

AVANOS

CLINICAL APPENDIX

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The Clinical Appendix consists of a literature summary surrounding the use of cooled radiofrequency ablation for the treatment of chronic joint pain. It is an abridged list of studies, and readers are advised to review all relevant sources for complete information. Study summaries are organized by modality and include a link to the abstract on PubMed (National Library of Medicine).

SELECTION CRITERIA FOR STUDY SUMMARIES:

- Published in peer reviewed journals
- Randomized controlled, retrospective comparison, case series; and review papers (systematic/meta-analysis).
- Related to the use and/or anatomical considerations of cooled radiofrequency ablation.

This appendix is a balance of favorable, neutral, and unfavorable studies proportional to the number published in the literature.

Abbreviations:

CRFA- Cooled Radiofrequency Ablation

HA- Hyaluronic Acid

IAS- Intraarticular Steroid

IDB- Intradiscal Biacuplasty

OA- Osteoarthritis

QOL- Quality of Life

SIJ- Sacroiliac Joint

THA- Total Hip Arthroplasty

TKA- Total Knee Arthroplasty

How to use this Clinical Appendix

| Author | Year Published | Journal | Type |
|-----------------------|--------------------|---------------|--------------------|
| Lead Author Last Name | The Year Published | Journal Title | Type of Manuscript |

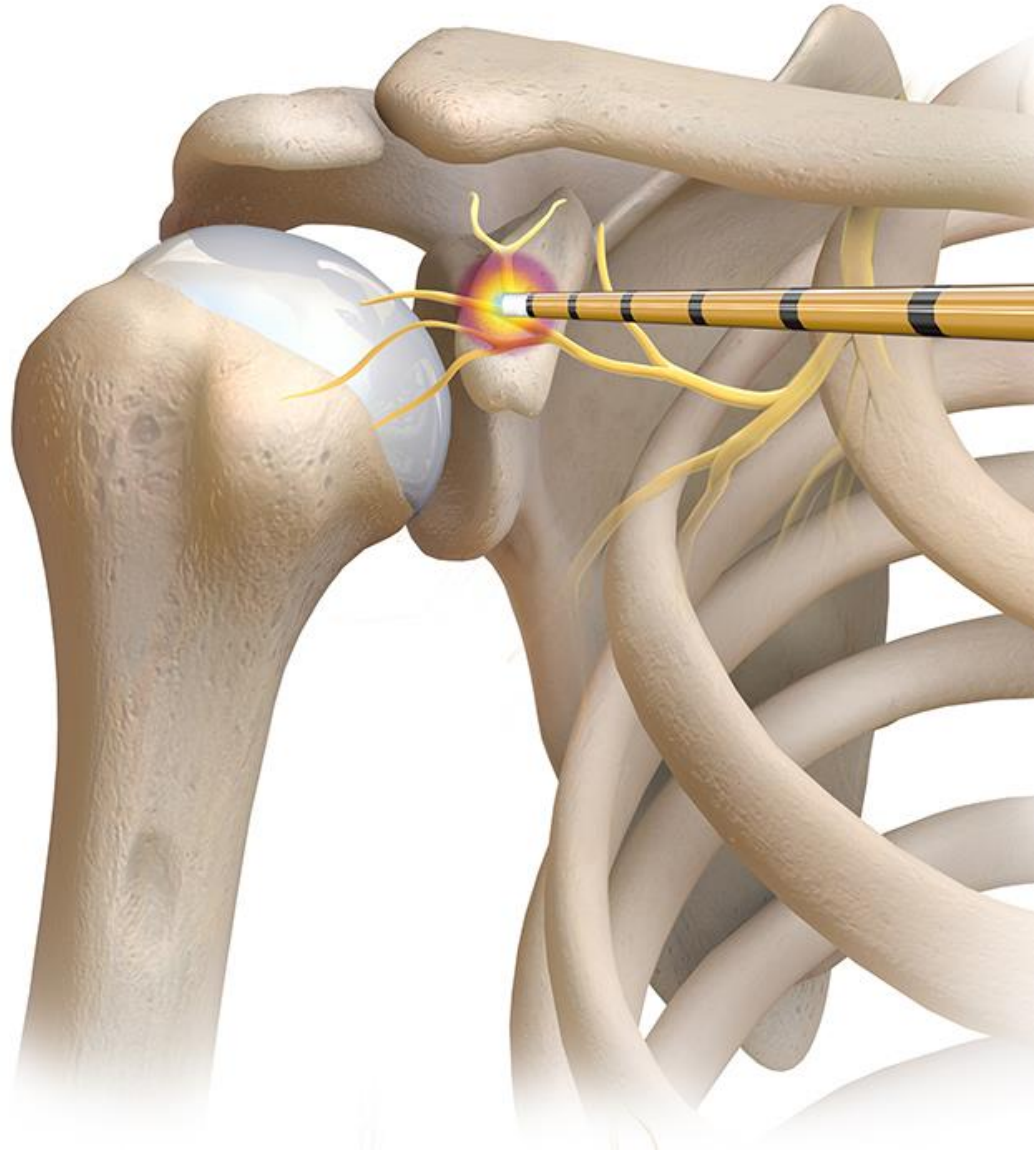
Title: *Full Title of the Manuscript*

Publication Overview: A background in what the study was investigating or discussing.

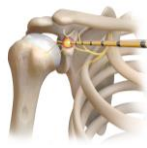
Summary Points: Take-home points that are supported by the data contained within the publication.

Link to the Manuscript: [Link](#)

SHOULDER



SHOULDER



| Author | Year Published | Journal | Type |
|---------|----------------|---------------|-------------|
| Eckmann | 2019 | Pain Medicine | Case Series |

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

Publication Overview: The author describes a retrospective study in which subjects with chronic shoulder pain received RF, and pain relief was tracked for up to one year.

Summary Points: CRFA is an effective procedure for treating chronic shoulder pain.

Link to the Manuscript: <https://pubmed.ncbi.nlm.nih.gov/31851366/>

| Author | Year Published | Journal | Type |
|----------|----------------|-----------------------------|---------------------|
| Gonzalez | 2020 | 2020 RSNA Annual Conference | Poster Presentation |

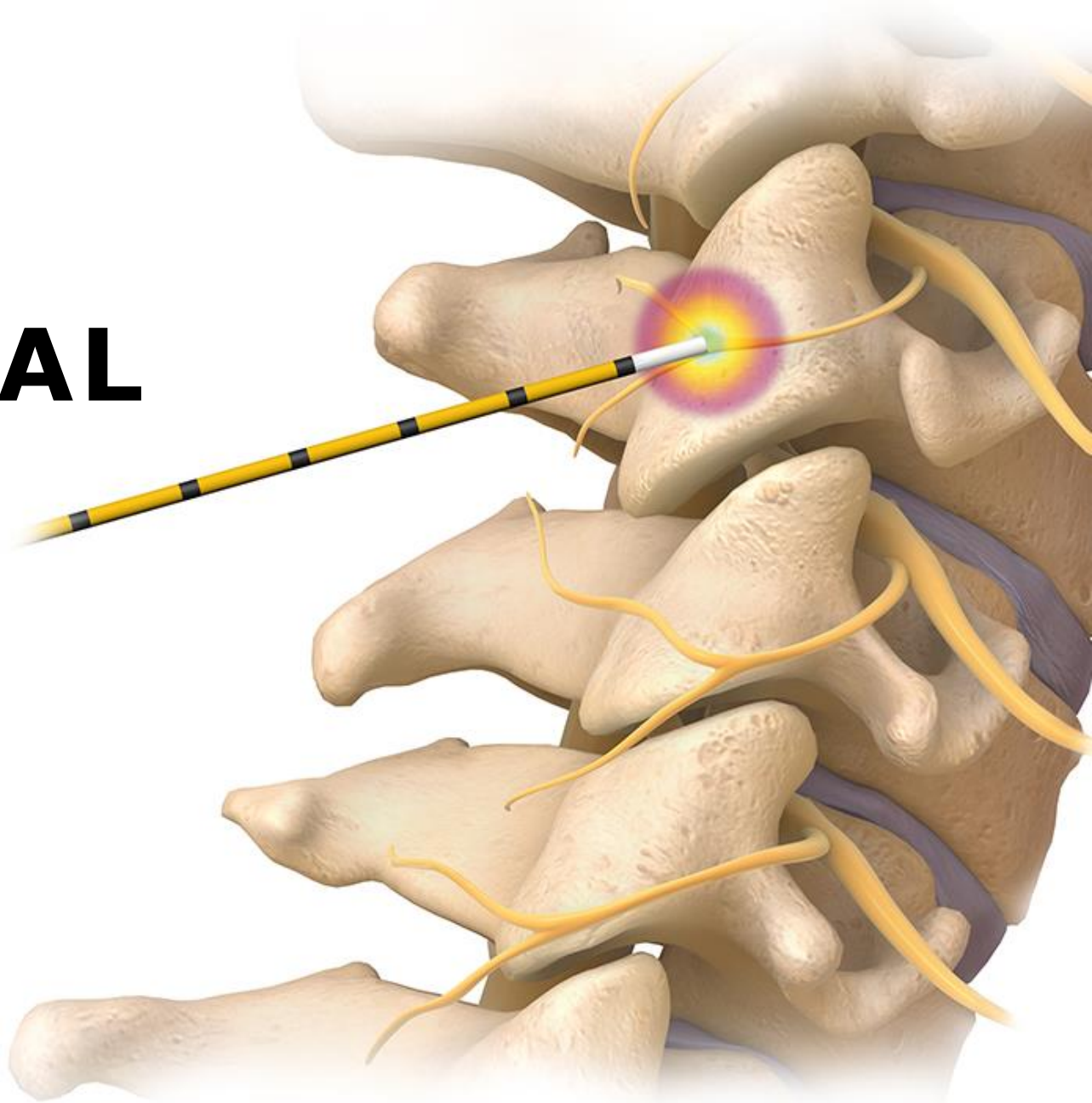
Title: *Safety and Efficacy of Image Guided Radiofrequency Ablation of The Articular Sensory Nerves for Pain Management in Patients with Moderate to Severe Osteoarthritis of the Shoulder and Hip: Initial Single Institutional Experience*

Publication Overview: This was a poster presentation at the 2020 RSNA conference. It details an IRB approved prospective study of patients with moderate to severe shoulder or hip pain that was recalcitrant to other treatments. CRFA was performed to evaluate efficacy.

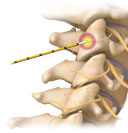
Summary Points: In patients with chronic hip and shoulder joint pain, data demonstrates a statistically significant decrease in joint pain and increase in function following image-guided CRFA of the respective articular sensory nerve fibers.

Link to the Manuscript: https://press.rsna.org/pressrelease/2020_resources/2223/abstract.pdf

CERVICAL



CERVICAL



| Author | Year Published | Journal | Type |
|---------|----------------|---------------|------------------------------|
| Burnham | 2020 | Pain Medicine | Cross-sectional cohort study |

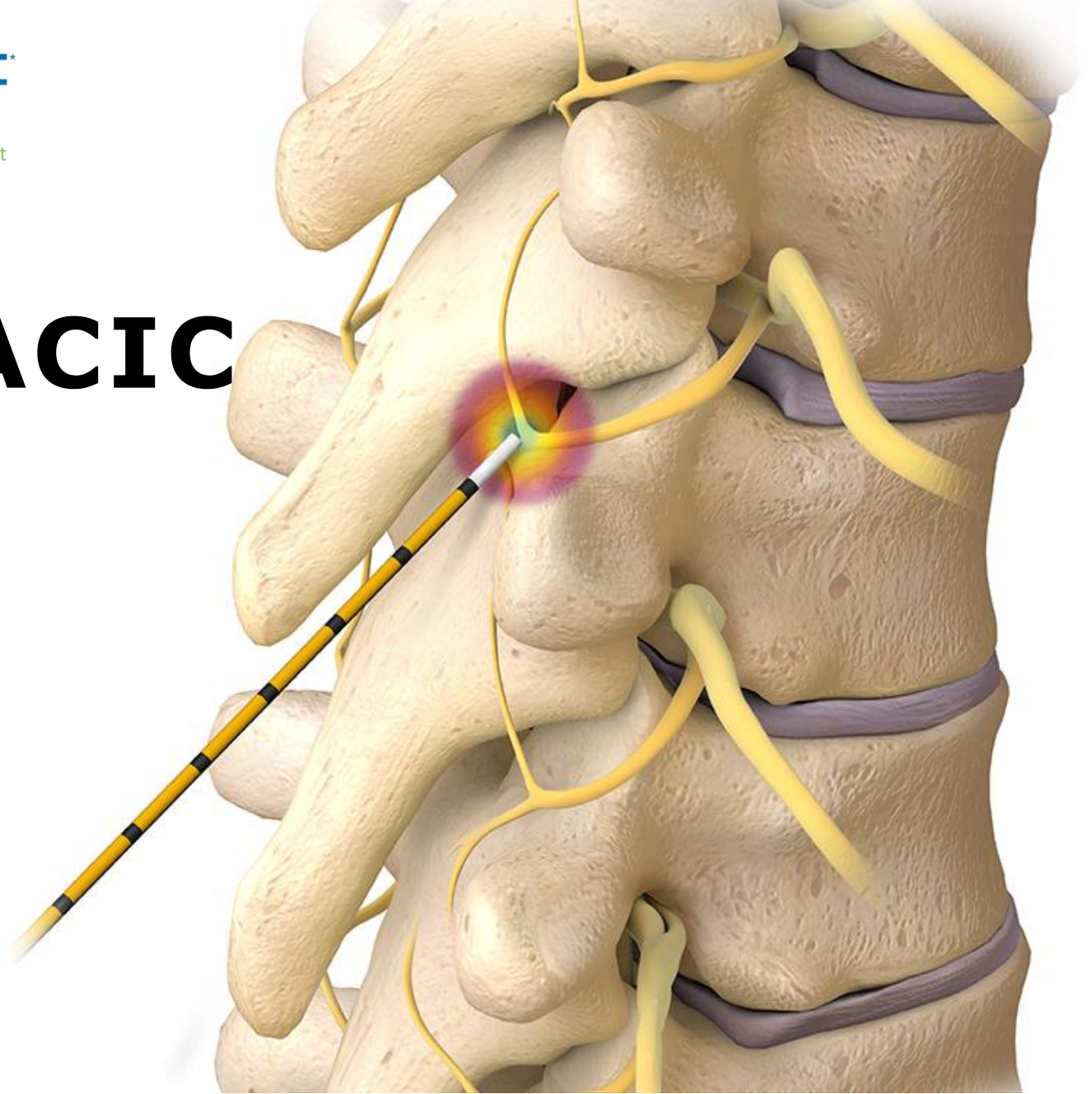
Title: *The Effectiveness of Cervical Medial Branch Radiofrequency Ablation for Chronic Facet Joint Syndrome in Patients Selected by a Practical Medial Branch Block Paradigm.*

Publication Overview: The researchers analyzed the outcomes of 50 patients who received CRFA after gaining >80% relief from diagnostic blocks; pain levels were reported through 24 months.

Summary Points: CRFA is an effective treatment for patients with cervical pain who respond favorably to diagnostic blocks.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/32022889>

THORACIC



THORACIC



Author

Year Published

Journal

Type

Gungor

2020

Medicine(Baltimore)

Retrospective Review

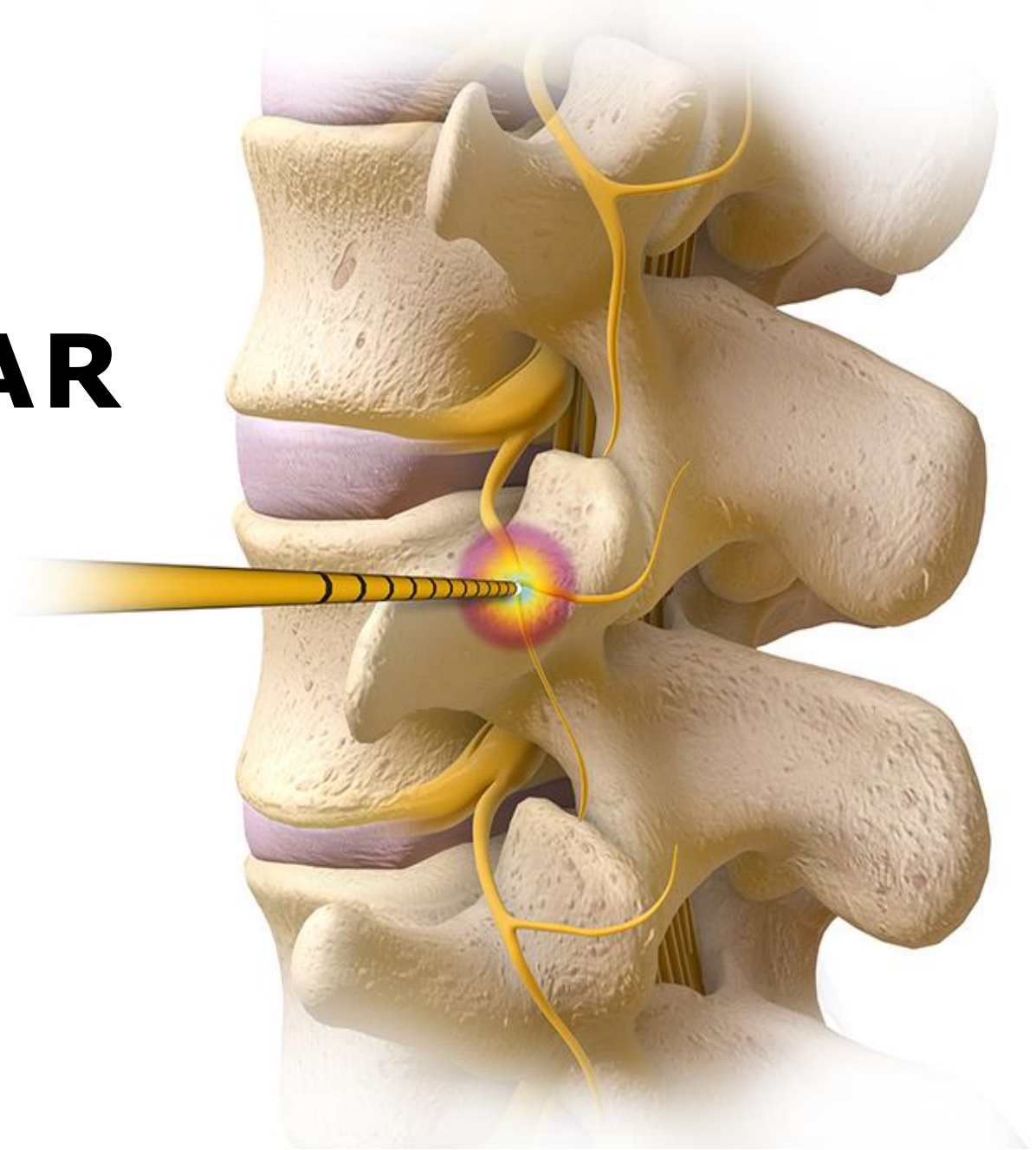
Title: *The efficacy and safety of cooled-radiofrequency neurotomy in the treatment of chronic thoracic facet (zygapophyseal) joint pain: A retrospective study.*

Publication Overview: CRFA was performed on 23 patients with upper/mid back pain, and the authors then assessed the duration of pain relief, time to repeat treatment, and adverse effects of the procedure.

Summary Points: CRFA is an effective treatment for thoracic pain, with minimal adverse effects. The majority of patients did not require repeat treatment for over a year.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/32243409>

LUMBAR



LUMBAR



| Author | Year Published | Journal | Type |
|--------|----------------|---------|------|
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|-----------|------|---------------------------------------|-------------------------------|
| McCormick | 2019 | Regional Anesthesia and Pain Medicine | Randomized, Prospective Study |
|-----------|------|---------------------------------------|-------------------------------|

Title: *Randomized prospective trial of cooled versus traditional radiofrequency ablation of the medial branch nerves for the treatment of lumbar facet joint pain*

Publication Overview: Patients were randomly assigned to receive either SRFA or CRFA for lumbar facet joint pain; pain was assessed through 6 months.

Summary Points: CRFA is effective in reducing lumbar facet joint pain at 6 months.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/30777903>

| Author | Year Published | Journal | Type |
|--------|----------------|---------|------|
|--------|----------------|---------|------|

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|--------|------|---------------|------------------------------|
| Conger | 2019 | Pain Medicine | Cross-sectional Cohort Study |
|--------|------|---------------|------------------------------|

Title: *The Effectiveness of Radiofrequency Ablation of Medial Branch Nerves for Chronic Lumbar Facet Joint Syndrome in Patients Selected by Guideline-Concordant Dual Comparative Medial Branch Blocks*

Publication Overview: The authors aimed to report on the long-term outcomes of RF on patients with lumbar joints and to determine predictors of treatment success by collecting patient data through 24 months post procedure.

Summary Points: RFA, including CRFA, is a durable and effective treatment for lumbar joint pain. Older age appears to be associated with greater likelihood of success.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/31609391>

| Author | Year Published | Journal | Type |
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|------|------|-------------------------------------|---------------|
| Shih | 2020 | Clinical Neurology and Neurosurgery | Meta-Analysis |
|------|------|-------------------------------------|---------------|

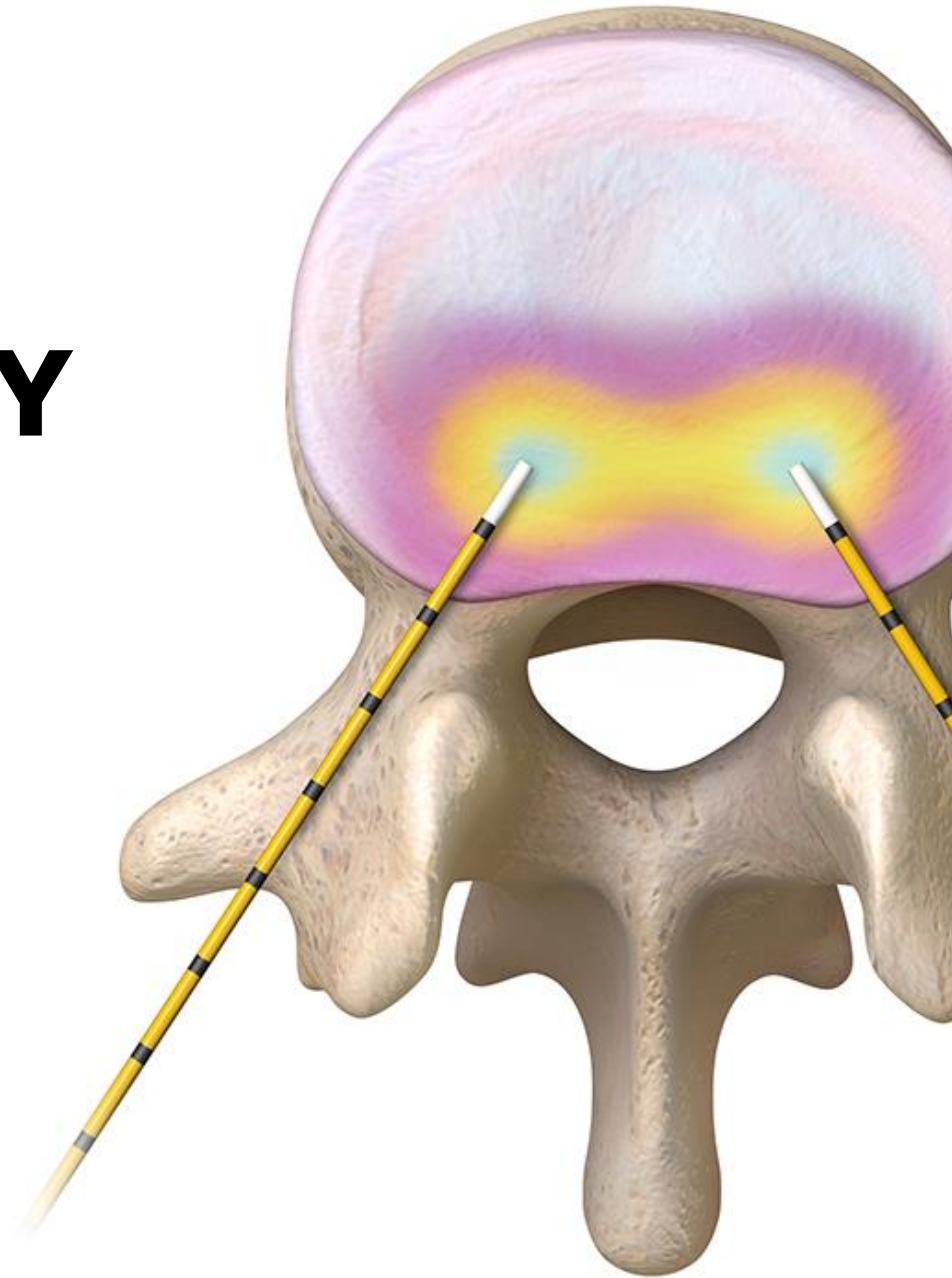
Title: *A comparison of efficacy among different radiofrequency ablation techniques for the treatment of lumbar facet joint and sacroiliac joint pain: a systematic review and meta-analysis*

Publication Overview: The authors reviewed 21 publications on the use of radiofrequency for lumbar pain in order assess the effectiveness of thermal, pulsed, and cooled RFA for pain reduction.

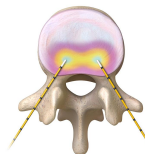
Summary Points: At 6 months, CRFA was the most effective type of RFA in treating pain in the lumbar facet joint.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/32353665>

BIACUPLASTY



BIACUPLASTY



| Author | Year Published | Journal | Type |
|---------|----------------|--------------------|------------|
| Kapural | 2007 | Pain Practitioners | Case Study |

Title: *Novel Intradiscal Biacuplasty (IDB) for the Treatment of Lumbar Discogenic Pain*

Publication Overview: The authors performed biacuplasty on a patient who was exhibiting axial lower back pain; pain levels and functionality were assessed at one and six month follow-ups.

Summary Points: Biacuplasty for discogenic pain is effective in improving pain and functionality through six months.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/17559482>

| Author | Year Published | Journal | Type |
|---------|----------------|---------------|-------------|
| Kapural | 2008 | Pain Medicine | Case Series |

Title: *Intervertebral disc biacuplasty for the treatment of lumbar discogenic pain: results of a six-month follow-up.*

Publication Overview: 15 patients underwent IDB for the treatment of degenerative disk disease. Pain, functionality, and opioid usage were reported through 6 months.

Summary Points: Biacuplasty is a safe and effective treatment for pain related to degenerative disk disease.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/18254768>

| Author | Year Published | Journal | Type |
|---------|----------------|---|-------------|
| Kapural | 2008 | Journal of Physical Medicine & Rehabilitation | Case Series |

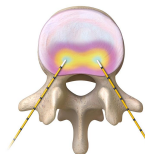
Title: *Intervertebral Disk Cooled Bipolar Radiofrequency (Intradiskcal Biacuplasty) for the Treatment of Lumbar Discogenic Pain: A 12-Month Follow Up of the Pilot Study*

Publication Overview: This is a 12 month follow-up to the Kapural 2007 study, in which the researchers collected 12 month functionality and pain data from patients who participated in the original study.

Summary Points: Benefits of CRFA as used in IDB persist at 12 months post-procedure.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/18489632>

BIACUPLASTY



| Author | Year Published | Journal | Type |
|---------|----------------|---|-------------|
| Karaman | 2011 | International Journal of Medicine Science | Case Series |

Title: *6-Month Results of Transductal Biacuplasty on Patients with Discogenic Low Back Pain: Preliminary Findings*

Publication Overview: The researchers performed biacuplasty on fifteen patients presenting with severe chronic discogenic pain; pain, physical condition, and satisfaction were assessed at through 6 months.

Summary Points: Biacuplasty is effective through 6 months in improving pain, physical condition, and patient satisfaction.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3005544/>

| Author | Year Published | Journal | Type |
|---------|----------------|---------------|-------------------------------|
| Kapural | 2012 | Pain Medicine | Randomized, Prospective Trial |

Title: *A randomized, placebo-controlled trial of transdiscal radiofrequency, biacuplasty for treatment of discogenic lower back pain.*

Publication Overview: The authors performed biacuplasty on subjects presenting with chronic low back pain; pain, functionality, and disability were assessed at 1, 3, and 6 months.

Summary Points: Biacuplasty has non-placebo effects on pain and functionality in patients with chronic discogenic low back pain through 6 months.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/23279658>

| Author | Year Published | Journal | Type |
|---------|----------------|---------------|-------------------------------|
| Kapural | 2015 | Pain Medicine | Randomized, Prospective Trial |

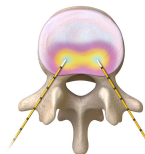
Title: *Radiofrequency intradiscal biacuplasty for treatment of discogenic lower back pain: a 12-month follow-up.*

Publication Overview: The researchers assessed the conditions of the subjects originally assigned to receive IDB as well as subjects who crossed over to receive IDB.

Summary Points: The benefits of IDB persist at one year post-procedure. Furthermore, patients who crossed over to receive IDB also saw benefits 6 months following the procedure.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/25339501>

BIACUPLASTY



| Author | Year Published | Journal | Type |
|--------|----------------|---------|------|
|--------|----------------|---------|------|

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|-------|------|-------|-------------------------------|
| Desai | 2016 | Spine | Randomized, Prospective Trial |
|-------|------|-------|-------------------------------|

Title: *A Prospective, Randomized, Multicenter, Open-label Clinical Trial Comparing Intradiscal Biacuplasty to Conventional Medical Management for Discogenic Lumbar Back Pain.*

Publication Overview: The researchers assigned half of the subjects to receive IDB in addition to conventional methods, while the other half were assigned to only receive conventional methods. At six months, pain was assessed by the authors.

Summary Points: IDB in conjunction with conventional treatment methods is more effective in treating chronic lower back pain than conventional methods alone.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/26689579>

| Author | Year Published | Journal | Type |
|--------|----------------|---------|------|
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|-------|------|---------------|-------------------------------|
| Desai | 2016 | Pain Medicine | Randomized, Prospective Trial |
|-------|------|---------------|-------------------------------|

Title: *Twelve-Month Follow-up of a Randomized Clinical Trial Comparing Intradiscal Biacuplasty to Conventional Medical Management for Discogenic Lumbar Back Pain.*

Publication Overview: This was a 12 month follow up to the Desai 2015 study, in which the researchers assessed the effects of IDB in the original IDB cohort and as well as the crossover cohort.

Summary Points: The combination of IDB and conventional methods are clinically effective in treating chronic low back pain one year post-procedure. Subjects who crossed over to receive IDB experience similar benefits at 6 months after treatment.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/27570246>

| Author | Year Published | Journal | Type |
|--------|----------------|---------|------|
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|------|------|----------------|-------------------|
| Helm | 2017 | Pain Physician | Systematic Review |
|------|------|----------------|-------------------|

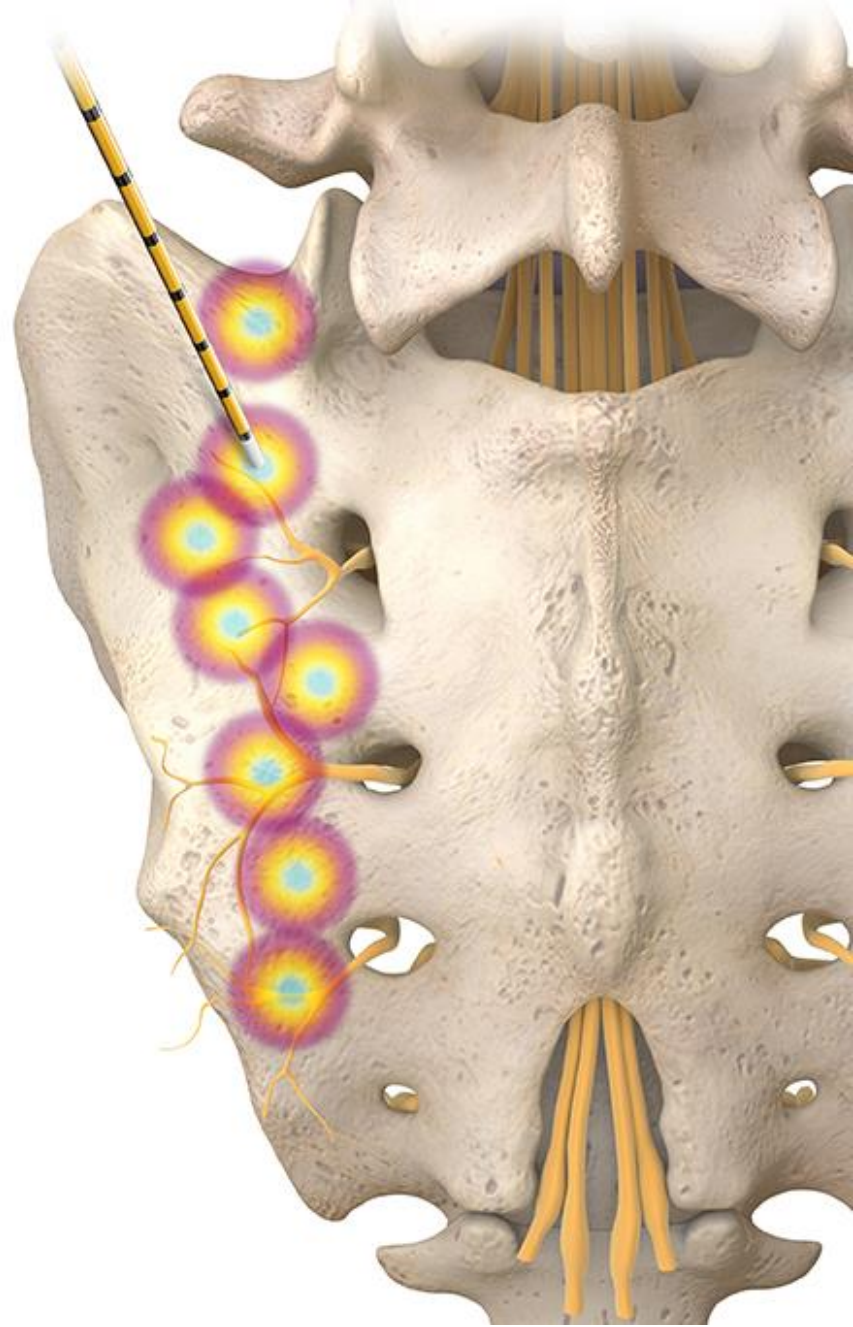
Title: *Effectiveness of Thermal Annular Procedures in Treating Discogenic Low Back Pain*

Publication Overview: The authors examined 49 studies related to the use of thermal procedures, including biacuplasty, to treat chronic lower back pain. The primary outcomes under study were pain and functionality.

Summary Points: Biacuplasty is effective in treating chronic discogenic pain, and may be considered as a first-line treatment for such pain.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/28934777>

SACROILIAC



SACROILIAC



| Author | Year Published | Journal | Type |
|--------|----------------|----------------|--------------------------------------|
| Cohen | 2008 | Anesthesiology | Randomized, Placebo-Controlled Trial |

Title: *Randomized Placebo-controlled Study Evaluating Lateral Branch Radiofrequency Denervation for Sacroiliac Joint Pain*

Publication Overview: The researchers assigned half the subjects to receive CRFA, and the other half to receive a placebo treatment. Pain and functionality were reported through 6 months.

Summary Points: Non-placebo effects of CRFA on pain and function can be seen in patients with SIJ pain for at least 6 months.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/18648237>

| Author | Year Published | Journal | Type |
|---------|----------------|---------------|---------------------------|
| Kapural | 2008 | Pain Practice | Retrospective Case Series |

Title: *Cooled Radiofrequency System for the Treatment of Chronic Pain from Sacroiliitis: The First Case-Series*

Publication Overview: The authors reviewed the records of 26 patients who received CRFA as treatment for chronic SIJ pain, evaluating the effects of CRFA on pain and function.

Summary Points: CRFA improves pain and function in patients with chronic SIJ pain 3-4 months post-procedure.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/18844853>

| Author | Year Published | Journal | Type |
|--------|----------------|-------------------------------------|-------------------|
| Cohen | 2009 | Regional Anesthesia & Pain Medicine | Dual Center Study |

Title: *Outcome predictors for sacroiliac joint (lateral branch) radiofrequency denervation.*

Publication Overview: The researchers performed CRFA on subjects who presented with chronic lower back pain in order to identify factors associated with CRFA outcomes.

Summary Points: The use of cooled RF, rather than conventional RF, was associated with a higher percentage of positive outcomes.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/19587617>

SACROILIAC



| Author | Year Published | Journal | Type |
|---------|----------------|---------------|---------------------------|
| Kapural | 2010 | Pain Medicine | Retrospective Case Series |

Title: *Cooled Radiofrequency (RF) of L5 Dorsal Ramus for RF Denervation of the Sacroiliac Joint: Technical Report*

Publication Overview: The authors reviewed post-procedural complications of patients who received CRFA for SIJ pain.

Summary Points: CRFA for SIJ pain is a safe procedure without significant complications.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/20030745>

| Author | Year Published | Journal | Type |
|---------|----------------|----------------------|-------------|
| Karaman | 2011 | Acta Neurochirurgica | Case Series |

Title: *Cooled radiofrequency application for treatment of sacroiliac joint pain*

Publication Overview: CRFA was performed on 15 patients who presented with chronic low back pain; pain levels, physical improvement, and patient satisfaction were assessed through 6 months.

Summary Points: CRFA is a safe and effective treatment for SIJ pain in the short to intermediate term.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/21479801>

| Author | Year Published | Journal | Type |
|--------|----------------|---------------|--------------------------------------|
| Patel | 2012 | Pain Medicine | Randomized, Placebo-Controlled Study |

Title: *A Randomized, Placebo-Controlled Study to Assess the Efficacy of Lateral Branch Neurotomy for Chronic Sacroiliac Joint Pain*

Publication Overview: The researchers assigned half the patients to receive CRFA, and the other half to receive a placebo treatment. Pain, function, disability, and quality of life were assessed at through 9 months. Crossover from the placebo group was allowed after 3 months.

Summary Points: CRFA has non-placebo effects on chronic SIJ pain that last more than 9 months.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/22299761>

SACROILIAC



| Author | Year Published | Journal | Type |
|---------|----------------|---------------|-------------|
| Stelzer | 2012 | Pain Medicine | Case Series |

Title: *Use of cooled radiofrequency lateral branch neurotomy for the treatment of sacroiliac joint-mediated low back pain: a large case series*

Publication Overview: The authors assessed the durability of pain relief in 105 patients who received CRFA for chronic low back pain through 12 months.

Summary Points: CRFA is a durable treatment for patients with chronic low back pain who do not respond to conventional methods of treatment.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/23279364>

| Author | Year Published | Journal | Type |
|-----------|----------------|----------------|-------------------|
| Ramasubba | 2013 | Pain Physician | Literature Review |

Title: *Cooled Sacroiliac Radiofrequency Denervation for the Treatment of Pain Secondary to Tumor Infiltration: A Case-Based Focused Literature Review*

Publication Overview: CRFA was performed on a woman with acute SIJ pain due to cancer.

Summary Points: CRFA is potentially effective in treating SIJ pain caused by cancer.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/23340529>

| Author | Year Published | Journal | Type |
|--------|----------------|--------------------------|----------------------|
| Cheng | 2013 | Clinical Journal of Pain | Retrospective Review |

Title: *Comparative outcomes of cooled versus traditional radiofrequency ablation of the lateral branches for sacroiliac joint pain.*

Publication Overview: The authors aimed to compare CRFA with SFRA. The researchers retrospectively collected patient data regarding pain relief through 12 months post-procedure.

Summary Points: RFA, including CRFA is effective in reducing pain for patients with SIJ pain for 3-6 months.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/22688606>

SACROILIAC



| Author | Year Published | Journal | Type |
|--------|----------------|--------------------------|----------------------|
| Ho | 2013 | Journal of Pain Research | Retrospective Review |

Title: *Cooled radiofrequency denervation for treatment of sacroiliac joint pain: two-year results from 20 cases*

Publication Overview: The authors examined the charts of 20 patients with chronic SIJ pain who underwent CRFA, evaluating pain intensity, global perceived effect, and global impression of change.

Summary Points: CRFA is effective in the treatment of SIJ pain for up to two years.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3706381/>

| Author | Year Published | Journal | Type |
|-------------|----------------|---------------|----------------------------|
| Stolzenberg | 2014 | Pain Medicine | Retrospective Chart Review |

Title: *Incidence of Neuropathic Pain after Cooled Radiofrequency Ablation of Sacral Lateral Branch Nerves*

Publication Overview: The authors aimed to determine the incidence of neuropathic pain after CRFA for SIJ pain.

Summary Points: CRFA is a safe procedure and causes minimal neuropathic pain.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/25220749>

| Author | Year Published | Journal | Type |
|------------|----------------|----------------|-------------------|
| Simopoulos | 2015 | Pain Physician | Literature Review |

Title: *Systematic Review of the Diagnostic Accuracy and Therapeutic Effectiveness of Sacroiliac Joint Interventions*

Publication Overview: The authors evaluated the diagnostic accuracy and therapeutic effectiveness of sacroiliac joint interventions by assessing the evidence levels of 25 publications related to SIJ interventions.

Summary Points: The evidence in literature supporting CRFA is more durable than the evidence supporting SRFA or periarticular injections.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/26431129>

SACROILIAC



| Author | Year Published | Journal | Type |
|--------|----------------|---------------|------------------|
| Patel | 2015 | Pain Practice | Randomized Trial |

Title: *Twelve-month follow-up of a randomized trial assessing cooled radiofrequency denervation as a treatment for sacroiliac region pain*

Publication Overview: This was a follow-up to the Patel 2012 study, the researchers explore the effects of CRFA 12 months post-procedure for the original treatment group, as well as 6 months post-procedure for the crossover group.

Summary Points: CRFA is an effective option for improving pain, function, and quality of life through 12 months for patients with chronic SIJ pain, with few complications.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/25565322>

| Author | Year Published | Journal | Type |
|--------|----------------|---|-------------|
| Biswas | 2016 | Journal of Anesthesiology Clinical Pharmacology | Case Series |

Title: *Water-cooled radiofrequency neuroablation for sacroiliac joint dysfunctional pain.*

Publication Overview: The patient, a 35 year old male, presented with chronic lower back pain. He received CRFA, and his pain levels were monitored for the following 18 months.

Summary Points: CRFA for SIJ pain can provide relief out to 18 months.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/28096589>

| Author | Year Published | Journal | Type |
|---------|----------------|--------------------------|---------------------|
| Stelzer | 2017 | Journal of Pain Research | Retrospective Study |

Title: *Influence of BMI, gender, and sports on pain decrease and medication usage after facet-medial branch neurotomy or SI joint lateral branch cooled RF-neurotomy in case of low back pain: original research in the Austrian population*

Publication Overview: The authors collected data on 160 subjects who received RF for chronic lower back pain, evaluating pain levels and medication usage through 12 months.

Summary Points: CRFA on the SIJ is a safe and effective method for long-term pain reduction in patients presenting with lower back pain.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/28144161>

SACROILIAC



| Author | Year Published | Journal | Type |
|------------|----------------|---------------|-----------------------------------|
| Tinnirello | 2017 | Pain Medicine | Retrospective observational study |

Title: *Conventional (Simplicity III) and Cooled (SInergy) Radiofrequency for Sacroiliac Joint Denervation: One-Year Retrospective Study Comparing Two Devices.*

Publication Overview: The authors compared the effectiveness of conventional and cooled radiofrequency for pain relief in patients presenting with lower back pain; pain and function were assessed through 12 months.

Summary Points: The benefits of CRFA are more durable and long lasting than those of SRFA.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/28340063>

| Author | Year Published | Journal | Type |
|--------|----------------|---------------------|---------------|
| Sun | 2018 | Medicine(Baltimore) | Meta-Analysis |

Title: *The efficacy and safety of using cooled radiofrequency in treating chronic sacroiliac joint pain*

Publication Overview: The authors assessed 84 peer-reviewed articles in order to evaluate the safety and effectiveness of CRFA in the treatment of chronic SIJ pain.

Summary Points: CRFA is a safe and effective approach to managing chronic SIJ pain, with limited complications.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5944663/>

| Author | Year Published | Journal | Type |
|------------|----------------|---------------|---------------------|
| Kurklinsky | 2019 | Pain Medicine | Retrospective Study |

Title: *Repeat Cooled Radiofrequency Ablation Is Beneficial for Chronic Posterior Sacroiliac Joint Pain*

Publication Overview: The researchers reviewed the records of 41 patients who received CRFA for chronic SIJ pain and collected data regarding the duration of pain relief and utilization of medical care for 6 months before and 6 months after the procedure.

Summary Points: Repeat treatment of CRFA is a safe and effective treatment for SIJ pain and reduces the use of medical services.

Not indexed on PubMed, available at : <https://academic.oup.com/painmedicine/advance-article-abstract/doi/10.1093/pm/pnz295/5625713?redirectedFrom=fulltext>

SACROILIAC



| Author | Year Published | Journal | Type |
|------------|----------------|------------------------|---------------------|
| Tinnirello | 2020 | Korean Journal of Pain | Retrospective Study |

Title: *Reduction of opioid intake after cooled radiofrequency denervation for sacroiliac joint pain: a retrospective evaluation up to 1 year.*

Publication Overview: The authors assessed the effect of CRFA on opioid usage in patients with chronic low back pain.

Summary Points: CRFA is an effective treatment for SIJ pain and reduces opioid usage.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7136294/>

| Author | Year Published | Journal | Type |
|-----------|----------------|------------------------------|---------------------|
| Kleinmann | 2020 | Scandinavian Journal of Pain | Retrospective Study |

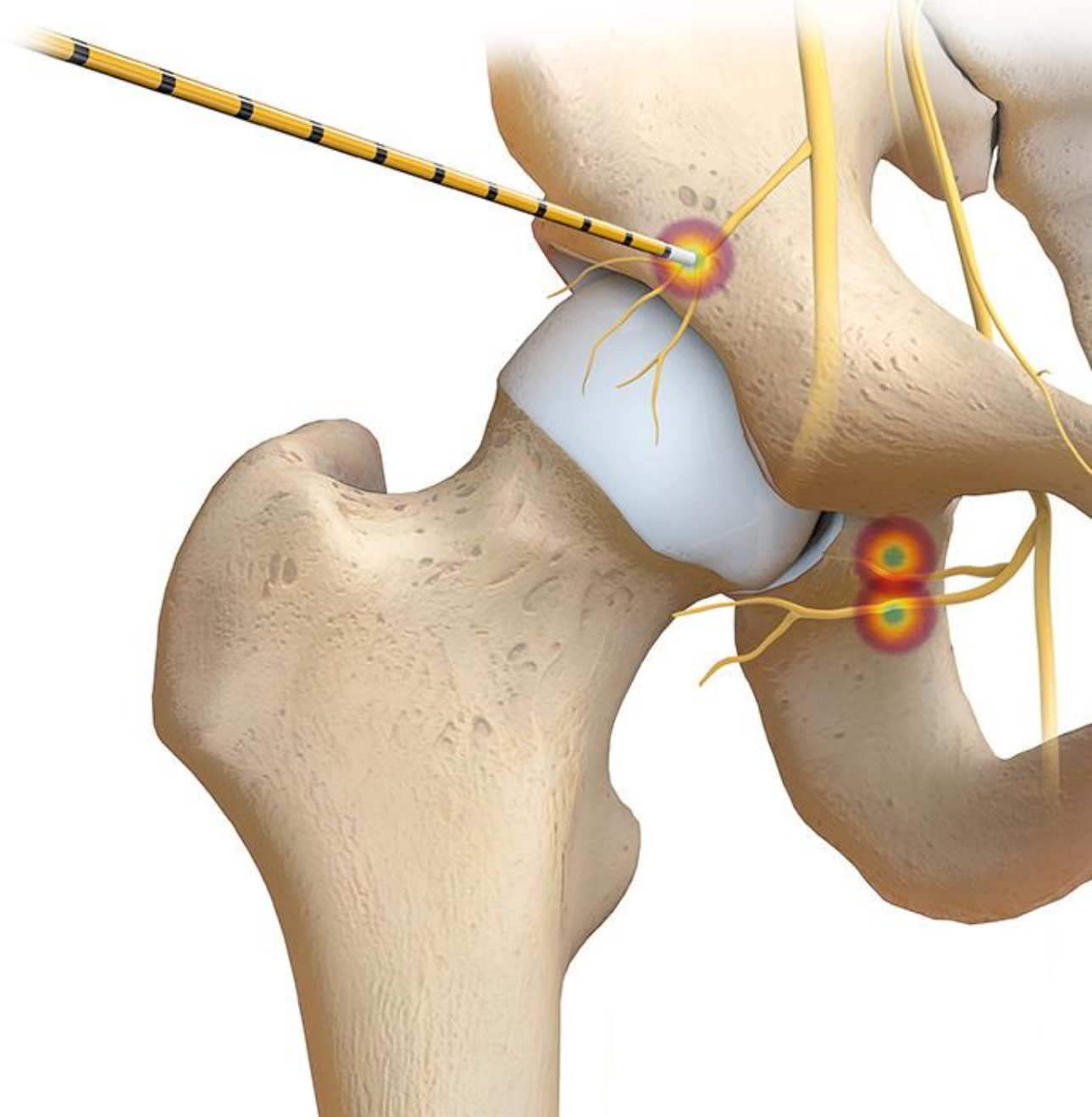
Title: Cooled radiofrequency for the treatment of sacroiliac joint pain - impact on pain and psychometrics: a retrospective cohort study

Publication Overview: The authors reviewed the data of 28 patients who received CRFA for chronic SIJ pain in order to assess the impact on psychological factors such as anxiety and depression.

Summary Points: Patients showed improvements in pain, sleep quality, and possibly depression, but did not show improvements in anxiety and pain disability

Link to the Manuscript: <https://pubmed.ncbi.nlm.nih.gov/32841170/>

HIP



HIP



| Author | Year Published | Journal | Type |
|--------|----------------|----------------|-------------|
| Kim | 2017 | Pain Physician | Case Report |

Title: *Ultrasound-guided radiofrequency lesioning of the articular branch of the femoral nerve for the treatment of chronic post-arthroplasty hip pain*

Publication Overview: A patient with hip OA who had previously undergone arthroplasty had persisting pain and thus received CRFA as treatment. Pain and functionality were reported through 24 months.

Summary Points: CRFA via ultrasound guidance is an effective, minimally invasive, long-term pain treatment for patients who have already undergone THA.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/28158168>

| Author | Year Published | Journal | Type |
|---------|----------------|----------------|----------------------------|
| Kapuraj | 2018 | Pain Physician | Retrospective Chart Review |

Title: *Cooled radiofrequency neurotomy of the articular sensory branches of the obturator and femoral nerves – combined approach using fluoroscopy and ultrasound guidance: technical report and observational study on safety and efficacy*

Publication Overview: The authors collected data on previously performed CRFA procedures; they described the method implemented and the resulting outcomes.

Summary Points: CRFA can provide significant pain relief for hip OA, and it creates larger volume lesions than SFRA, which seem to be ideal for denervation.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/29871372>

| Author | Year Published | Journal | Type |
|--------|----------------|-----------------|-------------|
| Naber | 2019 | Pain Management | Case Series |

Title: *Clinical Efficacy Assessment of Cooled Radiofrequency Ablation of the Hip in Patients with Avascular Necrosis*

Publication Overview: The authors examine the methods and results of a combined ultrasound and fluoroscopy approach to using CRFA for pain related to avascular necrosis in the hip in seven patients.

Summary Points: CRFA is safe and effective in treating hip pain in patients with avascular necrosis.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/31215846>

HIP



| Author | Year Published | Journal | Type |
|-----------|----------------|--|-------------|
| Mariconda | 2020 | European Journal of Physical and Rehabilitation Medicine | Case Series |

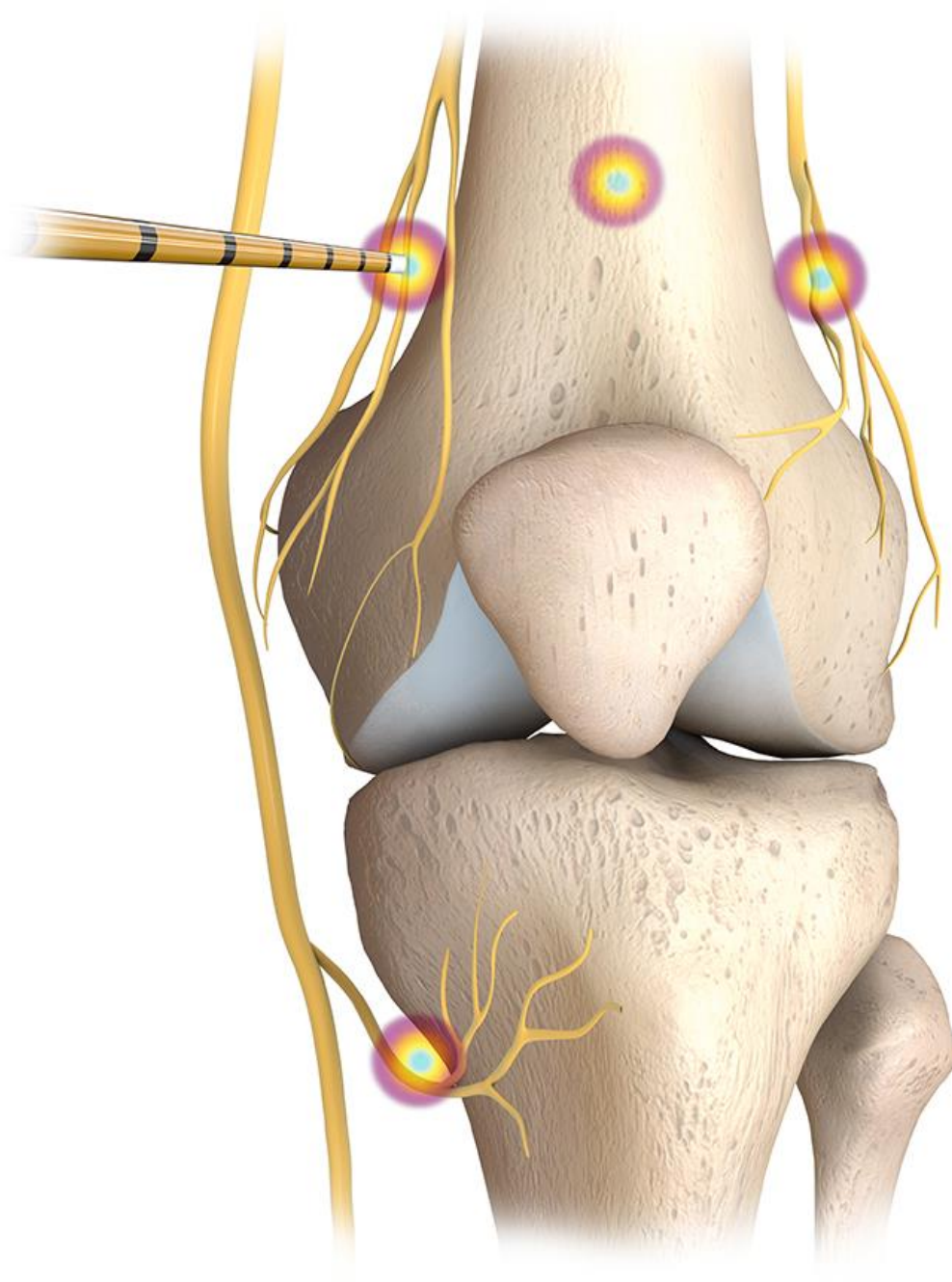
Title: *Therapeutic exercise and radiofrequency in the rehabilitation project for hip osteoarthritis pain: a case series.*

Publication Overview: 25 patients with severe hip OA for whom THA was not an option received CRFA in combination with physical therapy; pain and functionality were assessed through 6 months.

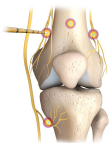
Summary Points: CRFA in conjunction with physical therapy is an effective alternative to surgery for patients with hip OA.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/32162859>

KNEE



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| Author | Year Published | Journal | Type |
|---------|----------------|----------------------------------|-------------|
| Bellini | 2015 | Anesthesiology Intensive Therapy | Case Series |

Title: *Cooled radiofrequency system relieves chronic knee osteoarthritis pain: the first case-series*

Publication Overview: The researchers performed CRFA on the genicular nerve of nine elderly patients with knee OA, and monitored pain and functionality through 12 months.

Summary Points: CRFA of genicular nerves is effective in improving pain and function in patients not recommended for invasive procedures.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/25751290>

| Author | Year Published | Journal | Type |
|---------|----------------|-------------------------|-------------|
| Menzies | 2015 | World Institute of Pain | Case Report |

Title: *Analgesia and Improved Performance in a Patient Treated by Cooled Radiofrequency for Pain and Dysfunction Post bilateral Total Knee Replacement*

Publication Overview: A patient who had already had total knee replacements underwent CRFA; the authors monitored his pain and functionality for nine months afterward.

Summary Points: CRFA is effective in improving pain, function, and medication dependence, even in patients who have already undergone total knee replacement.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/25857719>

| Author | Year Published | Journal | Type |
|---------|----------------|---|-------------|
| Rojhani | 2016 | Journal of Physical Medicine & Rehabilitation | Case Report |

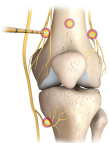
Title: *Water-Cooled Radiofrequency Provides Pain Relief, Decreases Disability, and Improves Quality of Life in Chronic Knee Osteoarthritis*

Publication Overview: A patient with end-stage knee OA received CRFA, and the authors assessed pain, functionality, and quality of life through 3 months.

Summary Points: CRFA has the potential to improve pain, functionality, and quality of life in patients with end stage knee OA, with minimal adverse effects.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/27196385>

KNEE



| Author | Year Published | Journal | Type |
|--------|----------------|----------------------------------|-------------|
| Reddy | 2016 | Anesthesiology and Pain Medicine | Case Series |

Title: *Cooled Radiofrequency Ablation of genicular Nerves for Knee Osteoarthritis Pain: A Protocol for Patient Selection and Case Series*

Publication Overview: CRFA was performed on the genicular nerve of four patients presenting with knee OA. Pain levels, functionality, and medication usage were assessed at six and twelve months.

Summary Points: CRFA was successful in the reduction of pain, improvement of function, and avoidance of surgery at six months; however, patients should be selected under a stringent protocol.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/28975074>

| Author | Year Published | Journal | Type |
|---------|----------------|---------|-------------|
| Farrell | 2016 | PM&R | Case Report |

Title: *Demonstration of Lesions Produced by Cooled Radiofrequency Neurotomy for Chronic Osteoarthritic Knee Pain: A Case Presentation.*

Publication Overview: A patient presented with degenerative joint disease, and subsequently received CRFA. In vivo images of the lesions created during ablation were captured.

Summary Points: Images of lesions show CRFA as causing large, spherical lesions, which are thought to be more effective than lesions created in SRFA.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/27639652>

| Author | Year Published | Journal | Type |
|--------|----------------|----------------|-------------------|
| Gupta | 2017 | Pain Physician | Literature Review |

Title: *Comparative Effectiveness Review of Cooled Versus Pulsed Radiofrequency Ablation for the Treatment of Knee Osteoarthritis: A Systematic Review*

Publication Overview: The authors reviewed 17 publications related to various kinds of RF for the treatment of knee OA, providing an overview of procedures, nerve targets, adverse events, and duration of treatment effects.

Summary Points: CRFA is an effective treatment for both pre-surgery knee OA patients and post-TKA patients.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/28339430>

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| Author | Year Published | Journal | Type |
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| McCormick | 2017 | Pain Medicine | Retrospective, Cross-sectional survey |
|-----------|------|---------------|---------------------------------------|

Title: *Cooled Radiofrequency Ablation of the Genicular Nerves for Chronic Pain due to Knee Osteoarthritis: Six-Month Outcomes*

Publication Overview: The authors surveyed patients who underwent CRFA six or more months after the procedure to assess pain levels, global subjective improvement, and medication usage. It also aimed to identify factors that contributed to more successful outcomes.

Summary Points: CRFA improves pain and functionality and has the potential to provide total pain relief in knee OA patients six months post-procedure. Pain duration and diagnostic blocks can serve as predictors of success for the procedure.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/28431129>

| Author | Year Published | Journal | Type |
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| McCormick | 2017 | Pain Medicine | Prospective Randomized Trial |
|-----------|------|---------------|------------------------------|

Title: *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*

Publication Overview: The authors evaluated the potential of nerve blocks to predict the outcome of CRFA by comparing pain reduction after 6 months in patients who received nerve blocks with that of those who did not.

Summary Points: CRFA improves pain and functionality at 6 months, and effectiveness is not impacted by the implementation of nerve blocks prior to the procedure.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/29300971>

| Author | Year Published | Journal | Type |
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| Camprodon | 2017 | Clinical Trials in Degenerative Disease | Retrospective Case Series |
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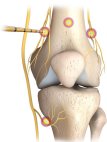
Title: *Pain treatment with cooled radiofrequency in osteoarthritis and total knee arthroplasty: case series in Hospital Universitario de Son Espases*

Publication Overview: The authors reviewed the records of 40 patients who underwent CRFA of the genicular nerve to analyze the results of CRFA one year post-procedure.

Summary Points: CRFA is effective in improving pain, general health, and overall rating one year post-procedure.

Not indexed on PubMed, available at: <https://www.researchgate.net/publication/322230274>

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| Author | Year Published | Journal | Type |
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| Davis | 2018 | Regional Anesthesia and Pain Medicine | Randomized Prospective Trial |
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Title: *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*

Publication Overview: The effectiveness of CRFA and a single corticosteroid injection were compared with regard to pain relief six months post-procedure.

Summary Points: CRFA is superior to a single steroid injection in pain reduction six months post-procedure.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/29095245>

| Author | Year Published | Journal | Type |
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| Jamison | 2018 | Journal of Pain Research | Literature Review |
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Title: *Radiofrequency techniques to treat chronic knee pain: a comprehensive review of anatomy, effectiveness, treatment parameters, and patient selection.*

Publication Overview: The authors evaluate nine clinical studies related to RFA, reviewing the anatomy, selection criteria, parameters, clinical studies, and complications.

Summary Points: RFA, including CRFA, is an effective treatment option for knee OA patients, with effects sustaining for at least three months.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/30271194>

| Author | Year Published | Journal | Type |
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| Desai | 2019 | BMC Musculoskeletal Disorders | Economic Study |
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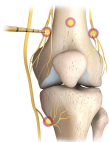
Title: *Cooled radiofrequency ablation of the genicular nerves for chronic pain due to osteoarthritis of the knee: a cost-effectiveness analysis based on trial data*

Publication Overview: The authors examined the economic outcomes of CRFA, including costs, cost-effectiveness, and health benefits.

Summary Points: CRFA is a highly cost-effective treatment for patients with knee OA.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/31238925>

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| Author | Year Published | Journal | Type |
|---------|----------------|-------------------------|-------------------|
| Oladeji | 2019 | Journal of Knee Surgery | Literature Review |

Title: *Cooled radiofrequency ablation for the treatment of osteoarthritis-related knee pain: evidence, indications and outcomes*

Publication Overview: The authors reviewed eight existing publications that investigate the effects of CRFA in patients with knee OA.

Summary Points: CRFA is an effective alternative to traditional treatments for patients with knee OA.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/30396206>

| Author | Year Published | Journal | Type |
|---------|----------------|---------------|-------------------|
| Ajrawat | 2019 | Pain Medicine | Systematic Review |

Title: *Radiofrequency Procedures for the Treatment of Symptomatic Knee Osteoarthritis: A Systematic Review.*

Publication Overview: The authors reported on the effect of RFA on pain, functionality, quality of life, patient satisfaction, and adverse events across 33 studies.

Summary Points: RFA improves pain, functionality, and QOL in knee OA patients for up to 3-12 months with limited complications.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/31578561>

| Author | Year Published | Journal | Type |
|--------|----------------|---------------------------------------|------------------------------|
| Davis | 2019 | Regional Anesthesia and Pain Medicine | Randomized Prospective Trial |

Title: *Twelve-month analgesia and rescue, by cooled radiofrequency ablation treatment of osteoarthritic knee pain: results from a prospective, multi-center, randomized, cross-over trial*

Publication Overview: This was a 12 month follow up to the 2018 Davis study, and it reviews pain relief in patients 12 months after receiving CRFA and the 6 month pain-relieving effects of CRFA in patients who crossed over after receiving IAS in the original study.

Summary Points: CRFA can provide pain relief for at least 12 months, and it is also effective in patients who had unsatisfactory pain relief results from receiving IAS injections.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/30772821>

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| Author | Year Published | Journal | Type |
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| Hunter | 2019 | Regional Anesthesia and Pain Medicine | Long Term Follow up from Randomized, Prospective Trial |
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Title: *Cooled Radiofrequency Ablation Treatment of the Genicular Nerves in the Treatment of Osteoarthritic Knee Pain: 18 and 24-Month Results*

Publication Overview: In this long term follow up to the 2018 Davis study, the effects of CRFA are examined at 18 and 24 months post-procedure in subjects who originally received CRFA and subjects who crossed over to receive CRFA.

Summary Points: CRFA can provide improved pain levels, functionality, and perceived effects in knee OA patients through 24 months.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/31605667>

| Author | Year Published | Journal | Type |
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| Orhurhu | 2019 | Current Pain and Headache Reports | Systematic Review |
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Title: *Systemic Review of Radiofrequency Ablation for Management of Knee Pain*

Publication Overview: The authors examined 18 publications related to the use of RF in the knee to assess the short and long term effects of the procedure.

Summary Points: RF treatments provide immediate, short term, and long term pain relief in patients with knee OA.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/31286282>

| Author | Year Published | Journal | Type |
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| Kapuraj | 2019 | Pain Physician | Retrospective Clinical Trial |
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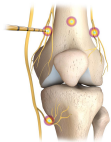
Title: *Long-Term Retrospective Assessment of Clinical Efficacy of Radiofrequency Ablation of the Knee Using a Cooled Radiofrequency System.*

Publication Overview: The authors reviewed the electronic health records of patients from their clinics and determined patients outcomes based on their charts

Summary Points: CRFA is effective in a large, real world patient population. Repeat CRFA treatments and post-TKR CRFA treatments are as effective as initial CRFA treatments.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/31561648>

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| Author | Year Published | Journal | Type |
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| Carrier | 2019 | Interventional Pain Management | Retrospective Chart Review |
|---------|------|--------------------------------|----------------------------|

Title: *Effectiveness of Genicular Nerve Cooled Radiofrequency Ablation on Chronic Knee Osteoarthritis Pain*

Publication Overview: The authors analyzed the change in pain scores of 33 subjects who underwent CRFA for knee OA at 2 weeks, 4-6 weeks, and 7-33 weeks post-procedure.

Summary Points: CRFA is effective in reducing pain in knee OA patients at 2 weeks and 4-6 weeks post-procedure. BMI does not appear to correlate with outcomes.

Not indexed on PubMed, available at: <https://www.researchgate.net/publication/315886163>

| Author | Year Published | Journal | Type |
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| Shea | 2019 | Interventional Pain Management | Retrospective Chart Review |
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Title: *Conventional Thermal versus Water-Cooled Genicular Nerve Radiofrequency Lesioning: A Retrospective Chart Review*

Publication Overview: The authors examined the VAS across the first year of follow up in patients who received RFA for chronic knee pain to compare standard to cooled RFA.

Summary Points: RFA is effective in improving pain in patients with chronic knee pain through 6 months.

Not indexed on PubMed, available at: <https://painmedicine-casereports.com/current/pdf?article=MzI4&journal=18>

| Author | Year Published | Journal | Type |
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| House | 2019 | Pain Medicine | Prospective observational cohort study |
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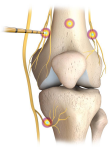
Title: *Severity of Knee Osteoarthritis and Pain Relief After Cooled Radiofrequency Ablation of the Genicular Nerves*

Publication Overview: Investigators performed 91 knee CRFA procedures in order to identify factors associated with successful results of CRFA.

Summary Points: CRFA is most effective when implemented in the earlier stages of knee OA.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/31045215>

KNEE



| Author | Year Published | Journal | Type |
|---------|----------------|-----------------|-------------------|
| Kapuraj | 2020 | Pain Management | Literature Review |

Title: *A technological overview of cooled radiofrequency ablation and its effectiveness in the management of chronic knee pain.*

Publication Overview: The authors examine the clinical benefits, patient selection considerations, and predictors of treatment success for CRFA.

Summary Points: CRFA delivers more energy and creates larger lesions than SRFA, and it is clinically superior to steroid and hyaluronic acid injections.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/32167418>

| Author | Year Published | Journal | Type |
|--------|----------------|------------------------|------------|
| Broida | 2020 | Radiology Case Reports | Case Study |

Title: *Alternate treatment approach to subchondral insufficiency fracture of the knee utilizing genicular nerve cooled radiofrequency ablation and adjunctive bisphosphonate supplementation: A case report.*

Publication Overview: A patient with chronic knee pain, who could not undergo surgery due to her lifestyle, received CRFA, and her pain and functionality were monitored through 6 months.

Summary Points: CRFA provides an effective solution for patients with severe knee pain when there is a lack of consensus among doctors, or when surgery is not desired or not possible.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/32280400>

| Author | Year Published | Journal | Type |
|----------|----------------|---------------|-------------------|
| Hagedorn | 2020 | Pain Medicine | Literature Review |

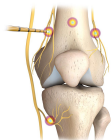
Title: *Beyond Revision Surgery: Work-Up and Interventional Treatments for the Painful Total Knee Arthroplasty.*

Publication Overview: The authors outline the diagnosis and evaluation of painful TKA and review interventional strategies for pain management.

Summary Points: Genicular RFA has been well studied, is considered safe, and has been shown to confer long-lasting improvements in pain and function in post-TKA patients.

Link to the Manuscript: <https://pubmed.ncbi.nlm.nih.gov/32515912/>

KNEE



| Author | Year Published | Journal | Type |
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|--------|----------------|---------|------|

Chen 2020 Journal of Bone and Joint Surgery Randomized, Prospective Trial

Title: *Cooled Radiofrequency Ablation Compared with a Single Injection of Hyaluronic Acid for Chronic Knee Pain*

Publication Overview: The effectiveness of CRFA and a single hyaluronic acid injection were compared with regard to pain relief, function, and patient satisfaction six months post-procedure.

Summary Points: CRFA is superior to HA in pain reduction, function, and patient satisfaction six months post-procedure.

Link to the Manuscript: <https://pubmed.ncbi.nlm.nih.gov/32898379/>

| Author | Year Published | Journal | Type |
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Chen 2020 BMC Musculoskeletal Disorders Randomized, Prospective Trial

Title: *Cooled Radiofrequency Ablation Provides Extended Clinical Utility in the Management of Knee Osteoarthritis: 12-month Results From a Prospective, Multi-Center, Randomized, Cross-Over Trial Comparing Cooled Radiofrequency Ablation to a Single Hyaluronic Acid Injection*

Publication Overview: This was a 12 month follow up to the 6-month Chen study, and it reviews pain relief in patients 12 months after receiving CRFA and the 6 month pain-relieving effects of CRFA in patients who crossed over after receiving HA in the original study.

Summary Points: CRFA can provide pain relief for at least 12 months, and it is also effective in patients who had unsatisfactory pain relief results from receiving HA.

Link to the Manuscript: <https://pubmed.ncbi.nlm.nih.gov/32517739/>

| Author | Year Published | Journal | Type |
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Chen 2020 Journal of the American Academy of Orthopedic Surgeons Literature Review

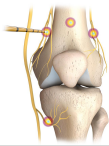
Title: *Thermal Nerve Radiofrequency Ablation for the Nonsurgical Treatment of Knee Osteoarthritis: A Systematic Literature Review.*

Publication Overview: The authors reviewed 7 randomized control trials to evaluate RFA in comparison to other nonsurgical modalities for knee OA.

Summary Points: RFA is superior to NSAIDs and IA corticosteroid injections for the treatment of pain from knee OA.

Link to the Manuscript: <https://pubmed.ncbi.nlm.nih.gov/32701684/>

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| Author | Year Published | Journal | Type |
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|----------|------|---|----------------|
| Gonzalez | 2020 | Techniques in vascular and interventional radiology | Review Article |
|----------|------|---|----------------|

Title: Cooled Radiofrequency Genicular Neurotomy

Publication Overview: Identifies the gap in the treatment options between short term pain solutions and surgical approaches.

Summary Points: This publication was written from the perspective of an interventional radiologist and provides an overview of the technology, technical considerations and summarizes the clinical evidence supporting the use of CRFA.

Link to the Manuscript: <https://pubmed.ncbi.nlm.nih.gov/33308582/>

Anatomy



ANATOMY



| Author | Year Published | Journal | Type | Location |
|----------|----------------|-----------------------------|------------------|----------|
| Birnbaum | 1997 | Surgical Radiologic Anatomy | Anatomical Study | Hip |

Title: *The sensory innervation of the hip joint- An anatomical study*

Publication Overview: The authors examine the innervation of the hip joint.

Summary Points: Symptoms and pain from the hip joint vary widely due to the varying nature of innervation in the hip.

Link to the Manuscript: <https://pubmed.ncbi.nlm.nih.gov/9479711/>

| Author | Year Published | Journal | Type | Location |
|--------|----------------|------------------------------------|-----------------|----------|
| Dellon | 2009 | Plastic and Reconstructive Surgery | Cadaveric Study | Knee |

Title: *Partial Joint Denervation II: Knee and Ankle*

Publication Overview: The authors describe the denervation of the knee and ankle based on cadaveric anatomical studies.

Summary Points: Denervation can help reduce pain and improve function. Using a diagnostic block allows for successful denervation.

Link to the Manuscript: <https://pubmed.ncbi.nlm.nih.gov/19116555/>

| Author | Year Published | Journal | Type | Location |
|--------|----------------|---------|------------------------------|--------------|
| Wang | 2016 | Spine | Ex vivo non-randomized trial | Non-specific |

Title: *Effects of Anesthetic Fluid Injectates on Lesion Sizes in Cooled Radiofrequency Ablation*

Publication Overview: The authors simulated human vertebra with pork chops in order to determine the effects of different types and concentrations of anesthetics on CRFA lesion characteristics.

Summary Points: The use of an anesthetic injectate does not seem to affect the lesions created in CRFA.

Link to the Manuscript: <https://pubmed.ncbi.nlm.nih.gov/27310024/>

ANATOMY



| Author | Year Published | Journal | Type | Location |
|--------|----------------|----------------|---------------|--------------|
| Cedeno | 2017 | Pain Physician | Ex vivo study | Non-specific |

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

Publication Overview: The authors compared the lesion volumes of 3 types of RF by performing RFA on 10 chicken breasts.

Summary Points: Lesions produced by CRFA are larger than those produced by other types of RFA.

Link to the Manuscript: <https://pubmed.ncbi.nlm.nih.gov/28934795/>

| Author | Year Published | Journal | Type | Location |
|--------|----------------|---------------------------------------|-----------------|----------|
| Tran | 2018 | Regional Anesthesia and Pain Medicine | Cadaveric Study | Knee |

Title: Anatomical Study of the Innervation of Anterior Knee Joint Capsule

Publication Overview: The authors dissected fifteen knees and recorded the number, origin, distribution, and relationship to anatomical landmarks of the articular branches.

Summary Points: The mapping of articular branches provides a basis for the development of protocols for CRFA. Larger lesions, which can be provided by CRFA, may contribute to better outcomes.

Link to the Manuscript: <https://pubmed.ncbi.nlm.nih.gov/29557887/>

| Author | Year Published | Journal | Type | Location |
|----------|----------------|----------------|-------------------|------------|
| Poilliot | 2019 | Pain physician | Literature Review | Sacroiliac |

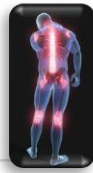
Title: *A Systematic Review of the Normal Sacroiliac Joint Anatomy and Adjacent Tissues for Pain Physicians*

Publication Overview: The authors aimed to describe the normal appearance of the SIJ and adjacent tissues.

Summary Points: This study provides an overview of normal SIJ structures, including all neuromusculoskeletal elements related to the joint

Link to the Manuscript: <https://pubmed.ncbi.nlm.nih.gov/31337164/>

ANATOMY



| Author | Year Published | Journal | Type | Location |
|--------|----------------|-----------------------------------|--------------------|----------|
| Tran | 2020 | Regional Anesthesia Pain Medicine | Publication Review | Knee |

Title: *Revisiting the anatomical evidence supporting the classical landmark of genicular nerve ablation*

Publication Overview: The authors provide an opposing view to the Fonkoue et al publication, in which the researchers conclude that the anatomical landmarks currently used are inaccurate and propose new ones.

Summary Points: There are varying schools of thought on the most accurate anatomical landmarks in the knee.

Link to the Manuscript: <https://pubmed.ncbi.nlm.nih.gov/31806682/>

| Author | Year Published | Journal | Type | Location |
|--------|----------------|---------|------------------|----------|
| Barros | 2020 | FASEB | Anatomical Study | Shoulder |

Title: *Revisiting the anatomical evidence supporting the classical landmark of genicular nerve ablation*

Publication Overview: The authors dissected nerves of the shoulder, defined bony landmarks, and subsequently performed denervation on 8 patients with chronic shoulder pain.

Summary Points: A safe and effective technique for shoulder denervation is described based upon the anatomical findings of the study.

Not indexed on PubMed, available at: <https://faseb.onlinelibrary.wiley.com/doi/abs/10.1096/fasebj.2020.34.s1.09421>

| Author | Year Published | Journal | Type | Location |
|--------|----------------|---|------------------|----------|
| Tran | 2020 | Regional Anesthesia and Pain Management | Anatomical Study | Knee |

Title: *Evaluation of nerve capture using classical landmarks for genicular nerve radiofrequency ablation: 3D cadaveric study*

Publication Overview: The authors dissected five knee to determine what branches are captured during classical landmarking techniques.

Summary Points: Classical landmarks for denervation of genicular nerves are effective, but supplementary landmarks could potentially increase capture areas and patient outcomes.

Link to the Manuscript: <https://pubmed.ncbi.nlm.nih.gov/32712453/>

ANATOMY



| Author | Year Published | Journal | Type | Location |
|------------|----------------|---------------------------------------|-------------------|----------|
| Laumonerie | 2020 | Journal of Shoulder and Elbow Surgery | Literature Review | Shoulder |

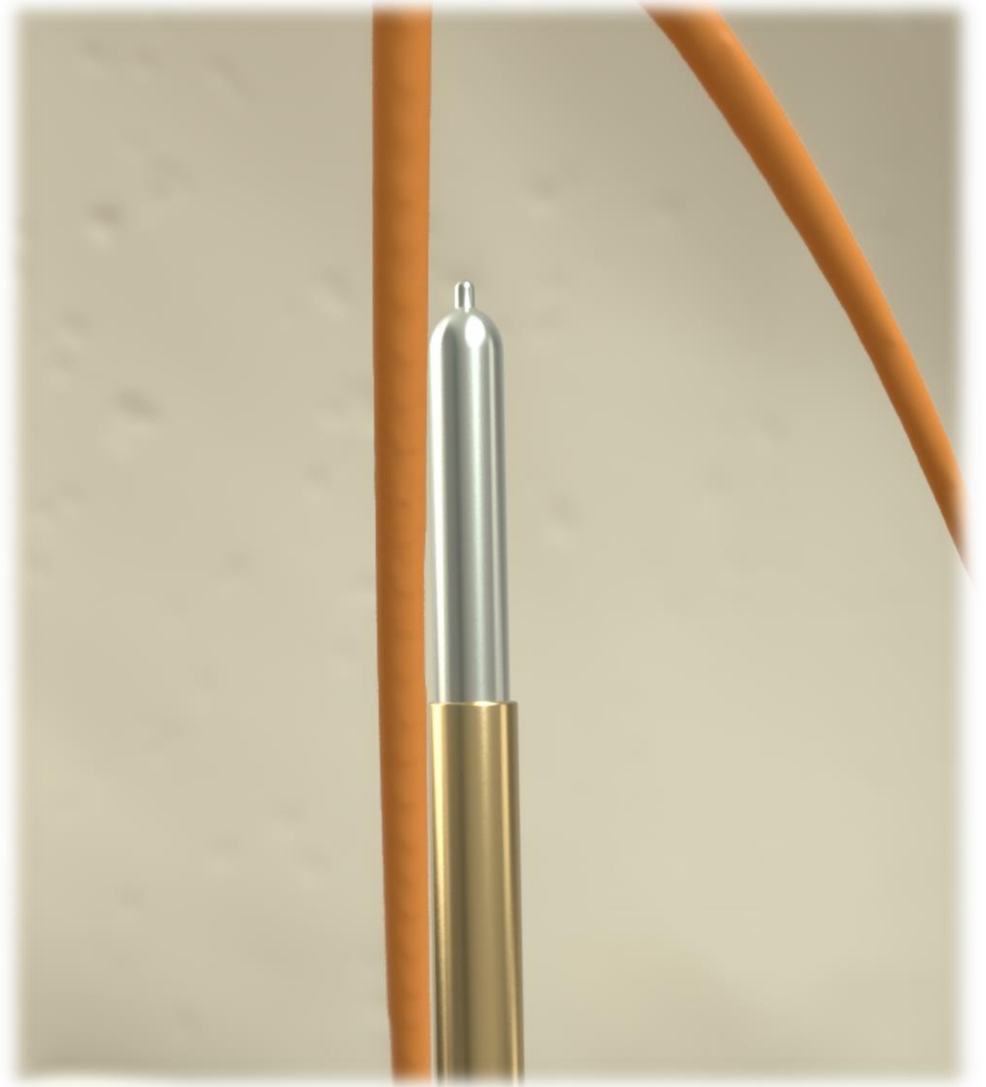
Title: *Sensory innervation of the human shoulder joint: the three bridges to break*

Publication Overview: Thirty publications were reviewed in order to determine the anatomic location of the sensory branches of the shoulder and the distribution of the sensory receptors.

Summary Points: The supra scapular, lateral pectoral, axillary, and lower sub scapular nerves innervate the shoulder.

Link to the Manuscript: <https://pubmed.ncbi.nlm.nih.gov/32712453/>

Technique



TECHNIQUE



| Author | Year Published | Journal | Type | Modality |
|--------|----------------|---------------|------------------|----------|
| Locher | 2008 | Pain Medicine | Anatomical study | Hip |

Title: *Radiological Anatomy of the Obturator Nerve and Its Articular Branches: Basis to Develop a Method of Radiofrequency Denervation for Hip Joint Pain*

Publication Overview: The authors imaged and analyzed the obturator nerve in ten cadavers, and administered MRIs to 20 patients in order to determine an effective and safe method for RF.

Summary Points: Multiple lesions during RF denervation can account for the location and variability of target nerves. The described approach allows for the safe and effective denervation of the hip joint.

Link to the Manuscript: <https://pubmed.ncbi.nlm.nih.gov/18366509/>

| Author | Year Published | Journal | Type | Modality |
|------------|----------------|---------------|--------|------------|
| Vanelderen | 2010 | Pain Practice | Review | Sacroiliac |

Title: *Sacroiliac Joint Pain*

Publication Overview: The authors review the diagnosis, treatment, and evidence associated with sacroiliac joint pain.

Summary Points: Diagnostic blocks must be interpreted with caution. CRFA is recommended for treatment of SIJ pain when IAS injections fail.

Link to the Manuscript: <https://pubmed.ncbi.nlm.nih.gov/20667026/>

| Author | Year Published | Journal | Type | Modality |
|--------|----------------|----------------|---------------------------------|------------|
| Cheng | 2016 | Pain Physician | Prospective Observational Trial | Sacroiliac |

Title: *A New Radiofrequency Ablation Procedure to Treat Sacroiliac Joint Pain*

Publication Overview: The authors aimed to develop a new bipolar RFA technique for SIJ pain by devising and applying this technique in 31 patients.

Summary Points: The described technique allows for a reduction of operating time, x-ray exposure time, and cost. It also allowed for greater pain reduction.

Link to the Manuscript: <https://pubmed.ncbi.nlm.nih.gov/27906939/>

TECHNIQUE



| Author | Year Published | Journal | Type | Modality |
|--------|----------------|---------------|------------------|----------|
| Conger | 2019 | Pain Medicine | Technical Report | Knee |

Title: *A Novel Technical Protocol for Improved Capture of the Genicular Nerves by Radiofrequency Ablation.*

Publication Overview: The authors describe an updated protocol for CRFA.

Summary Points: This new technique provides more complete denervation of nerves, and allows for more consistent lesioning.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/31131850>

| Author | Year Published | Journal | Type | Modality |
|--------|----------------|-----------------------------------|-------------------|----------|
| Kumar | 2019 | Current Pain and Headache Reports | Literature Review | Hip |

Title: *A Review of Current Denervation Techniques for Chronic Hip Pain: Anatomical and Technical Considerations*

Publication Overview: The authors collected data on 52 RF ablations regarding needle placement, stimulation parameters, and short-and long-term complications.

Summary Points: A combined ultrasound and fluoroscopy anterior approach in CRFA allows for successful denervation of the hip.

Link to the Manuscript: <https://pubmed.ncbi.nlm.nih.gov/31044316/>

| Author | Year Published | Journal | Type | Modality |
|--------|----------------|-----------------|-----------------------------------|----------|
| Lash | 2020 | Pain Management | Technique description/case series | Knee |

Title: *Ultrasound-guided cooled radiofrequency ablation of the genicular nerves: a technique paper.*

Publication Overview: The authors describe a technique for utilizing ultrasound technology in CRFA, and report on the outcomes of this procedure in 22 subjects.

Summary Points: Ultrasound-guided CRFA provides an effective alternative to fluoroscopy.

Link to the Manuscript: <https://www.ncbi.nlm.nih.gov/pubmed/32129148>

TECHNIQUE



| Author | Year Published | Journal | Type | Modality |
|--------|----------------|---------------|-----------------------|----------|
| Sperry | 2020 | Pain Medicine | Technique Description | Knee |

Title: *A Proposed Protocol for Safe Radiofrequency Ablation of the Recurrent Fibular Nerve for the Treatment of Chronic Anterior Inferolateral Knee Pain*

Publication Overview: The authors describe a technique for CRFA in the knee based on recent anatomical studies.

Summary Points: This new technique may allow for more effective denervation in the knee.

Link to the Manuscript: <https://pubmed.ncbi.nlm.nih.gov/32895719/>

| Author | Year Published | Journal | Type | Modality |
|--------|----------------|--------------------|---------------------|----------|
| Wong | 2020 | Skeletal Radiology | Retrospective Study | Knee |

Title: *Safety and efficacy comparison of three- vs four-needle technique in the management of moderate to severe osteoarthritis of the knee using cooled radiofrequency ablation.*

Publication Overview: The authors performed a retrospective study of 50 knee OA patients to evaluate the safety and efficacy of CRFA, while also comparing the impact of the three vs four needle technique

Summary Points: The 4 needle technique resulted in greater improvements in pain, function, and opiate usage

Link to the Manuscript: <https://pubmed.ncbi.nlm.nih.gov/32968824/>

| Author | Year Published | Journal | Type | Modality |
|--------|----------------|----------|-----------------------------------|----------|
| Park | 2020 | The Knee | Technique description/case series | Knee |

Title: *An anatomical neurovascular study for procedures targeting peri-articular nerves in patients with anterior knee pain*

Publication Overview: The authors dissected 20 knees to investigate the innervation of the knee.

Summary Points: The current target for the genicular nerve may not accurately target the correct nerve position; a more proximal target may improve safety and effectiveness.

.Link to the Manuscript: <https://pubmed.ncbi.nlm.nih.gov/33010776/>

TECHNIQUE



| Author | Year Published | Journal | Type | Modality |
|---------|----------------|---------------------------------------|------------------|----------|
| Fonkoue | 2020 | Regional Anesthesia and Pain Medicine | Anatomical study | Knee |

Title: Validation of a new protocol for ultrasound-guided genicular nerve radiofrequency ablation with accurate anatomical targets: cadaveric study

Publication Overview: Aims to provide a new protocol with ultrasound (US)-guided radiofrequency ablation (RFA) of genicular nerves (GNs) is increasingly performed to manage chronic knee pain.

Summary Points: Ultrasound guided RF accurately captured nerve targets, expected to improve clinical outcomes

Link to the Manuscript: <https://pubmed.ncbi.nlm.nih.gov/33273065/>

| Author | Year Published | Journal | Type | Modality |
|--------|----------------|---------------------|-----------------------|----------|
| Ares | 2020 | Interventional Pain | Technique Description | SI Joint |

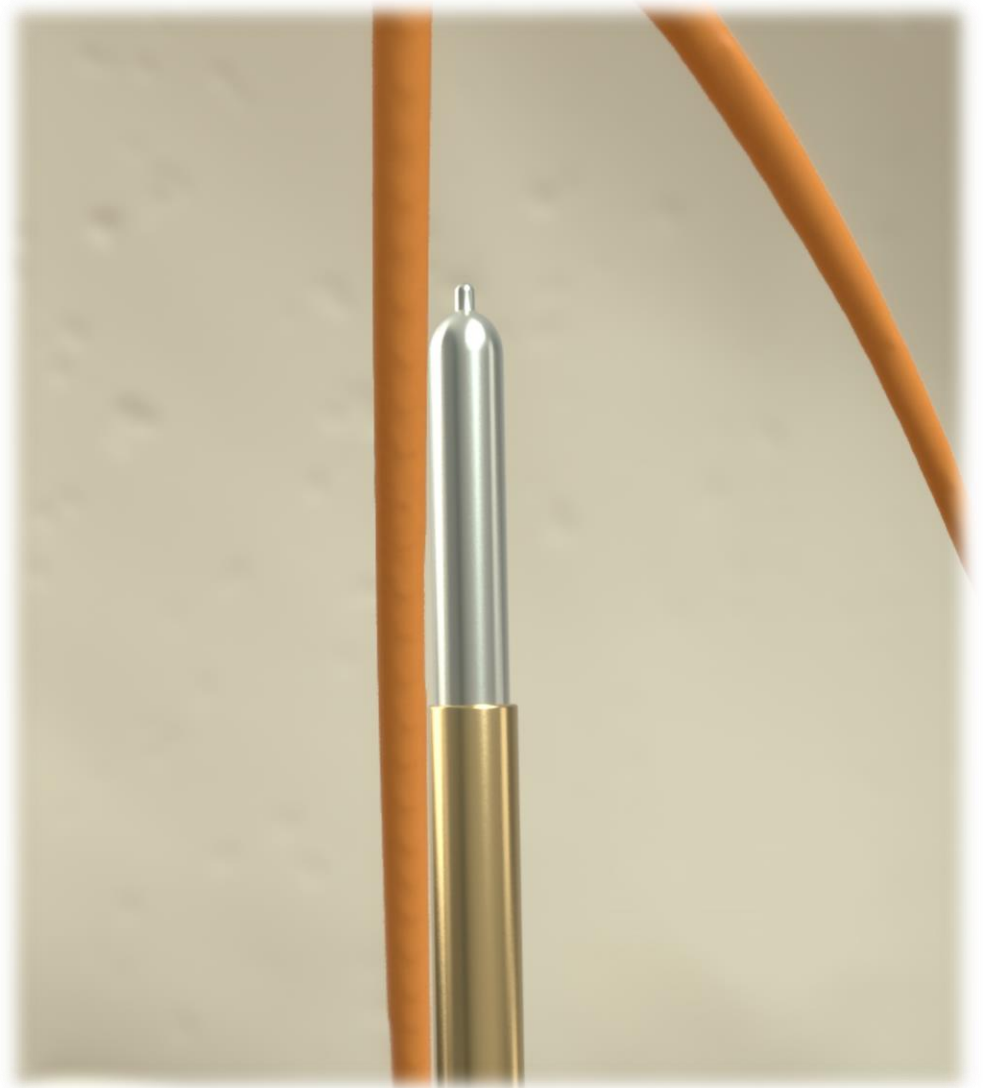
Title: Sacroiliac Joint Radiofrequency Ablation (Bipolar Palisade Technique)

Publication Overview: This book chapter goes through several technical considerations when doing RF of the SI joint.

Summary Points: Cooled radiofrequency has the highest level of supporting evidence compared to standard and pulsed radiofrequency.

Link to the Manuscript: https://link.springer.com/chapter/10.1007/978-3-030-31741-6_27

OTHER



OTHER



| Author | Year Published | Journal | Type | Location |
|--------|----------------|----------------|----------------------|--------------|
| Ball | 2014 | Pain Physician | Comprehensive Review | Non-specific |

Title: *The Science of Conventional and Water-Cooled Monopolar Lumbar Radiofrequency Rhizotomy: An Electrical Engineering Point of View*

Publication Overview: The author describes CRFA from a technical standpoint, detailing the electrode itself, the heating process, and the effects on the nerves in the lumbar region.

Summary Points: A thorough understanding of the technological aspects of CRFA allows for the maximum performance possible.

Link to the Manuscript: <https://pubmed.ncbi.nlm.nih.gov/24658487/>

| Author | Year Published | Journal | Type | Location |
|---------|----------------|---|-------------------|-----------------------|
| Salmasi | 2015 | Techniques in Regional Anesthesia and Pain Management | Literature Review | Sacroiliac, hip, knee |

Title: *Application of cooled radiofrequency in management of chronic joint pain*

Publication Overview: The authors review current literature related to the application of RF in the SI, hip, and knee joints.

Summary Points: CRFA is an effective treatment for pain in the SIJ, hip, and knee, and effective techniques are described in this publication.

Not indexed on PubMed, available at: <https://www.sciencedirect.com/science/article/abs/pii/S1084208X15000403>

| Author | Year Published | Journal | Type | Location |
|--------|----------------|-----------------------------------|------------|-------------------|
| Sperry | 2020 | Regional Anesthesia Pain Medicine | Case study | Phantom Limb Pain |

Title: *Cooled Radiofrequency Ablation of a Large Sciatic Neuroma at the Infrapiriformis Foramen for Recalcitrant Phantom Limb Pain in a Below-Knee Amputee*

Publication Overview: A patient with chronic below-knee phantom limb pain underwent CRFA of a sciatic neuroma.

Summary Points: Neuroma CRFA is a feasible treatment for chronic phantom limb pain.

Link to the Manuscript: <https://pubmed.ncbi.nlm.nih.gov/32451532/>

OTHER



| Author | Year Published | Journal | Type | Location |
|-----------|----------------|---------|-------------------|--------------|
| Zachariah | 2020 | RAPM | Preclinical Study | Non-specific |

Title: *Physiological and functional responses of water-cooled versus traditional radiofrequency ablation of peripheral nerves in rats*

Publication Overview: The authors performed CRFA and TRFA in rats to compare the physiological impacts of each treatment.

Summary Points: In comparison with TRFA, CRFA delivers more energy, creates larger lesions, and blocks nerve function for a larger duration and to a larger degree.

Link to the Manuscript: <https://pubmed.ncbi.nlm.nih.gov/32784232/>

