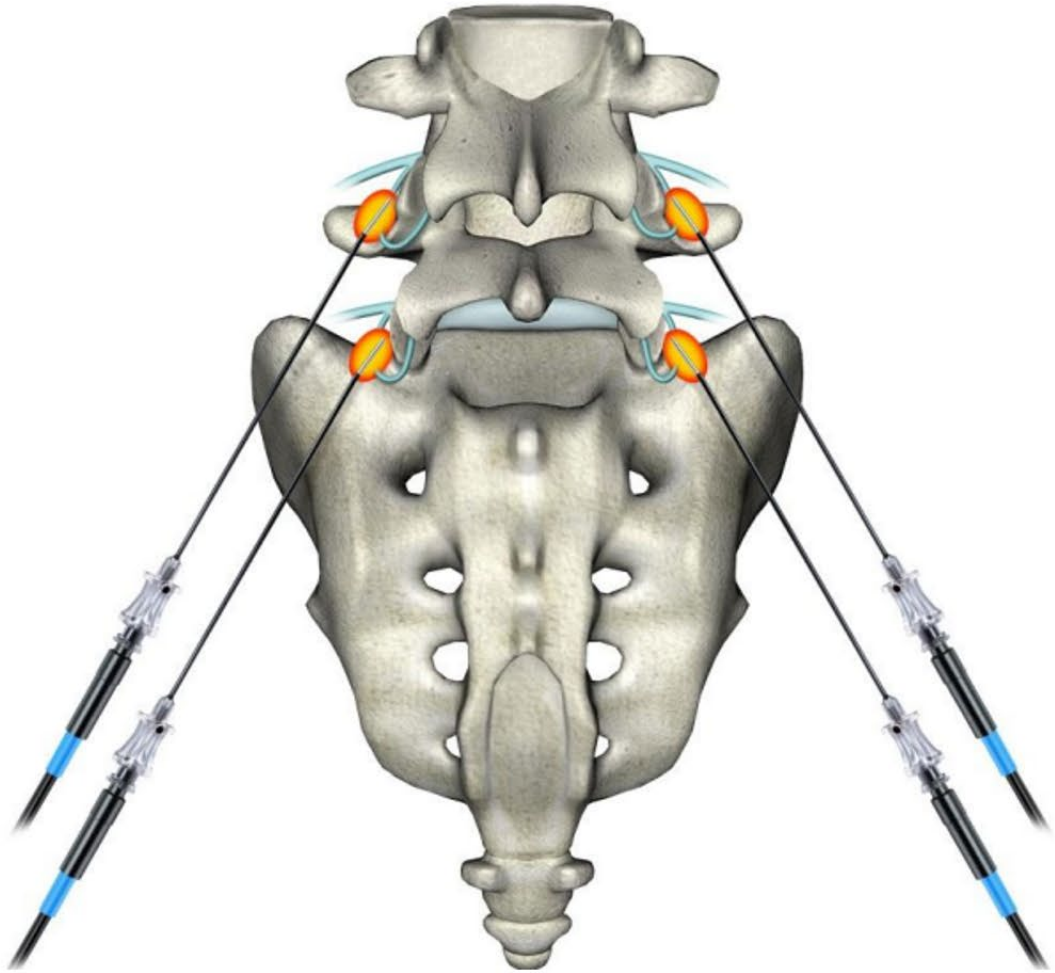
Parallel Placement



Potential to miss target

10mm Neurotomy

STANDARD CANNULA



LARGE VOLUME LESION

- SIMPLE COAXIAL PLACEMENT
- COST-EFFECTIVE DEVICE
- PREDICTABLE & DURABLE PAIN RELIEF AT 12 MONTHS[8,10]

Radiofrequency Neurotomy for Sacroiliac Joint Pain; Twelve Month Outcomes and Comparison Between Two Techniques[8]
R.E. Wright, M.D., DABPM, FIPP, Metro Pain Group, Melbourne, Australia. Poster Presentation at the 11thAnnual Congress of the European Pain Federation in Valencia, Spain, September 2019.

Development and Description of a New Multifidus-Sparing Radiofrequency Neurotomy Technique for Facet Joint Pain[10]
M.A. Russo, MBBS, DA(UK), FANZCA, FFPMANZCA; D.M. Santarelli, PhD. World Institute of Pain, Vol. 21, Issue 7, September 2021.

AANOS

American Academy of Neurological and Orthopaedic Surgeons

LESION VOLUME

Comparison

20g Mono*	18g Mono*	20g PE*	18g PE*	NIMBUS®**	Cooled RF*
143mm³	169mm³	155mm³	215mm³	601mm³	595mm³
80° C for 90 seconds					60° C for 150 seconds

Comparisons of Lesion Volumes and Shapes Produced by a Radiofrequency System with a Cooled, a Protruding, or a Monopolar Probe*

D.L. Cedeño, A. Vallejo, Courtney A.K., D.M. Tilley, and N. Kumar, Millennium Pain Center, Bloomington, Illinois; Illinois Wesleyan University, Bloomington, Illinois; University of Illinois at Urbana-Champaign, Champaign, Illinois, Illinois; Pain Physician: September/October 2017: 20:E915-E922

Technical Efficacy of a Direction Specific Radiofrequency Device in the Performance of Lumbar Medial Branch Neurotomies – An MRI and EMG Confirmation Study (Interim Analysis)**

J.S. Bainbridge, MD, R.E. Wright, MD, C.D. Pappas, MD, S. Light, BA, RC, R.B. McQueen, PhD, Pain Medicine, Volume 16, Number 8, 2015, page 1650

NIMBUS RFA

Best Practice Summary

- Nimbus is recommended with perpendicular or *down the beam* approach for thoracic, cervical, lumbar, postoperative spine, and SIJ applications. Peripheral nerve is essential.
- Nimbus must be fully deployed with tactile click prior to injectate, motor, stimulation or lesion
- Monopolar setting recommendation is 80° C for 80 seconds
- Bipolar setting recommendation is 85° C for 150 seconds

See IFU for complete instructions for use, warnings, precautions and contraindications

SEDATION

- Sedation encompasses a range from minimal awareness to full unconsciousness. This progression includes minimal sedation, conscious or moderate sedation, deep sedation, and culminates in general anesthesia. Sedatives like benzodiazepines are primarily used to reduce anxiety, whereas analgesics, such as opioids, target pain perception and may even affect diagnostic results. During moderate sedation, patients can actively respond to verbal cues and might also respond to gentle touch. At this level, patients maintain an open airway without external help, breathe naturally, and typically have stable cardiovascular functions. Achieving this state often involves a combination of both sedatives and analgesics.

POST-OP RECOMMENDATIONS

- Ice packs may be used intermittently to numb pain and reduce swelling. Heat packs are usually not advised on the injection site after RFA.
- Warm showers are preferred over baths for 1 to 2 days after the RFA procedure.
- Pain relief after RFA is typically experienced 1-3 weeks after the procedure. Patients should take it easy, immediately following the procedure. Patients may resume regular activities but should let pain levels be their guide for the first few days. Physical therapy may be prescribed to patients experiencing deconditioning due to pain (to help increase patient strength and activity level).

COMMON MINOR COMPLICATIONS

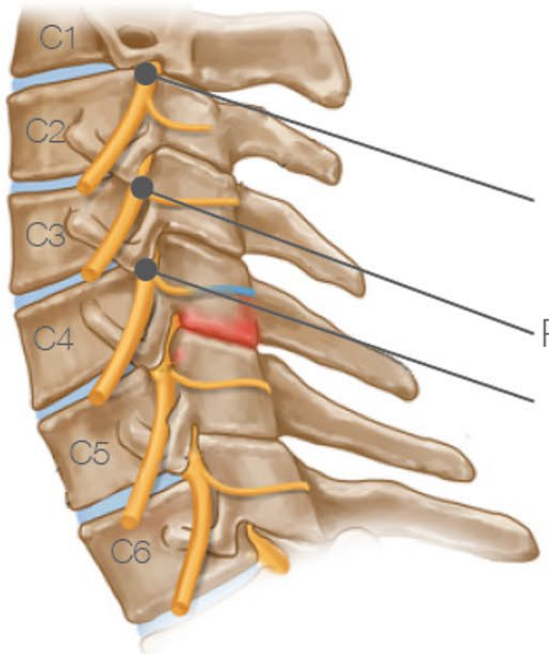
- Immediately after radiofrequency ablation, the following side effects may be experienced:
  - Burning and/or hypersensitivity over the injection site
  - Numbness and/or tingling over the injection site
  - Sometimes, these symptoms may feel like a sunburn in the treated area. While these symptoms may last for the first few days or weeks, they can be managed by resting, intermittently using an ice-pack over the sore area and using topical or oral medications.

RARE, BUT SERIOUS COMPLICATIONS

- Hyperesthesia—an excessive, abnormal sensitivity over the skin of the injection site
- Superficial skin infections over the injection site
- Damage to surrounding blood vessels and nerves during needle insertion resulting in excessive bleeding and/or irreversible neurologic damage causing long-term numbness and tingling
- Heat damage to structures adjacent to the target nerve
- Heat damage to skin from superficial placement of device or grounding pad
- Allergic reaction to the anesthetic used to numb the skin
- Apart from these risks, muscular tissue damage and itching at the injection site may occur in some cases.
- Sedation-related risks. Although the use of sedation is rare, mild to moderate sedation or general anesthesia may be used during the RFA procedure in some cases. Allergic reactions and respiratory depression (breathing difficulty) may result from the sedation process in rare cases.

CERVICAL

Lateral



Greater Occipital Nerve

Suboccipital Nerve (C1)

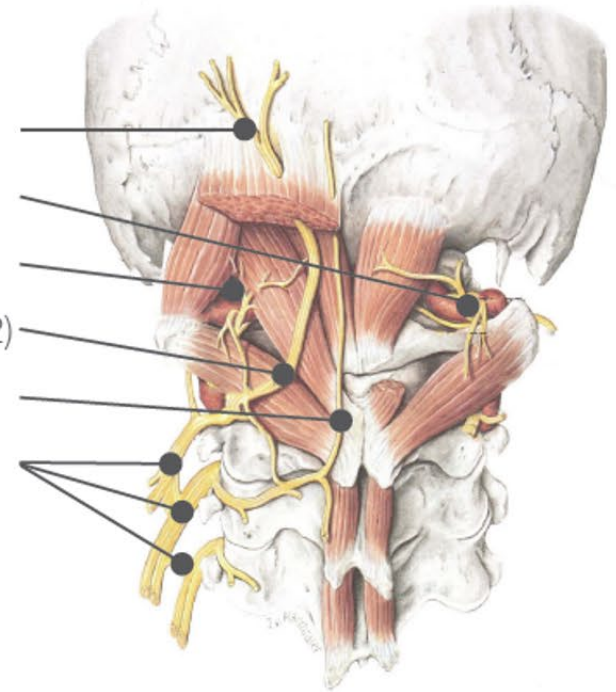
Vertibral Artery

Posterior Primary Ramus (C2)

3rd Occipital Nerve

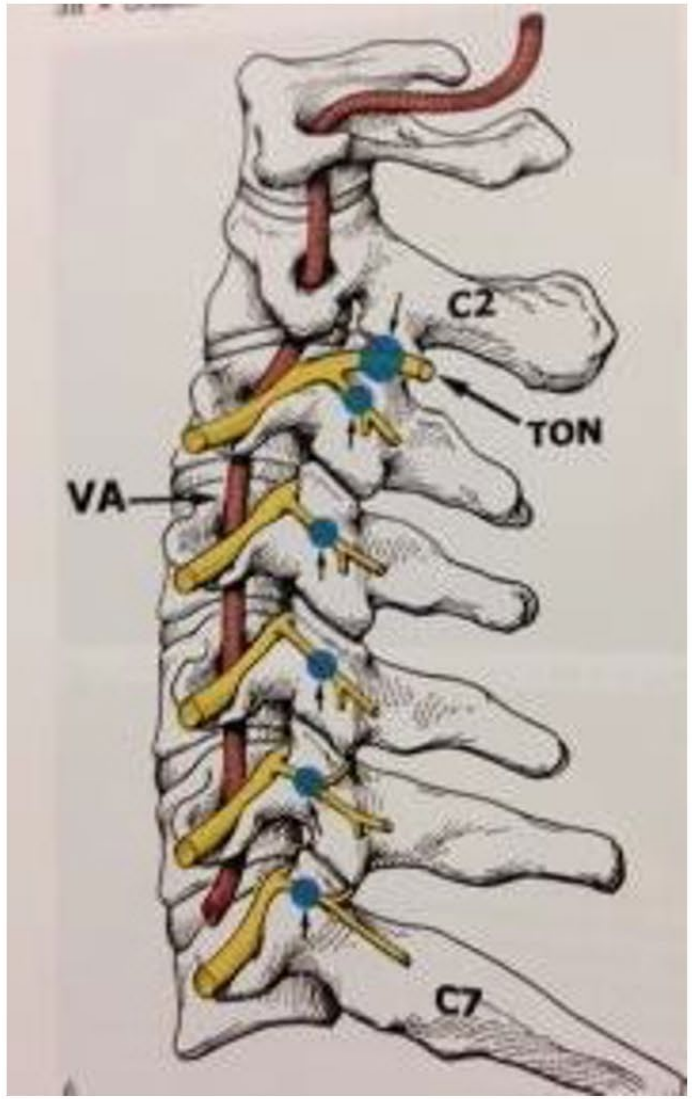
Cervical Plexus

AP



CERVICAL

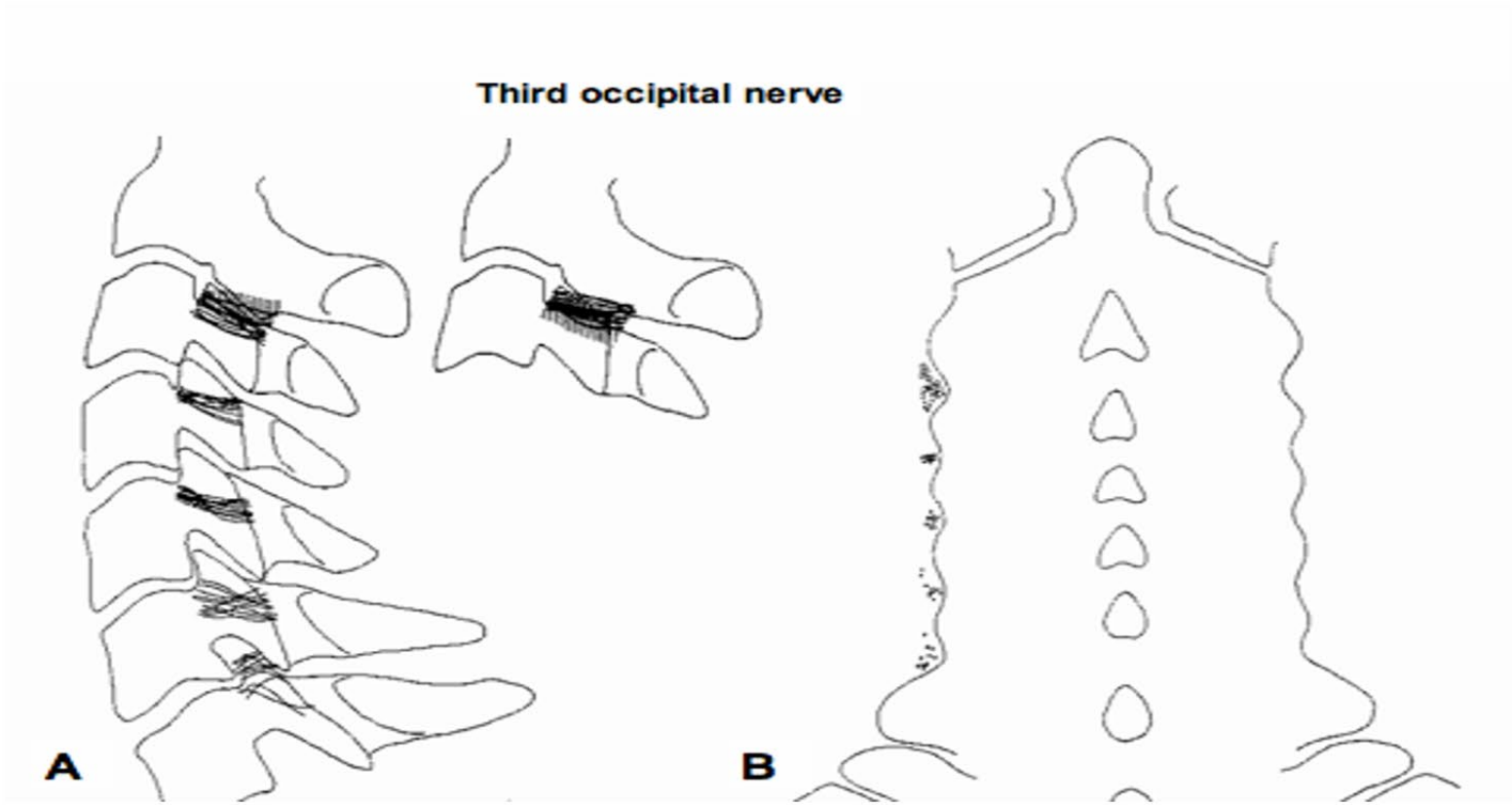
- Referred neck pain from the C2-C3 facet joint has been shown to cause headache in patients. Since the third occipital nerve (TON) innervates the C2-C3 facet joint, the pain derived from this joint, known as “third occipital headache.”[9]
- The TON is the superficial medial branch of the dorsal ramus of C3.
- TON block is used to confirm the diagnosis of C2–C3 joint pain. It is also used to select patients for RF neurotomy of the TON.[10]
- RF neurotomy can be performed using either a posterior approach or a lateral approach.



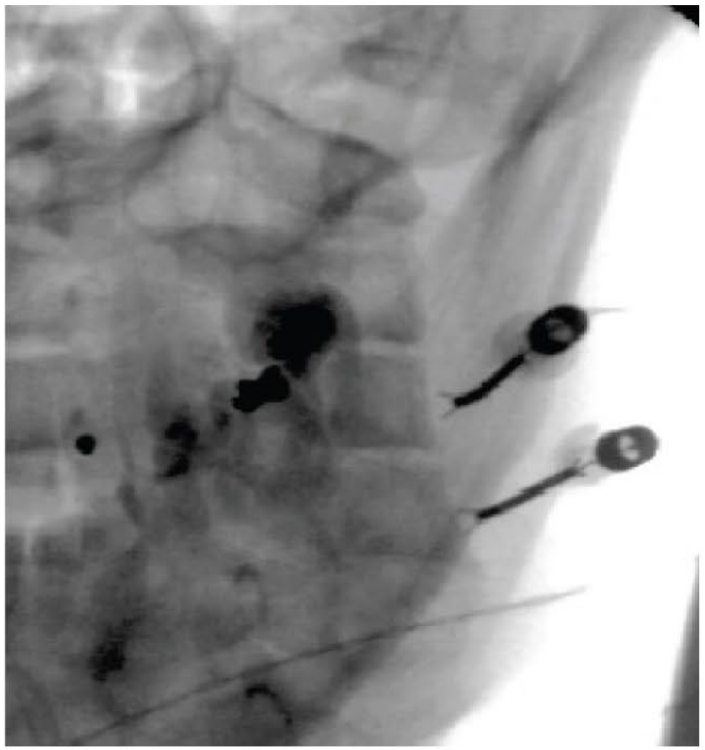
CERVICAL

- Posterior approach – Patients placed in prone position with head slightly flexed. The needle is placed parallel to the nerve, which creates a large lesion over entire length of the nerve. Bilateral procedures are performed with this approach.[10]

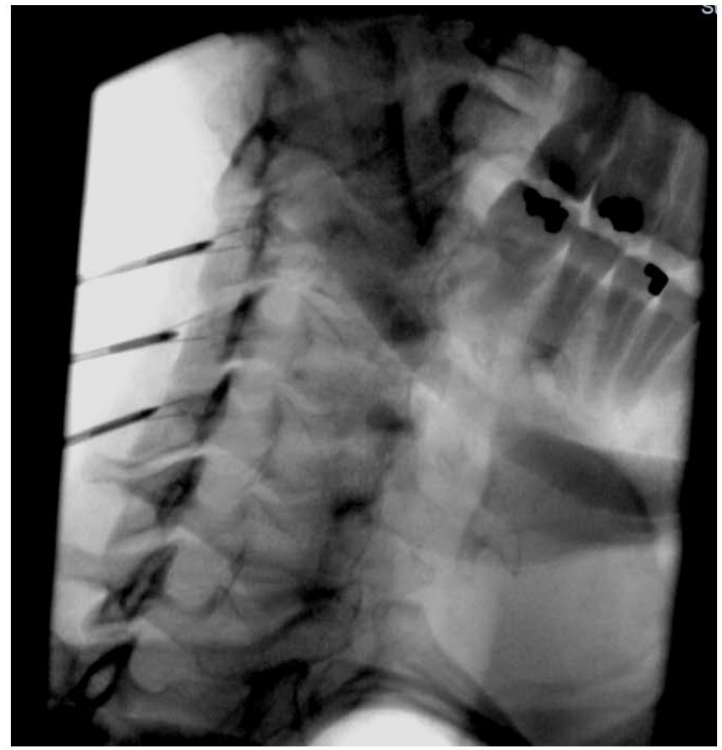
- Lateral approach – Patients placed in supine or lateral decubitus position with the injection side up. Unilateral procedures are often performed with this approach using a lateral decubitus position.[10]



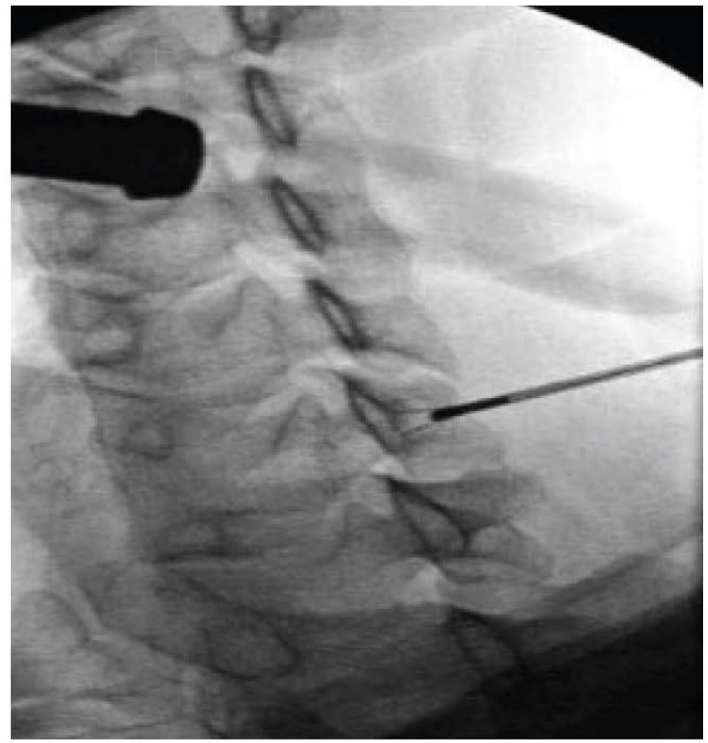
CERVICAL



C4/C5 AP (head rotated)



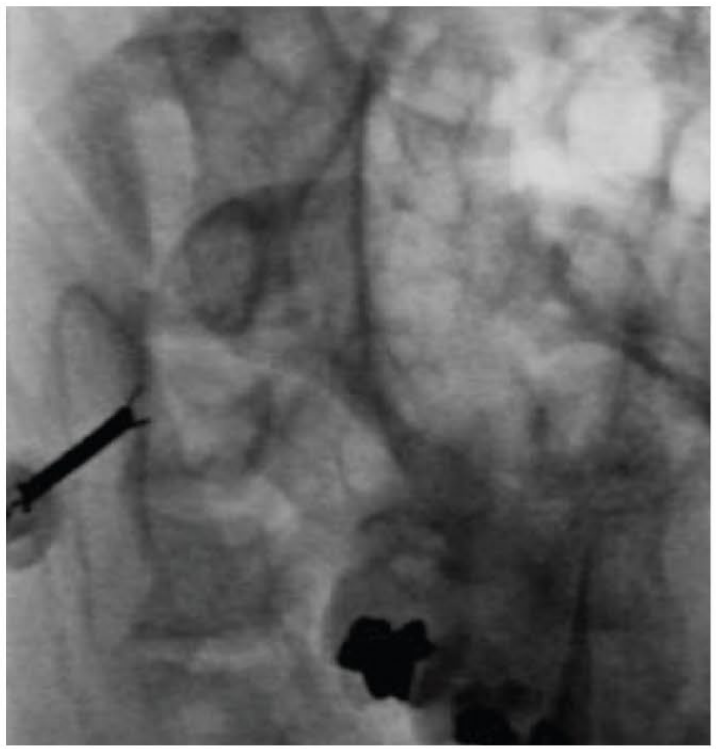
C3/C4/C5 Contralateral Oblique



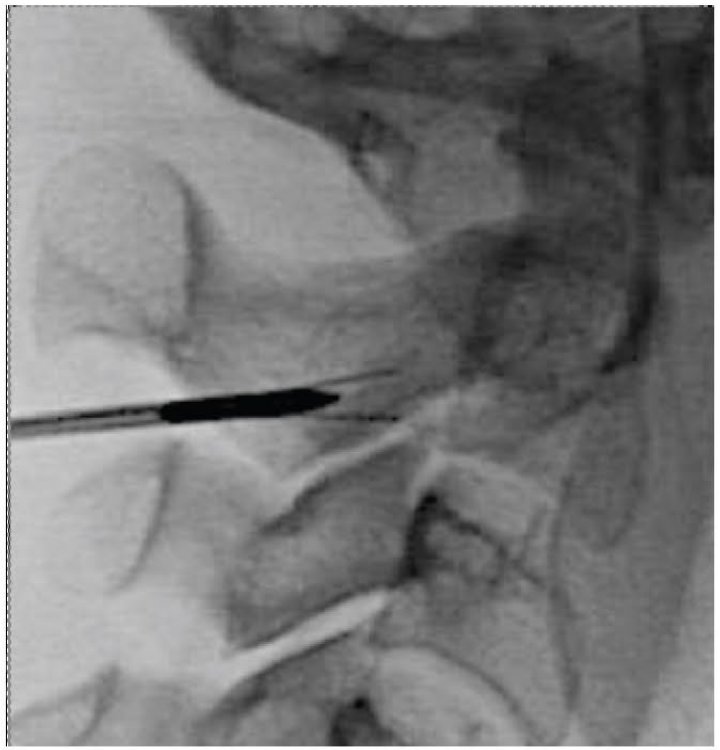
C6 Contralateral Oblique

NIMBUS CERVICAL RFA

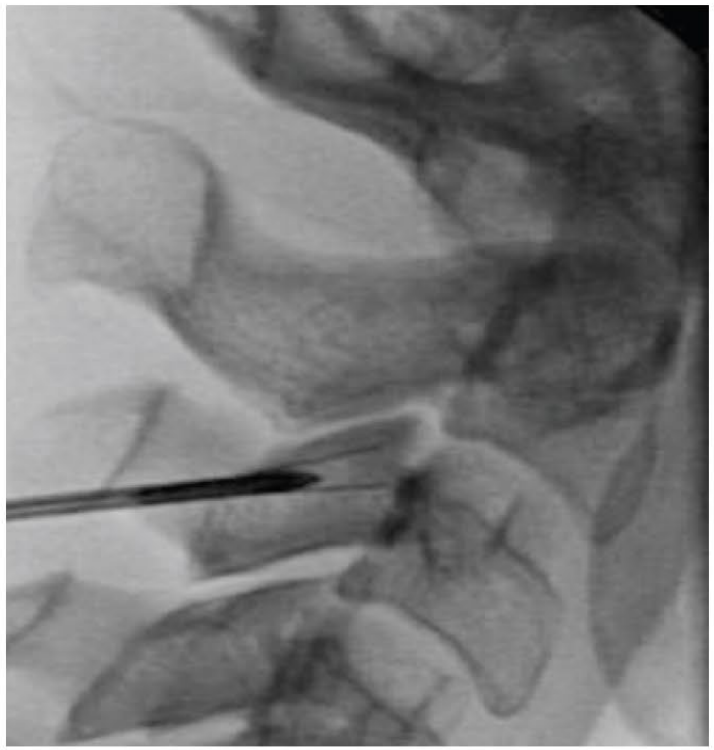
TON – C3



TON Inferior AP



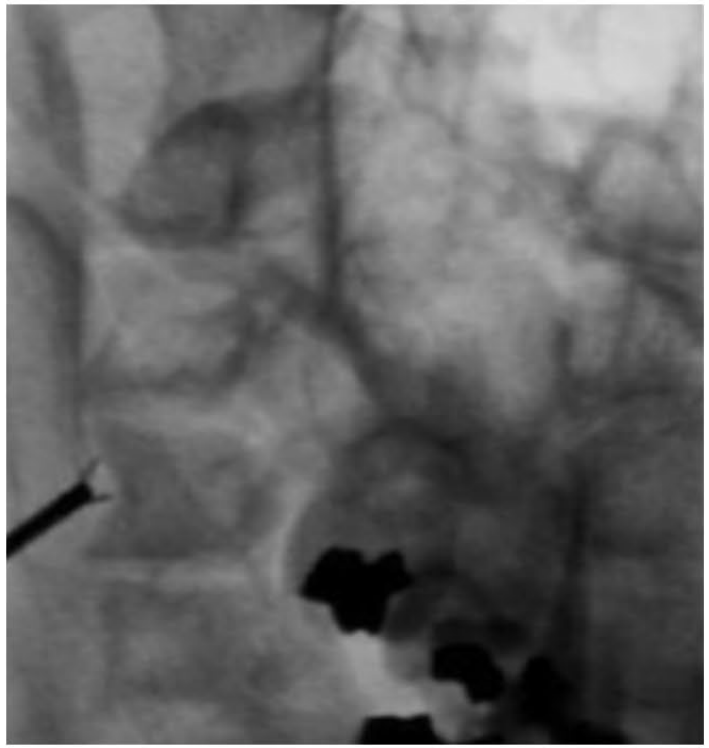
TON Inferior Lateral



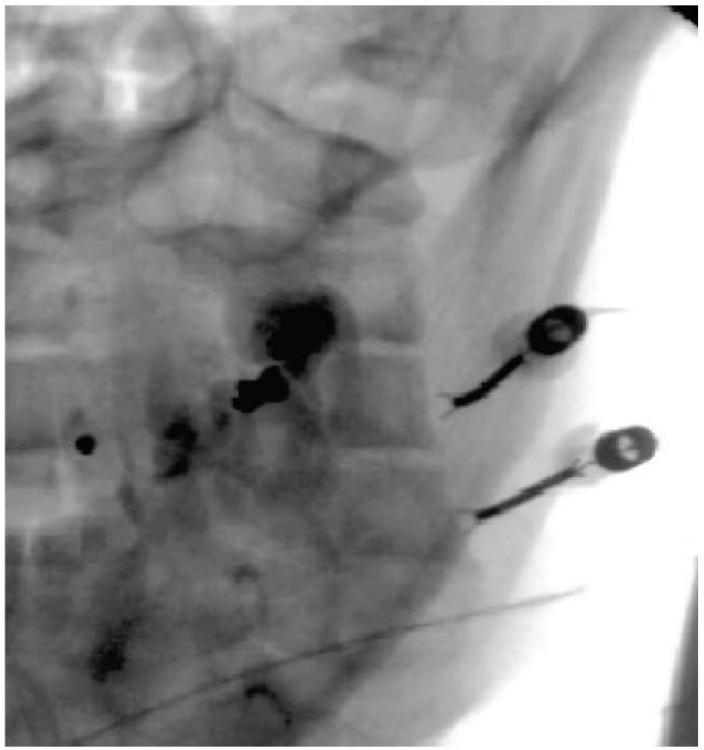
TON Superior Lateral

NIMBUS CERVICAL RFA

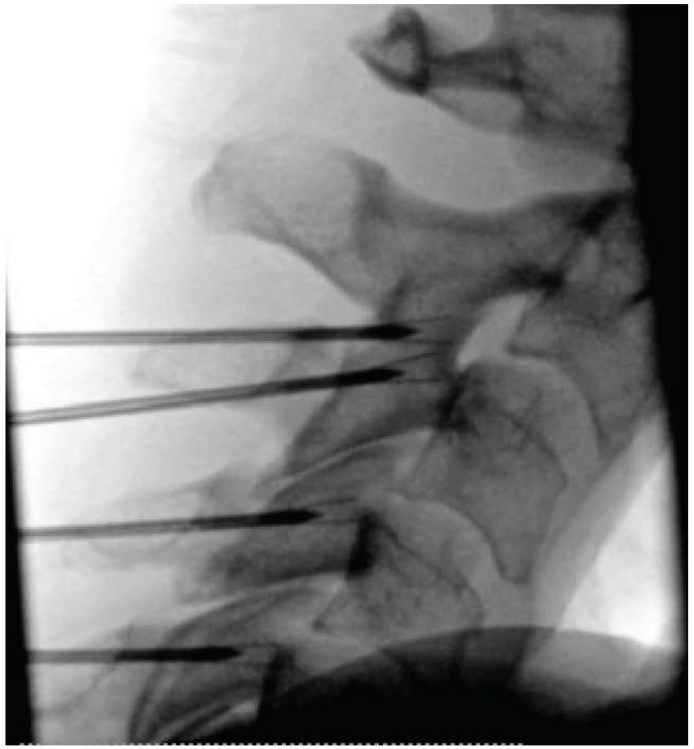
C4 – C5



C4 Placement AP



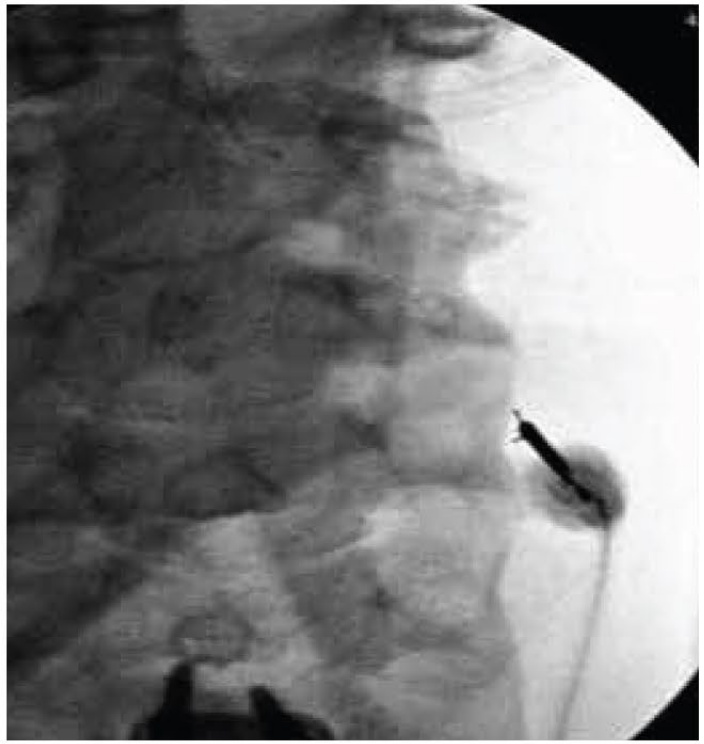
C4/C5 AP (head rotated)



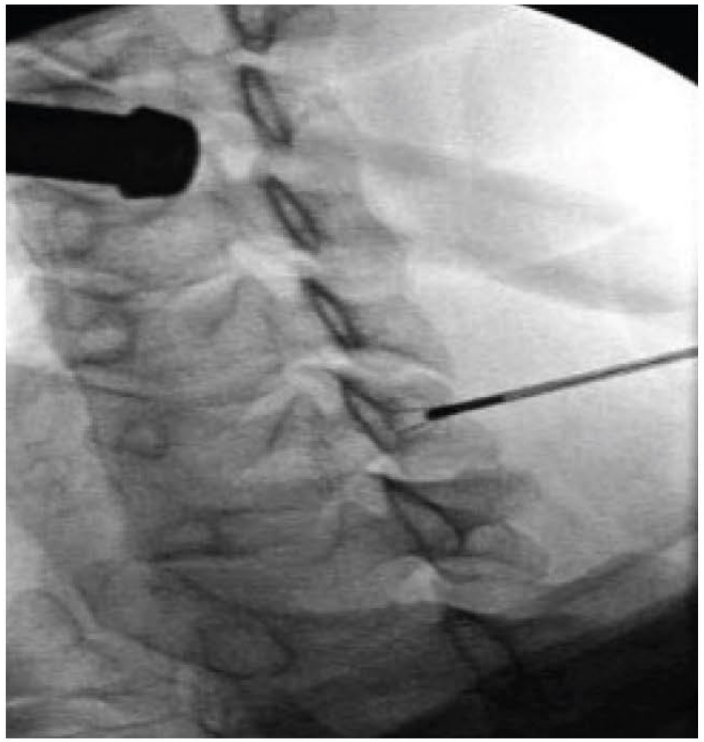
C3/C4/C5 Placement Lateral

NIMBUS CERVICAL RFA

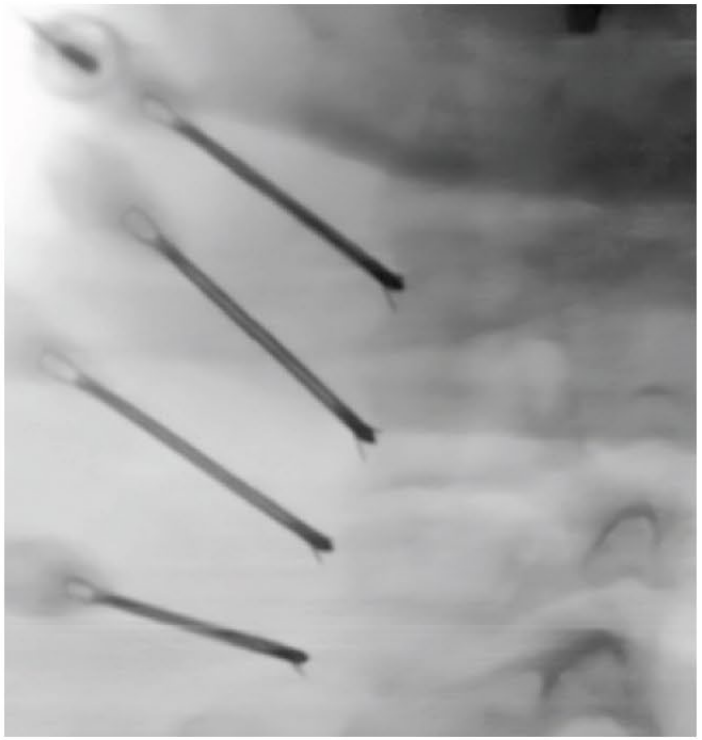
C6 – C7



C6 Placement AP



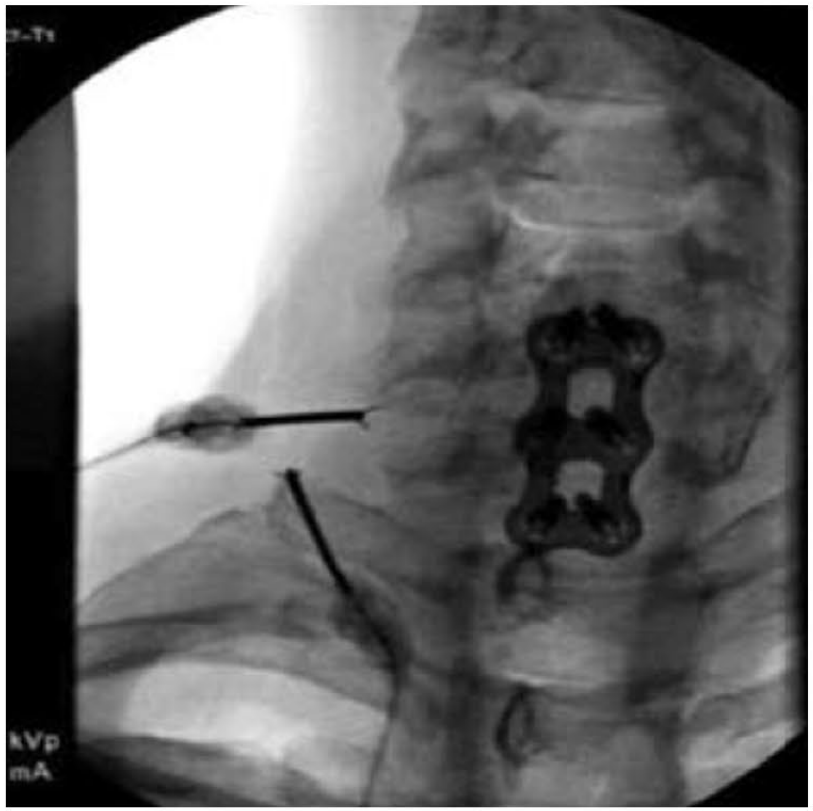
C6 Contralateral Oblique



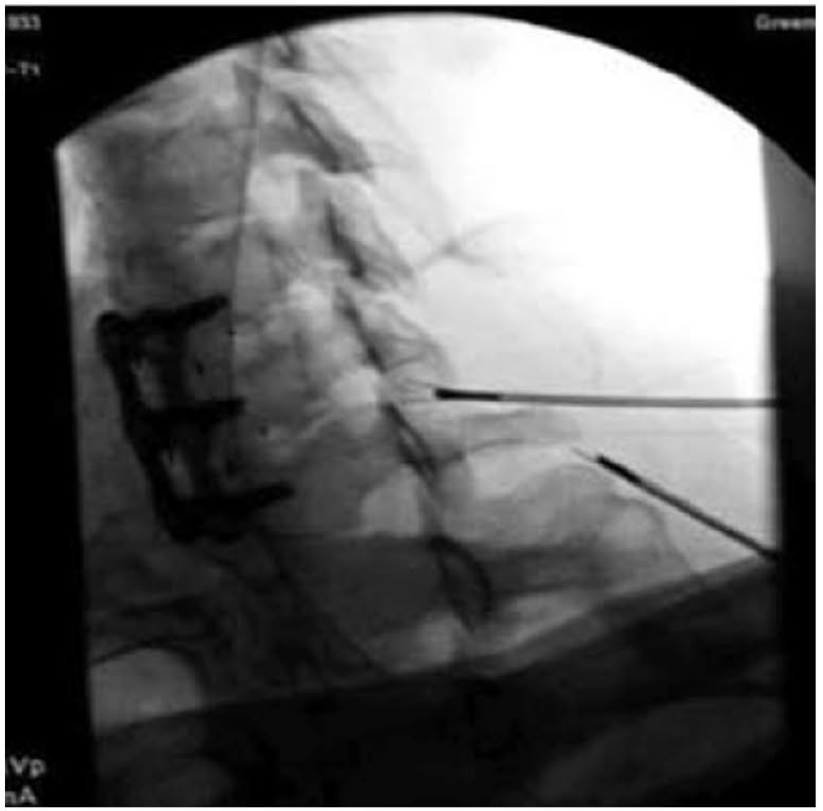
C4/C5/C6/C7 Placement AP

NIMBUS CERVICAL RFA

C8– T1

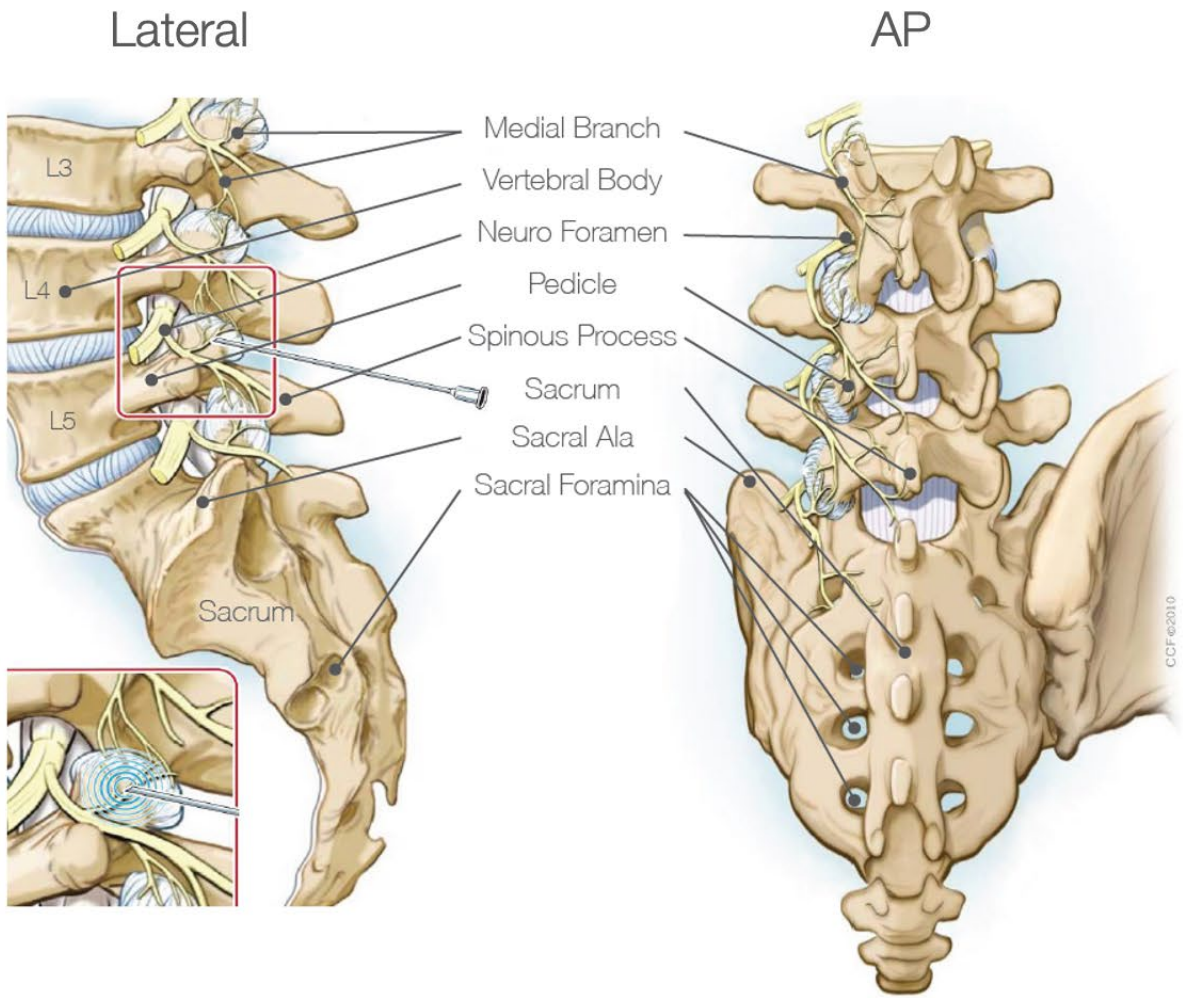


C7/T1 Placement AP



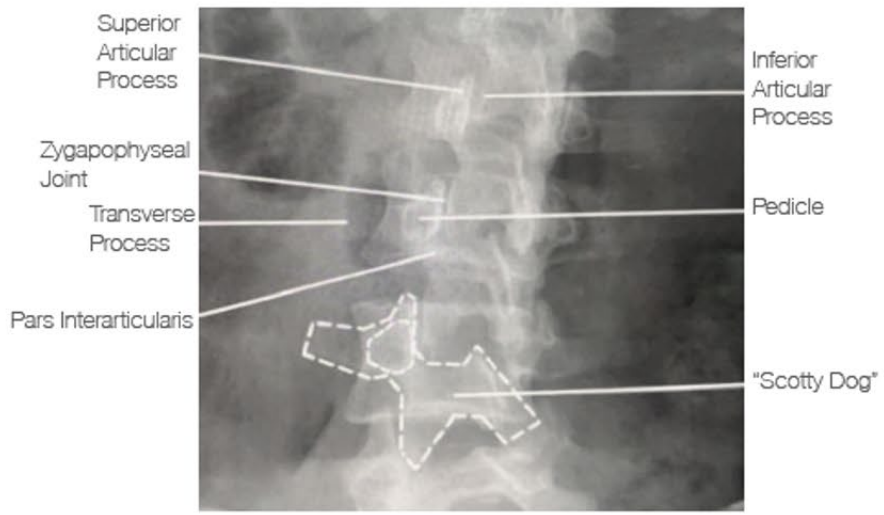
C7/T1 Contralateral Oblique

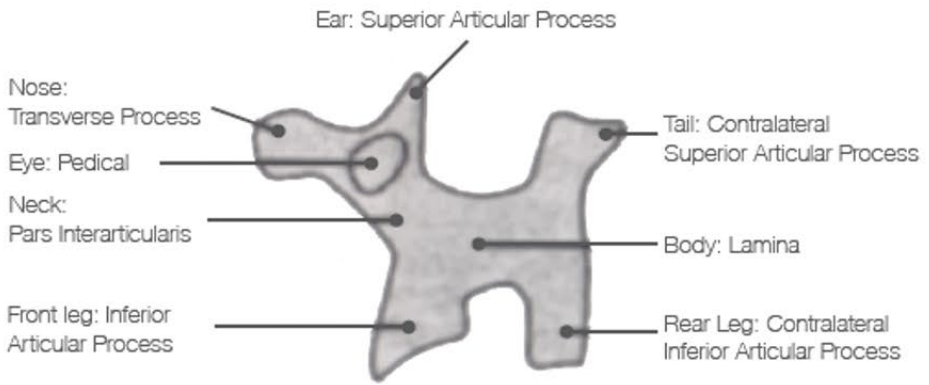
LUMBAR/SACRUM



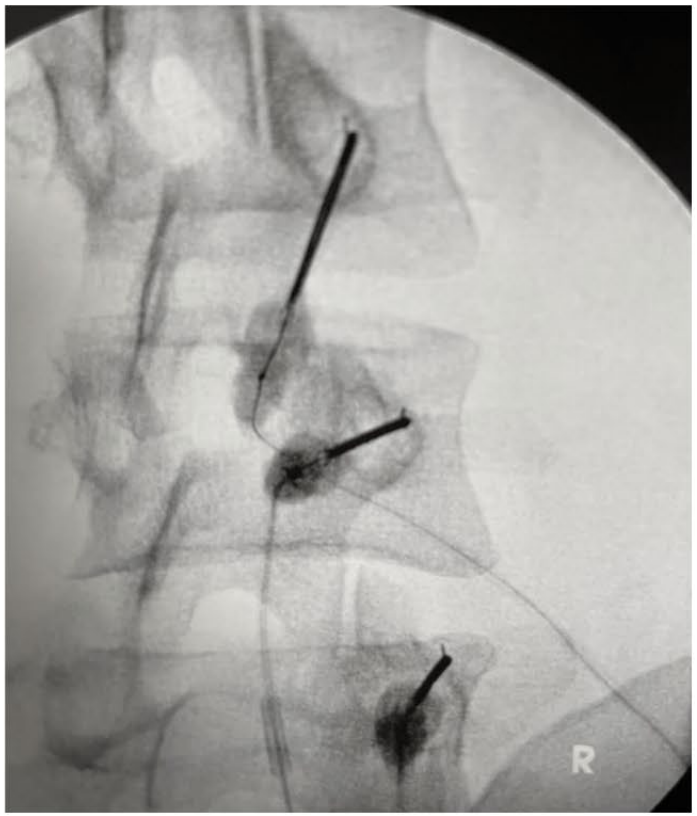
LUMBAR

“Scottie Dog” View

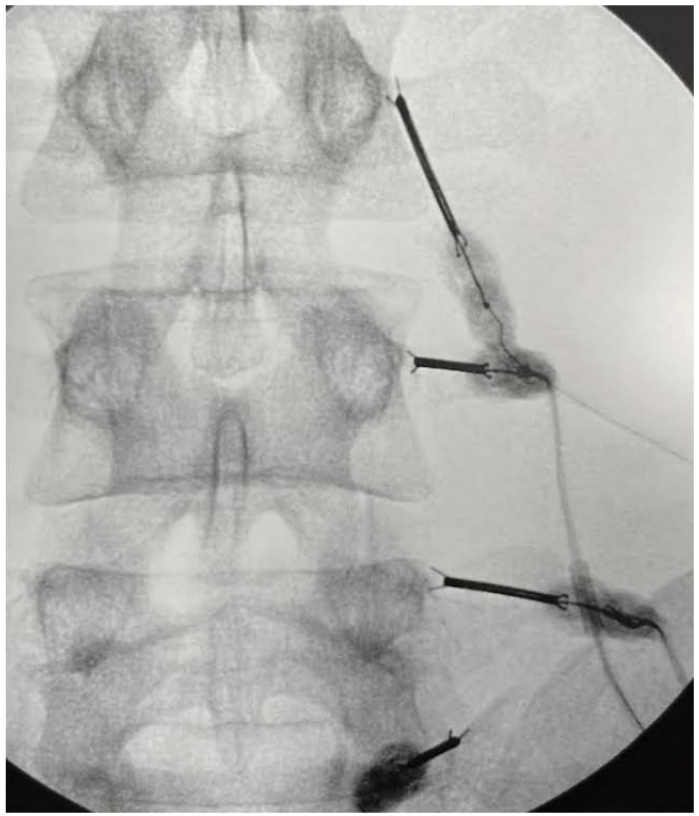




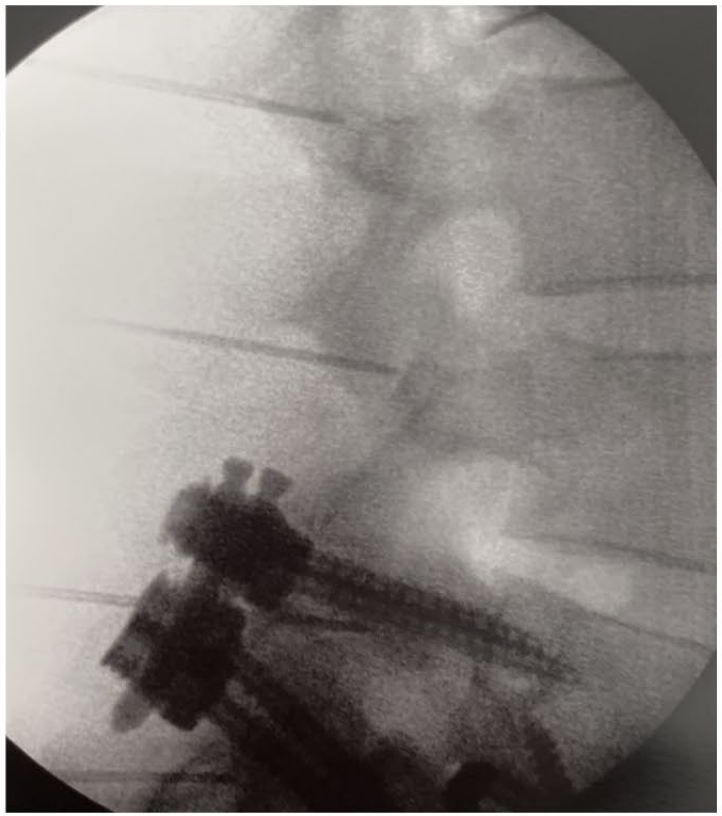
LUMBAR



L3/L4/L5 Placement Oblique

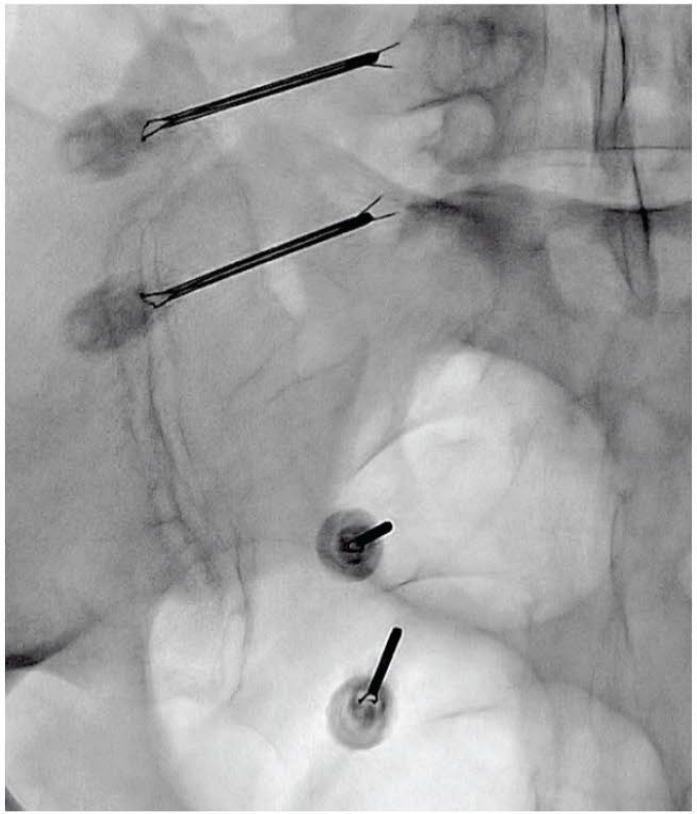


L3/L4/L5 Placement AP

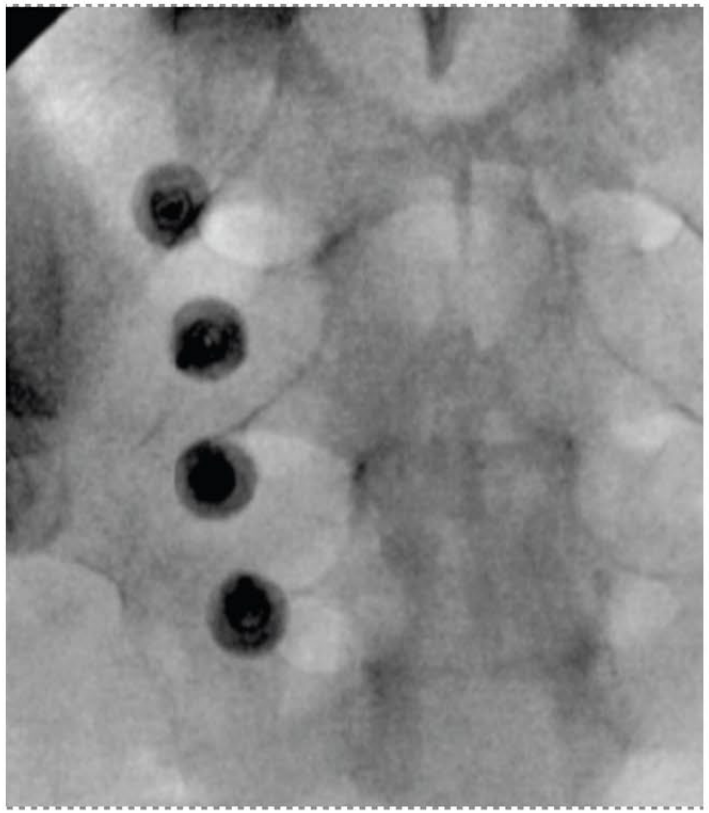


L3/L4/L5 Placement Lateral

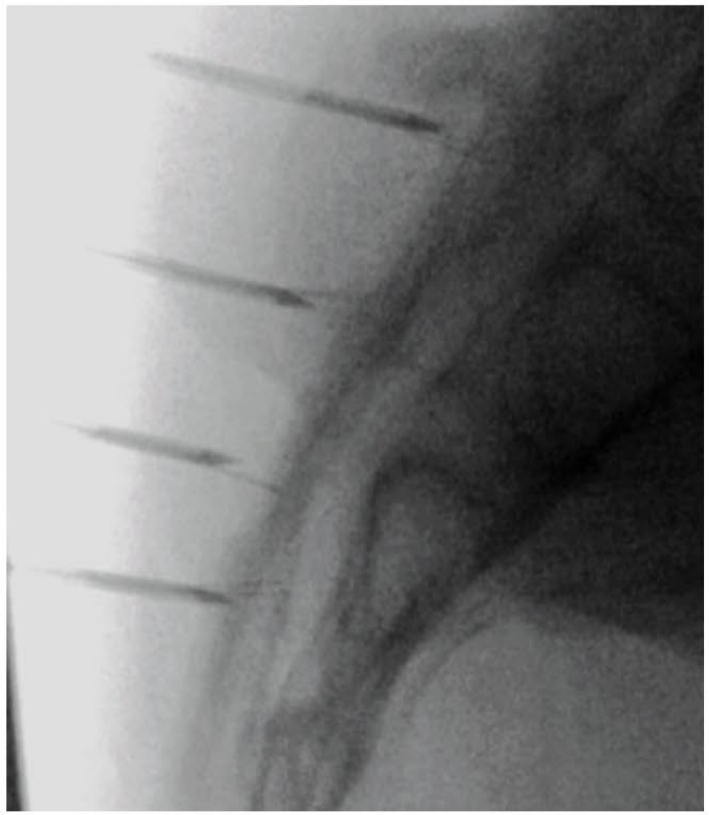
LUMBAR/SACRUM



L4/L5/S1/S2 AP
Strip Lesion Placement



S1/S2/S3 AP
Strip Lesion Placement



S1/S2/S3 Lateral
Strip Lesion Placement

QUESTIONS