Retrospective Study

Retrospective Study of the Analgesic Effect of Sacroiliac Joint Radiofrequency Denervation

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Background: Interventional radiofrequency (RF) ablation techniques are indicated when an adequate effect is not obtained with conservative measures.

Objectives: The primary objective of this study was to evaluate pain relief after RF denervation of the sacroiliac joint. The secondary objective was to evaluate pain intensity and relief duration.

Study Design: The study was retrospective.

Setting: The study was conducted at Vera Cruz Hospital, Campinas, Brazil.

Methods: Data were collected from the medical records of patients undergoing RF denervation for low back pain originating in the sacroiliac joint, from January 2015 to December 2017. There were 78 patients studied, between 18 and 65 years old, of both genders, ASA I or II, who underwent knee arthroscopic meniscectomy. The patients were submitted to denervation of sacroiliac joint by 3 types of RF (conventional, pulsed, and cooled).

The following parameters were evaluated, number of patients who obtained ≥ 50% pain relief; pain intensity, measured using the visual analog scale (before the procedure and 15, 30, 90 and 180 days after, performed by the same evaluator); and the use of complementary analgesic for 2 weeks.

Results: Of the 78 included patients, 56 (71.8%) underwent conventional RF, 9 (11.5%) underwent pulsed RF, and 13 (16.7%) underwent cooled RF. There were losses to follow-up including 40 patients who underwent conventional RF, 5 who underwent pulsed RF, and 12 who underwent cooled RF, who were retained for 6 months. There was significant pain relief with the three types of RF for up to 6 months of follow-up, with no difference among the types. After 6 months, 90.2% of patients who underwent conventional RF, 100% who underwent pulsed RF, and 91.7% who underwent cooled RF maintained ≥ 50% pain relief. Complementary analgesics were used by 95% of the patients who underwent conventional RF, 80% who underwent pulsed RF, and 91% who underwent cooled RF 2 weeks after the procedure. There were mild adverse effects, such as edema, hematoma, and local pain, without complications.

Limitations: As for limitations, the number of pulsed and cooled RF is low and in a retrospective study some data may be missing, especially from follow-up.

Conclusions: RF denervation of the sacroiliac joint is effective and promotes a long-lasting analgesic effect.

Key words: Analgesia, denervation, low back pain, radiofrequency, sacroiliac joint

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Sacroiliac joint (SIJ) pain accounts for up to 30% of low back pain (1). The manifestations of SIJ dysfunction are: pain in the superior medial quadrant of the buttock and the lateral buttock, and thigh inferior to the posterosuperior iliac crest and groin, with radiation to the thigh and trochanter and worsening pain when lying or sitting.

Interventional techniques, such as radiofrequency

(RF) denervation, are indicated when no effect is obtained with conservative measures, or when serious adverse drug effects occur (2). The types of RF are ablative, pulsed, and cooled. Before the RF lesion is formed, a local anesthetic is injected intra- or peri-articularly to evaluate the effectiveness of a more lasting block. The possible complications of the lesion are buttock dysesthesia, temporary worsening of pain, infection, hematoma, nerve trauma, and thromboembolism (3).

Despite the possible benefits of SIJ denervation, there are controversies regarding its long-term efficacy.

The primary objective of this study was to investigate pain relief after SIJ denervation with 3 different RF techniques. The secondary objective was to evaluate pain intensity and relief duration.

Methods

The study was conducted after approval was received from the Ethics Committee (CAAE: 03493418.4.0000.5505) on April 3, 2019. Patients signed an informed consent form before RF denervation occurred.

The clinical trial was registered with the Brazilian Registry of Clinical Trials (ReBEC) under code RBR-8x52jd on February 10, 2020. Data were collected from the medical records of patients who underwent SIJ RF denervation from January 2015 to December 2017.The full protocol can be assessed at University Ethics Committee. The study was retrospective and analytical.

Data were obtained from patients aged 18 years or older, who underwent SIJ denervation with conventional, pulsed, or cooled RF for pain lasting more than 6 months. Patients with fracture, tumor, cognitive impairment (inability to answer questions), coagulation disorder or infection at the puncture site, and pregnant women were excluded from denervation. Data were obtained from the electronic medical records (TASY management and information system; Philips Healthcare). The following data were collected from the medical records: age, gender, pain duration, pain intensity, and drugs used for pain treatment.

The study was conducted at Hospital Vera Cruz, Campinas, Brazil. The diagnosis was made based on the criteria established by the International Association for the Study of Pain (IASP) (Vanelderen, 2010): pain location; 3 provocative tests (joint compression test, Patrick's sign, and Gaenslen's test); pain on contrast arthrogram during test block; test block with pain intensity reduction ≥ 50% for 5 hours; and imaging examination (computed tomography or magnetic resonance imaging of the SIJ).

For the procedure, the patient was placed in ventral decubitus with a cushion under the abdomen, followed by antisepsis and local anesthesia with 1% lidocaine. The test block used a 10-cm 22G spinal needle and was guided by fluoroscopy. Next, 1 mL of nonionic contrast was administered and an arthrogram was performed while the patient's pain was evaluated. When pain occurred during the arthrogram, 2 mL of 0.75% ropivacaine was injected. If ≥ 50% pain relief occurred, RF denervation was indicated after 2 weeks and performed under sedation with midazolam 5 mg, fentanyl 50 µg and propofol.

In conventional RF, denervation was performed with a three-electrode probe (Neurotherm, Inc., USA) in the lateral branches from S1 to S4, which created 3 simultaneous lesions for 60 seconds at 80 °C from an insertion point and was followed by denervation of the L5-S1 facets at 80 °C for 90 seconds. Pulsed RF (Neurotherm, Inc. USA) was performed from S1 to S3 for 9 minutes at 45 °C and at the dorsal branch of L5. In cooled RF, denervation was performed 5 mm laterally to the roots from S1 to S3 at the 2 o'clock and 5 o'clock positions for 150 seconds at 60 °C, and then to the dorsal branch of L5 (Coolief; Halyard).

The following parameters were evaluated: number of patients who obtained ≥ 50% pain relief; pain intensity, measured using the visual analog scale (before the procedure and 15, 30, 90 and 180 days after, performed by the same evaluator); and the use of complementary analgesic for 2 weeks. Adverse effects and complications were recorded. The primary outcome was a reduction in pain intensity ≥ 50%. The secondary outcome was the duration of the analgesic effect.

The results were subjected to statistical analysis using the R Project for Statistical Computing version 4.0.2. The following tests were used: Chi-square for gender; ANOVA for age and pain duration and intensity among the groups; Fisher's exact test for intragroup pain intensity; and Kruskal-Wallis for pain relief ≥ 50%. The significance level was set at < 0.05.

Results

RF denervation was performed in 153 patients, but 75 also underwent lumbar spine RF denervation and were excluded from the study. Of the 78 included patients, 56 (71.8%) underwent SJI denervation using the conventional technique, 9 (11.5%) underwent denervation using the pulsed technique, and 13 (16.7%) underwent denervation using the cooled technique. There were losses to follow-up including 40 patients who underwent denervation with conventional RF, 5

who underwent denervation with pulsed RF, and 12 who underwent denervation using cooled RF and who were retained for 6 months, as shown in the CONSORT flowchart (Fig. 1). The age range, gender, and pain duration are shown in Table 1. The complementary tests that the patients underwent were computed tomography (90%) and magnetic resonance imaging (10%) of the SIJ.

Complementary analgesics continued to be used for 2 weeks after the procedures by 95% patients in the conventional RF group, 80% in the pulsed RF group, and 91% in the cooled RF group.

There was a significant reduction in pain intensity with the 3 types of RF denervation for up to 6 months of follow-up (Table 2). The percentage of patients who obtained pain relief ≥ 50% is described in Table 3. There were adverse effects, such as edema, hematoma, and mild local pain, but without complications.

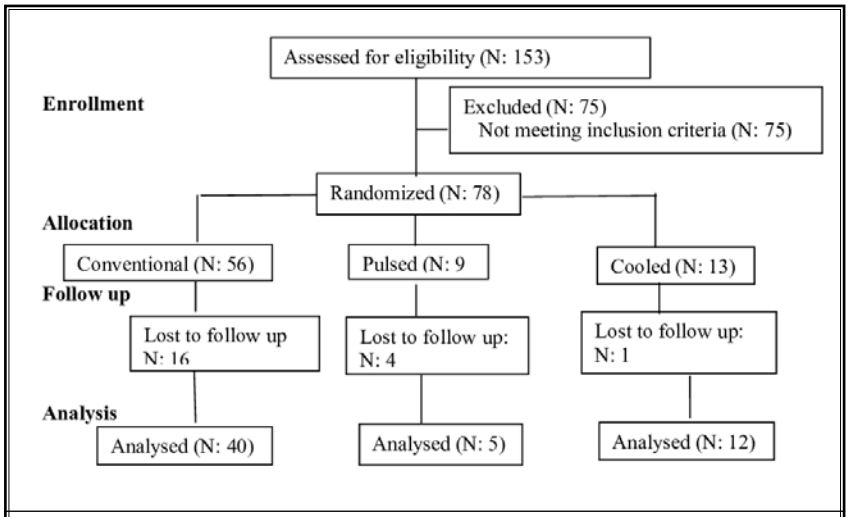

Fig. 1. *CONSORT Fuxogram*

Table 1. *Patient data in number for gender; mean ± SD for age, and duration of pain*

	Conventional	Pulsed	Cooled	*P*
Gender (W: M)	32 : 8	4 : 1	8 : 4	0.645†
Age (years)	58 ± 17	62 ±	51 ± 18	0.425‡
Duration of pain (days)	666 ± 441	660 ± 453	467 ± 301	0.461‡

†: Chi square test; ‡: ANOVA test; SD: standard deviation

Table 2. *Pain intensity by VAS (mean ± SD)*

	Conventional	Pulsed	Cooled	*P*†:
T0	8.2 ± 0.7	8.0 ± 1.0	8.3 ± 0.5	0.567
15days	4.3 ± 3.2	5.8 ± 2.3	4.6 ± 3.9	0.572
1mos	2.6 ± 2.7	4.2 ± 3.0	2.4 ± 2.8	0.369
3mos	1.4 ± 2.7	3.4 ± 3.2	2.3 ± 3.0	0.187
6mos	0.9 ± 2.5	0.4 ± 0.9	0.7 ± 1.6	0.927

†: ANOVA test; T0: before treatment; SD: standard deviation
Conventional, pulsed and cooled: T0 > 2sem, T0 > 1m, T0 >3m, T0 > 6m (Kruskal Wallis test; $P < 0.01$)

Table 3. *Pain relief ≥ 50% - number (%)*

	Conventional	Pulsed	Cooled
15 days	17 (42.5)	1 (20.0)	5 (41.7)
1 mo	27 (67.5)	2 (40.0)	8 (66.7)
3 mo	34 (85.0)	2 (40.0)	11 (75.0)
6 mo	37 (92.5)	5 (100.0)	11 (91.7)

Discussion

In this study, it was observed that RF denervation of the SJI is effective for the treatment of pain originating in this joint.

Sacroiliac pain was diagnosed according to criteria used in the literature and included, clinical manifestations, provocative maneuvers, radiological images, and test block. The sacroiliac anatomical structure, innervation, and biomechanism are complex, making both the diagnosis and treatment of pain difficult (4). The L4-S4 branches are considered important for the innervation of the SIJ (5,6); they comprise a large area that makes it difficult to completely block the transmission of the painful stimulus. Large forces are required in provocative maneuvers, which may cause false-negative results and if the forces are exerted incorrectly, pain can be provoked in neighboring structures, leading to false-positive results (3). The sensitivity of the clinical examination increases with the number of maneuvers performed and with 3 or more positive tests, as were used in this study, the diagnostic power increases. Test block is considered the gold standard for diagnosis, but the local anesthetic can disperse to neighboring structures causing false-positive results or can fail to reach all nerves, causing false-negative results.

RF produces pain relief through neuromodulation or neuroablation. The evidence suggests that RF denervation can relieve pain arising from the posterior SIJ

complex, but interpretation should be made cautiously, given the variability in patient selection, targeted nerves, type of RF, and technique used (7); larger and more comparable studies are needed (8). In the classic RF probe, the posterior curvature is not suitable for all sacral bone conformations, making positioning and ablation difficult. In addition, the probe cannot reach the L5 dorsal ramus from a single insertion point (9). Pulsed RF is the least frequently indicated approach for the SIJ because it does not create a nerve lesion; however, in both the present study and a previous study (10), a good result was obtained. Cooled RF causes more extensive lesions than conventional RF and is well indicated when the joint innervation is not as well defined anatomically, as in the sacroiliac region. The cooled RF probe is flexible, easily positioned, and can lesion the L5 dorsal branch (2). Thus, the pulsed technique is the easiest, and the conventional technique is the most difficult. The cooled technique is the most time-consuming approach because the cannulas are replaced one by one, and 9 lesions are created at each SIJ.

In this study, denervation was performed in a manner similar to that described in the literature for the 3 types of RF and no difference was observed in the efficacy and duration of the analgesic effect. A retrospective study showed good results with RF denervation by the conventional and cooled techniques (2), as in this study.

A systematic review showed that the 3 techniques have an effect for at least 6 months, with no significant difference among them (11). In the present study, there was also an analgesic effect with all 3 RF types with no significant difference among the 3. The duration of the effect in the present study was similar to that reported in the literature. After 6 months, the pain intensity was low for all RF types in this study, although the number of patients in the pulsed RF group was quite small. According to Patel 2016 (12), cooled RF offers longer sacral pain relief duration, due to the larger lesioned area which includes the S1-S3 lateral branches.

In a case series, 86% of patients who underwent cooled RF experienced pain relief ≥ 50% for 4-6 months (13). Bayerl, et al 2018 (14), obtained pain relief ≥ 50% with conventional RF in 36% of patients after 6 months. In the present study, after 6 months, ≥ 5 0% pain relief was maintained in more than 90% of patients with the 3 types of RF, which is higher than reported in the literature. Pulsed RF modifies mixed nerve conduction and should be the least effective method, but in the present study, it had a similar effect to the other types at 6 months. However, at 3 months, fewer patients had obtained relief with pulsed RF, showing that the other techniques are more effective.

The majority of patients in the present study needed to use some analgesic drugs for 2 weeks. According to Stelzer et al (13), 100% of patients reduced or discontinued the use of opioids 4-6 months after undergoing cooled RF. Initially, neuritis occurs due to the thermal lesion and no satisfactory analgesic effect is obtained.

No complications were reported in this study and the adverse effects were mild. The possible complications reported in the literature are infection, hematoma, nerve injury, thromboembolism, secondary weakness, neuritis during the first week, dysesthesia and hypoesthesia in the buttocks, and temporary worsening of pain 5 to 10 days after the procedure (3,9) Cooled RF has a lower risk of tissue necrosis than conventional RF because it uses a lower temperature than the conventional technique (2).

Limitations

Diagnosis is difficult and pain may be caused by changes in another structure and not in the SIJ. In the test block, even with small volumes, there may be dispersion to neighboring structures, leading to false-positive results. In the provocative tests, the patient may report pain even if it arises from other structures. The limitations of a retrospective study in which data are collected from electronic medical records are that all data cannot always be obtained and important data may be missing, especially from follow-up. The RF technique used was determined by each patient's health insurance provider, which funded the proposed SIJ innervation ablation treatment. The cooled RF technique emerged more recently and has received little approval by health insurance providers and the pulsed RF technique is seldom used and has little scientific evidence supporting its use for sacroiliac pain, factors which explain the small number of patients in these 2 groups.

Conclusion

RF denervation of the SIJ has lasting analgesic effects. The management of SIJ pain has changed with the evolution of interventional pain therapies. Accurate diagnosis of SIJ pain is important for adequate therapy. Regardless of the technique used for RF denervation, the analgesic efficacy is satisfactory.

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References

1. Cohen SP, Chen Y, Neufeld NJ. Sacroiliac join pain: A comprehensive review of epidemiology, diagnosis and treatment. *Expert Rev Neurother* 2013; 13:99-116.
2. Tinnirello A, Barbieri S, Todeschini M, Marchesini M. Conventional (Simplicity III) and Cooled (Sinergy) radiofrequency for Sacroiliac Joint Denervation: One-Year Restropective Comparing two Devices. *Pain Med* 2017; 18:1731-1744.
3. Vanelderen P, Szadek K, Cohen SP, et al. Sacroiliac Joint Pain. *Pain Pract* 2010; 10:470-478.
4. Chuang C-W, Hung S-K, Pan Po-T, Ming-Chang Kao M-C. Diagnosis and Interventional Pain Management Options for Sacroiliac Joint Pain. *Ci Ji Yi Xue Za Zhi* 2019; 31:207-210.
5. Cohen SP. Sacroiliac Joint Pain: A Comprehensive Review of Anatomy, Diagnosis, and Treatment. *Anesth Analg* 2005; 101:1440-1453.
6. Rashbaum RF, Ohnmeiss DD, Lindley EM, Kitchel SH, Patel VV. Sacroiliac Joint Pain and Its Treatment. *Clin spine Surg* 2016; 29:42-48.
7. Yang AJ, McCormick ZL, Zheng PZ, Schneider BJ. Radiofrequency Ablation for Posterior Sacroiliac Joint Complex Pain: A Narrative Review. *PMR* 2019; 11(Suppl 1):S105-S113.
8. Chen C-H, Weng P-W, Wu L-C, Chiang Y-F, Chiang C-J. Radiofrequency Neurotomy in Chronic Lumbar and Sacroiliac Joint Pain: A Meta-Analysis. *Medicine (Baltimore)* 2019; 98:e16230.
9. Tinnirello A. Reduction of opioid intake after cooled radiofrequency denervation for sacroiliac joint pain: A retrospective evaluation up to 1 year. *Korean J Pain* 2020; 33: 183–191.
10. Vallejo A, Benyamin RM, Kramer J, Stanton G, Joseph NL. Pulsed Radiofrequency Denervation for the Treatment of Sacroiliac Joint Syndrome. *Pain Med* 2006; 7:429-434.
11. Shih C-L, Shen P-C, Lu C-C, et al. 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. *Clin Neurol Neurosurg* 2020; 195:105854.
12. Patel N. Twelve-Month Follow-Up of a Randomized Trial Assessing Cooled Radiofrequency. *Pain Pract* 2016; 16:154-167.
13. Stelzer W, Aiglesberger M, Stelzer D, Stelzer V. Use of Cooled Radiofrequency Lateral Branch Neurotomy for the Treatment of Sacroiliac Joint-Mediated Low Back Pain: A Large Case Series. *Pain Med* 2013; 14:29-35.
14. Bayerl SH, Finger T, Heiden P, et al. Radiofrequency denervation for treatment of sacroiliac joint pain – Comparison of two different ablation techniques. *Neurosurg Rev* 2020; 43:101-107.