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¹Radiofrequency Ablation Using a Novel Multitined Expandable Electrode: Device Description and Research Study

Wright RE, Allan KJ, Kraft M, Holley BR. Minimally Invasive Surgery for Pain. *MISP J.* 2013;2(1):41-54.

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Abstract:

Durable pain remission using radiofrequency thermal neurotomy (RTN) requires thoughtful patient selection and a lesion of optimal size and position. Success necessitates complete ablation of approximately 8-10 mm of the targeted neural pathway. Technical failure may result if anatomic variations in the targeted pathway are not incorporated into the lesion and if the electrode is not positioned optimally relative to the target nerve. This paper presents an improvement in RF electrode design intended to improve RTN outcomes.

Conclusions:

This is the first description of a multitined, expandable electrode designed for use in spinal radiofrequency procedures. It is manufactured by Nimbus Concepts, LLC in Austin, Texas. This novel radiofrequency electrode was developed using dual deployable tines for electrical field diffusion and increased functional electrode surface area. The lesion it produces is geometrically predictable and thermally stable. ¶¶ The innovative design of the electrode and the resulting geometry and stability of the tissue lesion are uniquely suited to safe, technically efficient, and effective interruption of nociceptive pathways. Detailed anatomical research into afferent pain pathways provided the basis for the electrode design and supports the premise that this device will enable practitioners to consistently achieve appropriate tissue ablation with fewer heat cycles and less global tissue trauma compared to the various monopolar designs currently in use. ¶¶ The advent of a technologically advanced radiofrequency electrode that produces directional and optimally-sized lesions for neurotomy holds great promise for interventional pain management. The design simplifies technique and readily adapts to various RF ablation targets including the cervical, thoracic and lumbar zygapophyseal joints, the sacroiliac joint, and other targets along the spinal sympathetic chain. Furthermore, the multitinedconstruct has the potential to configure future devices that will shape lesions even more precisely for additional specific thermal ablation targets heretofore not possible with current electrodes.



²Comparisons of Lumbar Facet Radiofrequency Neurotomy Using a Conventional Monopolar versus Multitined Electrode

Burnham R. *Pain Medicine*. 2015;16(8):1650-1651.

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Background:

Strategies to expand radiofrequency (RF) lesion size to accommodate medial branch nerve location variability include multiple lesions using a conventional monopolar electrode and the use of a multitined (NIMBUS) electrode.

Objective:

To compare the effect of electrode type (conventional monopolar versus multitined) on relief of pain and disability, procedure time and fluoroscopy exposure.

Methods:

25 consecutive patients underwent lumbar facet RF using a single multitined thermal lesion per medial branch nerve. Each had previously undergone successful lumbar facet RF using 2 conventional monopolar lesions over the same medial branch nerves. Prospectively gathered Pain Disability Questionnaire (PDQ) scores were recorded prior to and at 2 months post RF for both groups and at 6 months post RF for the multitined electrode group. RF procedure duration and fluoroscopy times were also recorded. Data were analyzed using Analysis of Variance.

Results:

PDQ scores dropped significantly and comparably at 2 months post RF in both the monopolar and multitined electrode groups {pre:postmean(sd) scores – monopolar 28.8(5.5):11.6(6.1); multitined 28.6(5.6):11.0(6.7)}. The 6 month post RF PDQ score remained significantly improved the multitined group {14.9(7.5)}. Pain scores also dropped significantly and comparably in both groups {pre:post mean(sd) scores – monopolar 6.4(1.8):2.6(1.4); multitined 6.3(1.6):2.3(1.4)}. The 6 month post RF pain score remained significantly improved in the multitined group {3.3(2.1)}. At 2 months post RF, 76% and 72% of the monopolar and multitined groups respectively had experienced 50% or more pain relief. Procedure time was significantly shorter with the multitined electrode {in minutes – monopolar 45 (15.2); multitined 25.5(8.2)}. Fluoroscopy exposure was comparable {in seconds – monopolar 117 (49.8); multitined 98.4(34.4)}.

Conclusions:

Pain and disability relief from lumbar facet radiofrequency neurotomy are significant and comparable whether using a conventional monopolar or multitined electrode. The procedure is significantly quicker when using the multitined electrode. Fluoroscopy exposure is comparable.



⁴An Ex Vivo Study On Radiofrequency Tissue Ablation Using a Novel Multitined Expandable Electrode

Wright RE, Brandt SA. *Pain Medicine*. 2011;12(9):1446. Presented at: International Spine Intervention Society 19th Annual Meeting; Chicago, IL. (Best Basic Science Abstract).

[Click Here to View Full Abstract](#)

Radiofrequency (RF) ablation has been effectively used to interrupt nociception arising from various spinal pain generators¹. Anatomic variation in the targeted neural pathways and suboptimal electrode placement may result in technical failure and poor patient outcomes. Intuitively, larger lesions mean a larger tolerance for both errors in electrode placement as well as the inevitable variation in the anatomic position of target nerves². A novel multitined expandable RF electrode was developed.

Objective:

Investigate the evolution in typography of a thermal lesion produced by a novel RF electrode.

Methods:

Sections of raw muscle tissue were allowed to equilibrate to 37°C in a distilled water bath. RF electrode with tines deployed was positioned to contact tissue surface in 10 trials, and was inserted into tissue in 10 trials. A Radionics RFG 3C RF generator energy source was set at 75°C for 80 seconds. Propagation of tissue coagulation was documented with video and calibrated Flir T-400 thermal camera. Tissue samples were sectioned and coagulation zones measured.

Results:

Infrared observation demonstrated symmetric and homogenous lesion progression without hot spots or focal over-impeding. Calculated volume averaged $467 \pm 71 \text{ mm}^3/\text{lesion}$. Topography was elongate spheroid offset from the central axis toward tines.

Conclusions:

A novel RF electrode prototype using dual deployable tines for electrical field diffusion reliably produces a lesion potentially useful in spinal applications.

References:

1. Dreyfuss P, Halbrook B, Pauza K, Joshi A, McLarty J, Bogduk N. Efficacy And Validity Of Radiofrequency Neurotomy For Chronic Lumbar Zygapophysial Joint Pain. *Spine* 2000; 25:1270-7.
2. Lord S, McDonald G, Bogduk N. Percutaneous Radiofrequency Neurotomy of the Cervical Medial Branches: A Validated Treatment for Cervical Zygapophysial Joint Pain. *Neurosurgery Quarterly* 1998; 8(4): 288-308.

This is the first description of a multitined, expandable electrode designed for use in spinal radiofrequency procedures. It is manufactured by Nimbus Concepts, LLC in Austin, Texas. This novel radiofrequency electrode was developed using dual

deployable tines for electrical field diffusion and increased functional electrode surface area. The lesion it produces is geometrically predictable and thermally stable.



5th Technical Efficacy of a Direction Specific Radiofrequency Device in the Performance of Lumbar Medial Branch Neurotomies – An MRI and EMG Confirmation Study (Interim Analysis)

Bainbridge JS, Wright RE, Pappas CD, Light S, McQueen RB. *Pain Medicine*. 2015;16(8):1650.

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Background/Objective:

Lesion position and geometry are cardinal in maximizing safety and efficacy when performing lumbar medial branch radiofrequency ablation (LMBRFA). Technical efficacy of a multitined expandable electrode (MEE), with perpendicular approach, was demonstrated using a novel LMRI validation protocol and corroborated with paraspinous EMG (PEMG) findings in this IRB approved study.

Methods:

This is the first description of a multitined, expandable electrode designed for use in spinal radiofrequency procedures. It is manufactured by Nimbus Concepts, LLC in Austin, Texas. This novel radiofrequency electrode was developed using dual deployable tines for electrical field diffusion and increased functional electrode surface area. The lesion it produces is geometrically predictable and thermally stable.

Results:

Patients (n=6 MRI, n=5 EMG) chosen for LMBRFA underwent pre and post LMRI and PEMG[1]. Post-ablation LMRI using a previously described[2] protocol was obtained 7 days following RFA and used to quantify lesion size and provide lesion topography and anatomic relationship information. Post-LMBRFA EMG was obtained at 3-6 weeks. Monitoring of possible complications was carried out.

Comments:

Lesions were achieved, incorporating the target MB/SAP wall, in all cases*. Mean lesion volume was 601.7mm³ (n=40, 95%CI: 522.6, 680.8). No bony edema or complications were noted. EMG evidence of target medial branch ablation was achieved in 88%* (n=34, 95%CI: 77-99) of targets which compares favorably with EMG % ablation of Dreyfuss, et al [3] of 90.5%. *One subject underwent repeat procedure, adding one additional MRI/EMG positive ablation site – included in these results. There were no complications.

References:

- 1) Haig, A.J., et al., Paraspinal mapping: quantified needle electromyography in lumbar radiculopathy. *Muscle Nerve*, 1993. 16(5): p. 477-84.
- 2) Wright, R., Bainbridge, JS, Allan, KJ, MRI Protocol for Analysis of Tissue Ablation Following Dorsal SIJ Radiofrequency Denervation, in ISIS ASM July, 2013 Poster Session. 2013.
- 3) Dreyfuss, P., et al., Efficacy and validity of radiofrequency neurotomy for chronic lumbar zygapophysial joint pain. *Spine*, 2000. 25(10): p. 1270-7.



6In and Ex Vivo Validation of a Novel Technique for Radiofrequency Denervation of the Dorsal Sacroiliac Joint – Including a Case Study

Wright RE, Allan KJ, Bainbridge JS. *Regional Anesthesia Pain Medicine*. 2013;38(5)(Suppl 1):E161-E162. Presented at: 32nd Annual ESRA Congress; September 4-7, 2013; Glasgow, United Kingdom.

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Purpose:

A technique was developed for radiofrequency (RF) ablation of the L5 dorsal ramus (L5DR) and S1-3 lateral branches (LBs) making use of a novel (FDA approved NIMBUS Multitined Expandable Electrode) RF electrode.

Materials/Methods:

The typical distance between lateral walls of adjacent S1-3 foramina is 18-22mm. Tissue coagulation in chicken breast using NIMBUS electrodes in bipolar configuration with 20mm gap (and in vivo simulation with 37°C water bath) was observed thermographically. A Baylis RF generator produced parameters of 80°C for 120 seconds (30 sec. ramp time). Tissue samples were sectioned and geometric measurements were made at 10mm from either electrode (lesions >10mm in diameter). The experiment was replicated using the palisade bipolar strip lesion method, for comparison of data. Consented adults underwent the NIMBUS Continuum strip lesion technique, and MRI assessment was obtained 13 days post-RF. Lesion (edema) size was scored with an axial fat suppressed proton density sequence (echo train 8, TR 3000ms, TE 26ms) and the tubular (diam. 11.7mm) tissue change extended from L5-S1 through S4 segment inclusive, and overlapped the known dorsal sacroiliac joint (SIJ) innervation.

Results:

Bench and in vivo findings thus far support the NIMBUS Continuum technique as a method for the ablation of the L5DR and S1-3 lateral branches for dorsal SIJ denervation.

Conclusions:

This new RF technique appears to be technically effective and time efficient as a method for successful dorsal SIJ denervation.



7MRI Protocol for Analysis of Tissue Ablation Following Dorsal SIJ Radiofrequency Denervation

Wright RE, Weingardt J, Bainbridge JS, Allan KJ. Poster presentation at: International Spine Intervention Society 21st Annual Meeting; July 2013; New York, NY.

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Purpose:

The sacroiliac joint (SIJ) is a challenging radiofrequency target owing to variant anatomy of the S1, S2, and S3 lateral branches¹. Bipolar RF techniques have been described to expand lesion volume potentially increasing the likelihood of target ablation, currently there is no objective test for evaluating technical success following dorsal SIJ RF denervation. MRI may be useful to correlate the ablation zone with target anatomy. An MRI protocol was developed to quantify volume, and evaluate the spatial characteristics of tissue change pursuant to dorsal SIJ RF denervation.

Materials/Methods:

After consent a 64-year-old male underwent right-sided dorsal SIJ RF denervation. Electrodes (1.45 mm OD) were paired starting at the base of the S1 SAP progressively caudad<progressively 20mm gaps. The Baylis Pain Management generator in bipolar mode delivered an 80°C x150 seconds heat cycle.

Fourteen days post procedure an MRI study was optimized for both spatial and contrast resolution. A sequence sensitive to edema with preserved spatial resolution for accurate volumetric analysis was obtained. Lesion size was scored with an axial fat suppressed proton density sequence (echo train 8, TR 3000ms) at a slice thickness of 5mm with a 1mm gap. A region interest curve was drawn around edematous tissue on each slice providing an area, which was totaled for all of the slices. The total was multiplied by an effective slice thickness of 6mm providing the total volume of edematous tissue.

Results:

Right posterior parasacral edema extended from L5-S1 through S4 segments. Total volume of tissue change was 24.4cm³. The lesion was tubular with average diameter of 11.7mm. Tissue change incorporated described dorsal SIJ innervation.

Conclusions:

An MRI protocol is described which demonstrates RF induced tissue changes following dorsal SIJ denervation.

1. Yin W, et al sensory stimulation-guided sacroiliac joint radiofrequency neurotomy: technique based on neuroanatomy of the dorsal sacral plexus. Spine 2003; 28:2419-25.



⁸Radiofrequency Neurotomy for Sacroiliac Joint Pain: Twelve Month Outcomes and Comparison Between Two Techniques

Wright RE. Poster presented at: 11th Annual Congress of the European Pain Federation; September 2019; Valencia, Spain. Metro Pain Group, Melbourne, Australia.

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Method:

Retrospective chart review n=182.

Method:

The Sacroiliac Joint (SIJ) is an acknowledged pain generator; various descriptions of variable joint innervation inform Radiofrequency ablation (RFA) practices. Many practitioners target S1-S3 lateral branches (LBs) with a "strip lesion" RFA technique while others include the L4 medial branch (MB) and L5 dorsal ramus (DR) in their tactic (1).

Objective:

Ascertain whether RFA of the SIJ results in a durable (twelve month) benefit and determine if including RFA of the L4 MB and L5 DR improved outcomes.

Methods:

One hundred and eighty-two (n=182) patient charts were reviewed. 103 female 79 male average age 52 years. All patients presented with >5/10 on pain VAS index pain below the belt-line and positive Fortin's finger test. Fluoroscopically guided contrast-confirmed intra-articular injection with >70% relief of index pain and confirmatory multi-site multi-depth lateral branch blocks with >70% relief of index pain was required for RFA. Ninety-three (93) patients underwent bipolar ablation of S1-S3 lateral branches using a multitined expandable electrode (NIMBUS) based on the technique described by Wright et al (2). The author modified his technique and subsequently eighty-nine (89) patients underwent monopolar RFA of the L4 MB and L5 DR in addition to the S1-S3 LB bipolar RFA. Patient's pain VAS and global PDQSS (3) scores were obtained at baseline, one, six, and twelve months. Only twelve-month data was used to assess "durable" benefit.

Results:

Global baseline pain VAS was 7.2 ± 1.1 and global PDQQ-S score was 79.6 ± 11.2 . At twelve months pain VAS decreased to 2.6 ± 1.2 and PDQQ-S 35.2 ± 14.8 . (P values <0.001). *Subset analysis* of the S1-S3 RFA only group showed baseline pain VAS of 7.2 ± 1.0 and global PDQQ-S of 38.2 ± 14.2 . The group including RFA of L4 MB and L5 DR had baseline pain VAS of 7.1 ± 1.2 and PDQQ-S of 75.9 ± 11.5 . At twelve months pain decreased to VAS of 2.4 ± 1 and global PDQQ-S of 32 ± 15 .

Conclusions:

RFA of the S1-S3 sacral lateral branches in a well selected population using an anatomically accurate bipolar strip lesion technique producing the necessary and sufficient lesion topography provides highly significant pain reduction and improvement in PDQQ-S at twelve months follow up. Including L4 MB and L5 DR may provide additional benefit and further study is encouraged.



⁹NIMBUS: A Novel Multitined Expandable Electrode For Percutaneous Radiofrequency Lesioning Of The Sacroiliac Joint

Al-Kaisy A, Pang D. *Orthopedic Procedures*. 2018;96-B(Suppl 4). The British Editorial Society of Bone & Joint Surgery. February 2018.

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Introduction:

Percutaneous radiofrequency lesioning of the lateral branches of the sacroiliac joint has become a recognised method of treating chronic pain arising from this joint. Due to the large and varied innervation from the S1-3 lateral branches success has been achieved with large lesions that has a high chance of covering these nerves. Such lesions require specialised and expensive equipment and the NIMBUS needle is a large 17G electrode with expandable tines at the tip. It is compatible with all standard radiofrequency probes and it produces a large lesion at the tip. It has been in use in the USA in over 100 cases and we describe its use in the UK.

Methods:

Patients were identified as having sacroiliac joint pain by clinical assessment and positive pain response to local anaesthetic sacroiliac joint lateral branch blocks.

Under fluoroscopic control, the needle is inserted at the lateral edge of the sacral S1-3 posterior foramen. Three lesions at the lateral edge of the foramen are made at 80°C for 90s. A further lesion is made at the L5 dorsal ramus.

Results:

4 patients achieved very good pain relief $>50\%$ reduction in pain scores on the NRS scale at 6 weeks follow up. No complications were noted and there were no technical difficulties.

Conclusion:

Lesioning with the NIMBUS needle is feasible and allows clinicians a method of treating chronic sacroiliac joint pain using existing radiofrequency equipment. Further large, long term studies are warranted to establish clinical efficacy.



¹⁰Development and Description of a New Multifidus-Sparing Radiofrequency Neurotomy Technique for Facet Joint Pain

Russo MA, Santarelli DM. *Pain Practice*. Published online March 27, 2021. doi:10.1111/papr.13010.

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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.



11 Ultrasound-Guided Radiofrequency Ablation for SI Joint Pain: An Observational Study

Loh E, Agur AM, Burnham RS. *Interventional Pain Medicine*. 2022;1:100118.

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Objective:

An ultrasound (US) guided RFA technique for the SIJ, utilizing bipolar RF cannula placements along the lateral sacral crest (LSC), has been proposed in anatomical studies. This study evaluated changes in pain intensity, function and quality of life following this technique.

Methods:

Patients achieving $\geq 50\%$ pain relief on two blocks (one FL- and one US-guided) were included. US-guided SIJ RFA was performed with sequential bipolar lesions using two multitined RF cannulae placed along the LSC. The Pain, Disability, Quality of Life Questionnaire-Spine (PDQQ-S), which includes an 11-point (0–10) numeric rating scale (NRS) for pain intensity, was completed pre-RFA, and 2, 6, 9, 12 and 16 months post-RFA. Outcomes at 2 months post-RFA were compared between US-guided and FL-guided SIJ RFA in participants with previous FL-guided SIJ RFA.

Results:

31 patients were included. Statistically significant decreases in pain intensity were observed up to 9 months after US-guided SIJ RFA (Baseline NRS: mean = 6.8 SD = 1.6, 95%CI [6.169, 7.347]; 9 month: mean = 4.8, SD = 2.6, 95%CI [3.891, 5.786]; $p = 0.0005$), and up to 12 months for PDQQ-S. A clinically significant ≥ 2 point reduction in pain intensity on the NRS was seen in 48.4% of participants at 9 months. 11 participants had previous FL-guided SIJ RFA; no statistically significant differences were found in pain intensity or PDQQ-S scores between US- and FL-guided SIJ RFA 2-months post-RFA.

Conclusion:

Preliminary results suggest that SIJ RFA could be performed using US guidance. Further study is required to establish effectiveness.



¹²A History of the Development of Radiofrequency Neurotomy

Russo M, Santarelli D, Wright R, Gilligan C. *Journal of Pain Research*. 2021;14.

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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, multitined 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.

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.

History:

Prior to 1934, the year in which Mixter and Barr published on the slipped disc, low back pain was considered some 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.

Conclusion:

The history of RFN has been a long and winding one. Having started with an eccentric ophthalmologist, followed by an iconoclastic urological surgeon influenced by the inventor of prolotherapy, the story moves to a most remarkable and productive neurosurgeon who teams with a medical device entrepreneur to produce what is recognizable today as the existing therapy. It

was validated by an Australian anatomist and then significantly expanded by the enquiring mind of a Dutch anaesthesiologist. Along the way, it has survived the slings of poor practice reports and the arrows of poorly designed trials to remain one of the bedrock foundational techniques of interventional pain medicine. As we pass the first 100 years of the story, we believe there are more chapters to be written on this fascinating subject.



¹⁵Radiofrequency Neurotomy for Sacroiliac Joint Pain: Twelve Month Outcomes and Comparison Between Two Techniques

Wright RE, Block JE. *Med Research Archives*. 2023;11(12). doi:10.18103/mra.v11i12.4978.

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Background:

Radiofrequency neurotomy (RFN) is an effective treatment option for patients with severe sacroiliac joint (SIJ) pain.

Aims:

We evaluated the 12-month clinical outcomes between patients (n=93) having RFN of the lateral branches of S1-S3 compared to patients (n=89) undergoing the same procedure augmented with RFN of the L4 medial branch and L5 dorsal ramus.

Methods:

This was a retrospective chart review. Following diagnostic intra-articular anesthetic injections and multi-site multi-depth lateral branch nerve blocks to establish SIJ pain, patients underwent bipolar ablation of the S1-S3 lateral branches using the NIMBUS multitined electrode. The second group of patients underwent supplementary monopolar RFN of the L4 medial branch and the L5 dorsal ramus. Pain severity and global Pain Disability Quality of Life Questionnaire-Spine (PDQQ-S) scores were obtained prior to RFN and at 12 months.

Results:

There were 61% and 59% average 12-month improvements in SIJ-related pain severity and global PDQQ-S scores, respectively, in the overall study group ($P < 0.001$ for both comparisons). Efficacy was moderately better for patients with augmented ablation that captured the L4 medial branch/L5 dorsal ramus. For example, 12-month average pain reduction was 54% and 66%, and PDQQ-S improvement was 56% and 62% for patients treated with S1-S3 lateral branch RFN and the augmented RFN procedure, respectively. The percentage of patients exhibiting $\geq 50\%$ improvement in pain severity at 12-months was 73% (68 of 93) and 88% (78 of 89) ($P = 0.016$) for the same study groups.

Conclusion:

RFN of the S1-S3 sacral lateral branches using an anatomically accurate bipolar strip lesion technique produced a sufficient lesion topography to provide highly significant pain reduction and improvement in PDQQ-S at 12-months follow-up. Including the

L4 medial branch and L5 dorsal ramus in the RFN treatment protocol may offer more complete denervation of all afferent pain pathways and provide additional clinical benefit.



¹⁶Genicular nerve radiofrequency ablation for the treatment of chronic knee joint pain: a real-world cohort study with evaluation of prognostic factors

Caragea M, Woodworth T, Curtis T, Blatt M, Cheney C, Brown T, Carson D, Kuo KT, Randall D, BS, Huang EY, Carefoot A, Teramoto M, Mills M, Cooper A, Burnham T, Conger A, McCormick ZL. *Pain Medicine*. 2023;24:1332-1340. doi:10.1093/pm/pnad095.

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Background:

Genicular nerve radiofrequency ablation (GNRFA) is an effective treatment for chronic knee pain. However, there has been minimal investigation of real-world, long-term outcomes and factors that predict treatment success after GNRFA.

Objectives:

To evaluate the effectiveness of GNRFA for chronic knee pain in a real-world population and identify predictive factors.

Methods:

Consecutive patients who underwent GNRFA at a tertiary academic center were identified. Demographic, clinical, and procedural characteristics were collected from the medical record. Outcome data were numeric rating scale (NRS) pain reduction and Patient Global Impression of Change (PGIC). Data were collected by standardized telephone survey. Predictors of success were evaluated with logistic and Poisson regression analyses.

Results:

Of the 226 total patients identified, 134 (65.6 ± 12.7; 59.7% female) were successfully contacted and analyzed, with a mean follow-up time of 23.3 ± 11.0 months. Of those, 47.8% (n ¼ 64; 95% CI: 39.5%–56.2%) and 61.2% (n ¼ 82; 95% CI: 52.7%–69.0%) reported greater than or equal to ≥50% NRS score reduction and ≥2-point NRS score reduction, respectively, and 59.0% (n ¼ 79; 95% CI: 50.5%–66.9%) reported “much improved” on the PGIC questionnaire. Factors associated with a greater likelihood of treatment success (P < .05) were higher Kellgren–Lawrence osteoarthritis grade (2–4 vs 0–1); no baseline opioid, antidepressant, or anxiolytic medication use; and >3 nerves targeted.

Conclusion:

In this real-world cohort, approximately half of the participants experienced clinically meaningful improvements in knee pain after GNRFA at an average follow-up time of nearly 2 years. Factors associated with higher likelihood of treatment success were more

advanced osteoarthritis (Kellgren–Lawrence Grade 2–4); no opioid, antidepressant, or anxiolytic medication use; and >3 nerves targeted.



17 Characterizing an Angle of Cannula Insertion for Lumbar Medial Branch Radiofrequency Neurotomy: A Retrospective Observational Study

Patel A, Chang JL, Haffey PR, Mainkar O, Gulati A.
Pain Practice. 2021;21(7):747-758.

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Objective:

Evidence characterizing a starting angle of radiofrequency (RF) cannula insertion during radiofrequency neurotomy is lacking. Using computerized tomography (CT), this retrospective observational study attempts to establish a starting angle for RF cannula placement parallel to the transverse process (TP) at the junction of the superior articular process (SAP) near the targeted medial branch.

Methods:

This retrospective observational study utilized lumbar spine CT scans performed on adult cancer patients from January 2016 to May 2021 at a single center. No significant lumbar pathology was present on the included CT studies. For each patient, medial branches were assumed to lie at the junction of the right and left TP and SAP at each lumbar level. The angle of insertion from each segment's "squared" superior end plate needed for RF cannula placement parallel to the surface of the TP next to the SAP was calculated.

Methods:

This retrospective observational study utilized lumbar spine CT scans performed on adult cancer patients from January 2016 to May 2021 at a single center. No significant lumbar pathology was present on the included CT studies. For each patient, medial branches were assumed to lie at the junction of the right and left TP and SAP at each lumbar level. The angle of insertion from each segment's "squared" superior end plate needed for RF cannula placement parallel to the surface of the TP next to the SAP was calculated.

Results:

Images obtained from fifty patients were analyzed. Mean angle of insertion for L1 was $20.15 \pm 1.82^\circ$, L2 $20.95 \pm 2.07^\circ$, L3 was $25.54 \pm 1.76^\circ$, L4 was $31.01 \pm 1.83^\circ$, and L5 was $40.74 \pm 1.86^\circ$.

Conclusion:

This study demonstrates variations in inserting angle for RF cannula placement parallel to the surface of the transverse process at each lumbar level. To our knowledge, there are no studies in the current literature that have described an entry angle for RF cannula positioning parallel to lumbar medial branches using CT images.



¹⁸A Comparison of a Standard Radiofrequency Cannula to a Multitined Expandable Electrode in Determining Thermal Lesion Surface Area Size at the Muscle-Bone Interface in Ex-Vivo Model

Jones M, Patel AK, Hung J, Provenzano D, Gulati A.

Presented at: ASPN Meeting; Miami, Florida; 2023.

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Introduction:

- Monopolar radio frequency is a common interventional pain technique designed to treat spine pain.
- Inadequate disruption of the neural pathway has been proposed as a mechanism for inadequate therapeutic analgesia.
- Given the anatomical variation in the course of the neural target, a larger lesion size may enhance rates of success.
- A novel multitined radiofrequency electrode was introduced to produce a larger lesion. It relies on two tines that act to diffuse radiofrequency current density in the target tissue.
- This is the first study comparing lesion size between common monopolar electrode techniques and a multitined electrode.
- Evidence characterizing a starting angle of radiofrequency (RF) cannula insertion during radiofrequency neurotomy is lacking. Using computerized tomography (CT), this retrospective observational study attempts to establish a starting angle for RF cannula placement parallel to the transverse process (TP) at the junction of the superior articular process (SAP) near the targeted medial branch.

Methods:

- Ex-vivo preservative-free porcine spines were obtained after industrial processing.
- Monopolar radiofrequency lesions were performed with 100 mm, 18-gauge active NIMBUS multitined cannulas.
- Two single tine cannulas were utilized to reflect variance in clinical practice: one cannula was placed at a 90° perpendicular angle until bony contact was made, after which the tines were deployed.
- Prior to ablation, lidocaine was injected into each cannula to reflect dissected and the coagulation zone for each lesion was assessed.
- 126 lesions were performed on 42 separate samples, for a total of 42 lesions for each group.

Results:

Figure 1. Mean area of lesion size for the NIMBUS cannula with perpendicular placement was 225.64 mm, Standard cannula with perpendicular placement was 89.33 mm, and Standard cannula with 45° placement was 118.58 mm. (P<0.001)

Figure 2. No statistically significant difference in the mean lesion areas for each cannula type based on distance from the grounding pad.

Discussion:

- This study suggests that radiofrequency cannula design that accentuates the thermal ablation at contact with bone is likely to ablate the tissue structures at the bony surface.
- Using this protruding cannula to land one part on the transverse process should increase the likelihood of ablating the medial branch nerve.
- Lesion size should be expected to be the same irrelevant of distance from the grounding pad and efficacy is more dependent on the type of cannula used and position relative to the bony interface.
- Future studies should include a larger sample size and should include the marginal lesion area in lieu of the gross lesion area that we recorded.

Conclusion:

- The mean lesion area created by the multitined NIMBUS needle was significantly larger compared to the Standard monopolar perpendicular and the Standard monopolar at 45°.
- It is our hope that this serves as a proof-of-concept for future studies that help elucidate differences with more accuracy and power to further evaluate the utility of the NIMBUS cannula for the treatment of axial spine pain.



²⁰Radiofrequency Ablation of the Infrapatellar Branch of the Saphenous Nerve for the Treatment of Chronic Anterior Inferomedial Knee Pain

Beckwith M, Cushman D, Clark T, Park P, Burham T, Burnham R, McCormick Z, Conger A. *Pain Medicine*. 2023;24(2):150-157. doi:10.1093/pm/pnac108.

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Abstract:

Genicular nerve radiofrequency ablation (GNRFA) is an effective treatment for chronic knee pain related to osteoarthritis. It is often utilized when conservative management has failed and patients wish to avoid arthroplasty, are poor surgical candidates due to comorbid medical conditions, or in those suffering from persistent pain after arthroplasty. The classic targets for GNRFA include the superior lateral genicular nerve, superior medial genicular nerve, and inferior medial genicular nerve but multiple anatomic studies have demonstrated additional sensory innervation to the knee.

Objective:

In this research article, we propose an image-guided technique that can safely target the infrapatellar branch of the saphenous nerve which also provides sensory innervation to the anterior capsule.

Proposal:

The proposed technique includes variations for conventional bipolar radiofrequency ablation, cooled radiofrequency ablation, dual-tined bipolar radiofrequency ablation, and monopolar radiofrequency ablation using a long axis approach. The described technique is based on updated anatomic studies and takes into account safety concerns such as thermal risk to the skin and/or pes anserine tendons and breaching of the synovial cavity.

Conclusion:

Future clinical research should be performed to confirm the safety and effectiveness of this specific approach.



21 Sacroiliac Block and Ablation Joint Diagnostic Radiofrequency Ablation Techniques

Loh E, Burnham TR, Burnham RS. *Physical Medicine & Rehabilitation Clinics of North America*. 2021;32(4):725-744. doi:10.1016/j.pmr.2021.05.008.

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Key Points:

The posterior sacral network is located between S2 and S3 in most cadaveric specimens, but could extend to just proximal to the S1 level; a lesion from the level of S2 to S3 is most important for strip lesions.

The posterior innervation of the sacroiliac joint (SIJ) is at the level of the periosteum.

Inclusion of L5 may not be necessary for alleviation of SIJ-specific pain.

Diagnostics:

A single-depth block provides sufficient anesthetization of the SIJ and surrounding structures if appropriate locations along the lateral sacral crest are selected.

Radiofrequency Techniques:

Multiple lesioning techniques (conventional thermal, cooled, multipolar, multilesion probes, multitined electrodes) have been described with various needle placements (linear strip lesion and perforaminal types).

No current technique is clearly superior to other techniques based on clinical outcomes.

Larger studies with appropriate selection criteria are necessary to allow meaningful clinical comparison between techniques.

Other References

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Cedeño DL, Vallejo A, Courtney AK, Tilley DM, Kumar N. *Pain Physician*. 2017;20:E915-E922.

[Click Here to View Article](#)

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