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Technical notes &surgical techniques

Clinical results of the treatment for sacroiliac joint pain by radiofrequency neurotomy

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ABSTRACT

Objective: Sacroiliac joint pain is one of several causes of lower limb and lower back pain not originating from the spine, spinal cord, or nerve roots. The authors examined outcomes of treating sacroiliac joint pain using radiofrequency neurotomy (RFN), as described in several previous studies by Murakami et al. between 2007 and 2018. The RFN treatment in the present study was performed on 67 patients (31 male, 36 female; median age 61.8 years) who experienced re-flares of pain despite ≥2 injections of local anesthetics into the sacroiliac joint.
Patients and Methods: RFN treatment was considered to be effective when pain was reduced by ≤50% after treatment. Additional RFN treatment(s) was administered to patients who experienced pain re-flares.
Results: Of the 67 patients, 57 (85.1%) achieved sustained pain relief, 30 (44.8%) of whom experienced immediate pain relief after the first treatment and no longer required therapy. The other 27 patients who experienced subsequent re-flares underwent additional RFN treatment(s) and successfully achieved sustainable pain relief sufficient to end therapy.
Conclusion: RFN resulted in no complications and was safe and minimally invasive, and should be considered a conservative treatment option in advance of sacroiliac joint fusion surgery.

1. Introduction

Lower back and lower limb pain arise from a variety of causes, that are not necessarily associated with the spine and/or spinal cord. Neurosurgeons frequently encounter patients presenting with chronic pain in these regions despite the absence of imaging results revealing an apparent cause or neurologically explainable phenomena. In some cases, causes of slight to moderate pain are diagnosed and treated; however, favorable results are not achieved in some, resulting in refractory diseases, even after surgical intervention. Despite the remarkable advances in diagnostic and surgical techniques for spine-and spinal cord-related injuries and disease, treating pain not originating from the spine and/or spinal cord continues to present a challenge. Renewed attention has been devoted to treating the sacroiliac (SIJ) to alleviate pain in patients with such complicated symptoms [1–3]. In this study, we report the treatment effects of radiofrequency neurotomy (RFN) on SIJ pain, specifically as stipulated by Murakami et al. and others [4–10].

2. Patients and methods

2.1. Diagnosis of SIJ pain

Patients with low-back pain and/or leg symptoms were evaluated based on medical history and imaging results. All patients underwent radiography and magnetic resonance imaging; however, those with inflammatory findings on radiological examination were excluded. SIJ pain was diagnosed when patients exhibited all three of the following criteria: pain over the SIJ; positive findings on at least one of the three provocation tests (Gaenslen's test [11], Patrick's test [12], and SIJ shear [13]); and reproduction of pain when a needle was inserted into the SIJ with subsequent improvement in pain by ≧70% after injection of local anesthetic(s) into the SIJ under fluoroscopic guidance.

Following guidelines described by Murakami et al. [4,5], patients with lower back pain and lower limb pain caused by SIJ disorder were selected to undergo pain block at the SIJ using local anesthesia (Fig. 1). Based on the outcomes of visual analog scale (VAS) scores and Pain Relief Score (PRS), patients achieving pain relief ≧70% were diagnosed with SIJ pain. With this diagnostic treatment, there were patients who experienced repeated pain-flares, even though pain subsided immediately after the initial treatment. In these cases, repeated pain block

Abbreviations: PRS, pain relief score; RFN, radio frequency neurotomy; SIJ, sacroiliac joint; VAS, visual analog scale

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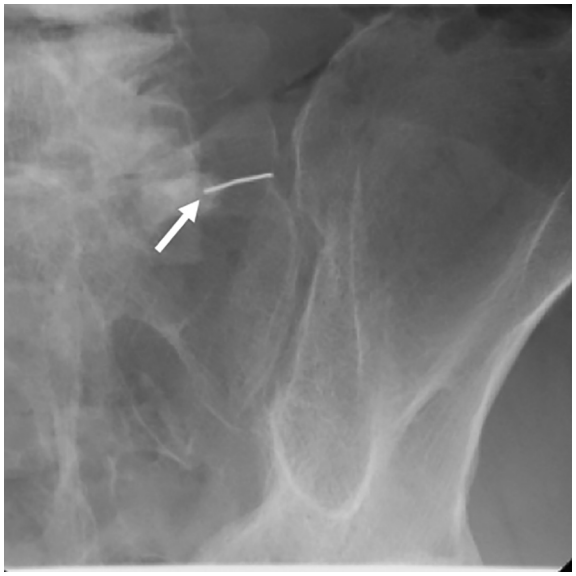

Fig. 1. Radiograph at the time of the puncture. Needle for nerve block (white arrow).

treatments were performed once every 1–2 weeks. Patients who experienced repeated re-flares and/or severe pain that significantly impacted the activities of daily living were designated candidates for surgical SIJ fusion treatment. For surgical fixation of the SIJ, several posterior, Lateral and anterior approaches have been attempted. However, this treatment is invasive and has not yet achieved satisfactory results [5].

To obtain long-term pain relief and/or cure, the authors' typically treat their patients with RFN before surgery. Patients who experienced ≧2 re-flares after additional pain block treatments, VAS score $>$ 50, and/or pain interfering with the activities of daily living/work were eligible for this treatment. Sixty-seven patients (31 male, 36 female, median age 61.8 years), who were treated between January 2009 and March 2014, were selected. A high-frequency generator (NeuroThermo JK3, St Jude Medical, Austin, TX, USA) and 18–22 gauge needles were used. The needle electrode was inserted under x-ray fluoroscopy into the site with reference to the area described by Murakami, and coagulation lesion was created at the site where intense pain was reproduced by the test cauterization (Fig. 2). The posterior ligament of the SIJ was stimulated with a needle to cauterize the site that reproduced the pain, and this was repeated until the pain disappeared. RF lesions were created at a temperature of 80 ˚C for 90 s. Before RFN, 0.5–1.0 mL of 2% lidocaine was injected to anesthetize the target area. Steroid use was avoided because of the higher risk of infection.

VAS scores before and after treatment were recorded. Treatment was considered to be to effective if pain reduction of ≧50% (PRS $<$ 5) was achieved. The percentage of effective case against the total was calculated as the effectiveness rate. VAS recovery rate was calculated using the following equation: treatment VAS score – post-treatment VAS score/pre-treatment VAS score $\times$ 100%. The effectiveness rate at initial treatment was calculated immediately after treatment (within 2 h), and at 1, 3, and 6 months to evaluate the sustainability of pain relief. For patients who experienced re-flares, a VAS score $>$ 50, and/or pain that interfered with the activities of daily living during the time series, the treatment was repeated.

Statistical analysis was performed using the paired-*t* test; differences with P $<$ 0.05 were considered to be statistically significant.

3. Results

Of the 67 patients included in the present study, 20 were treated

Fig. 2. A cauterization site was created in all patients from slightly outside the sacroiliac join outside the posterior sacral foramen and the medial sacroiliac joint space (white arrow).

bilaterally and 47 unilaterally. Fifty-three patients also complained of lower limb pain. In all cases, the cauterization was performed in the posterior sacral foramen, slightly outside the SIJ, and the medial SIJ space. The mean number of ablations was 5.5 for the right and 5.9 for the left.

Before initial treatment, patients experienced a mean (± SD) duration of disease of 15.2 ± 23.7 months (range, 1–144 months), with a mean VAS score of 70.8 ± 12.2 at initial consultation (range, 50–100). VAS scores decreased to 0 to 50, 2 h after RFN, with a mean score of 18.8 ± 15.4 (P $<$ 0.001). A PRS of $<$ 5 was demonstrated in all 67 cases, corresponding to an effectiveness rate of 100%. The VAS recovery rate ranged from 50% to 100%, with a mean value of 74.1 ± 19.6%.

Thirty (44.8%) patients fully recovered after the first treatment, with a VAS score $<$ 50 and no re-flares. Sustainable pain relief was also achieved by repeated treatments in patients who experienced re-flares, 12 of whom required an additional 2 treatments, 6 an additional 3 treatments, and 9 an additional 4 treatments.

Effectiveness rates after the first treatment (PRS $<$ 5 ratio) at immediately after treatment, and at 1, 3, and 6 months, were 100, 73.1, 46.3, and 43.3, respectively, demonstrating a gradual decrease (Fig. 3). There was a significant difference in the rates between post-treatment at 1 month and those at $>$ 3 months (P $<$ 0.01). In most cases, VAS scores at recurrences after RFN were lower than the initial VAS scores. In patients who underwent multiple treatments, the mean number of treatments on the right and left sides was 5.5 and 5.9, respectively, with no statistically significant difference. Ten patients with refractory pain required ≧5 repeat treatments. These individuals had a mean long-term disease duration of 49.2 ± 42.6 months (P $<$ 0.001), with a high mean VAS score of 85.0 ± 8.50 (P $<$ 0.001) at the initial consultation at the authors' hospital.

Forty-four patients had histories of other spinal cord disease(s), including: lumbar spinal canal stenosis (n = 18); lumber disc hernia

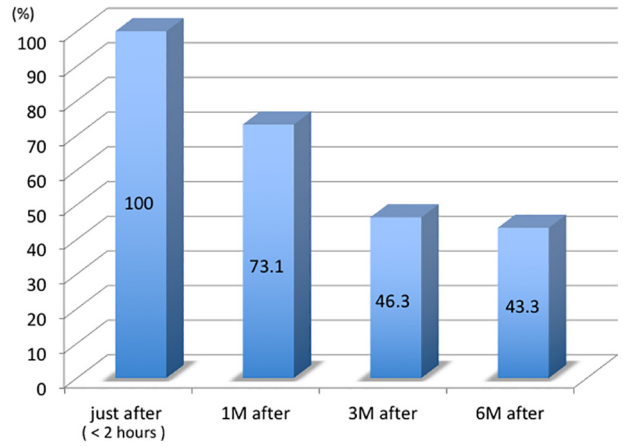

Fig. 3. Visual analog scale (VAS) scores before and after the operation, reduction of Pain Relief Score (PRS) to < 50%, and the effectiveness rate (effective cases/all cases) × 100% immediately after (within 2 h), and at 1, 3, and 6 months. Treatment and sustained effects were evaluated and compared. Trends in the rate of effectiveness of radiofrequency neurotomy (RFN). The effectiveness rate after the first treatment demonstrated a gradual decrease. There was a significant difference between 1-month post-treatment and at > 3 months ($P < 0.01$). A sustained effect was considered to be 1 month at minimum.

(n = 15); and post-lumber fusion surgery (n = 12). There were no complications, such as neurological disorder(s) or burns, after the treatments.

4. Discussion

Although SIJ pain with lower back pain is often associated with pain or stimulated pain in the lower limb(s), it should be discriminated from spinal cord disease. Because SIJ pain usually occurs outside the somatosensory region, pain block using local anesthesia is effective [3,6–10].

Pain block applied to the surface of the SIJ is effective; as such, the main cause of pain is believed to originate from nociceptors and afferent fibers distributed in this area [14]. However, it is a symptomatic treatment with a high rate of re-flaring/recurring pain, and often requires repeated treatments, which may lead to refractory disease [2,3].

The principle of RFN is to heat the needle point and use it to coagulate protein for selectively and continuously blocking pain in the nociceptors and afferent fibers [1,15–18]. The effectiveness of this treatment for lower back pain has been reported in the posterior branch of the spinal nerves surrounding the intervertebral areas [19].

There have been multiple reports describing RFN as a method of pain relief for SIJ pain in general (not as stipulated by Murakami et al.). Vallejo reported a relief rate of 73% (16/22 cases) using low-temperature (39–42 °C) pulsed radiofrequency denervation [15]. Ferrante et al. reported a success rate of 36.4% (33 cases) for sustained VAS < 50% (6 months) using thermocoagulation at 90°C/90 s [16]. Yin et al. reported 64% effectiveness (9/14 cases) at 6 months post-treatment using 20-gauge needles at 80°C/60 s [17]. Finally, Buijs et al. achieved complete pain relief at 12 months post-treatment using 80°C/60 s in 34.9% of 38 patients and 50% pain relief in 32.6% [18] (Table 1). Due to variation in needle size, temperature, coagulation interval, and methods of measuring effectiveness, small differences in outcomes are understandable. Nevertheless, the effectiveness of RFN for pain relief is widely acknowledged.

To our knowledge, the present study was the first to investigate the application and effectiveness of RFN specifically for SIJ pain stipulated by Murakami and Kurosawa et al. [4–10]. The novelty factor of this paper is that the patients discussed in this study are all having relapse after multiple block treatments, which should be more difficult to treat compared to the cases reported in the previous studies.

In our hospital, we encountered 30 (44.8%) patients who experienced an immediate positive effect after the first treatment and were able to complete their treatments successfully. An additional 27 patients who experienced pain re-flares also achieved sustainable pain relief through multiple treatments. The effectiveness rate after the first treatment demonstrated a gradual decrease; however, there were significant differences in rate between 1 and 3 months after treatment, suggesting that the effect persisted for at lease 1 month (Fig. 3). In the 37 cases that required multiple treatments, 91.9% (34/37) achieved a lower degree of pain every time the treatments were repeated. The effectiveness rate (PRS < 5 ratio) at the end of treatment in the 67 cases was 75.4%, and the mean final VAS score was 17.9 ± 18.7. Excluding the 10 cases of refractory disease, the mean effectiveness rate at the end of treatment was 80.8%, with a mean final VAS score of 12.8 ± 14.4. Moreover, the mean VAS score before treatment, compared with the end of treatment, was significantly lowered to 70.8 ± 12.2 ($P < 0.001$). Based on these positive results, with sustained VAS scores < 50 in all 57 cases of non-refractory disease, we believe this conservative treatment should precede fusion surgery.

Among the 10 cases that resulted in refractory disease after multiple RFN treatments, 65.7% had a history of spinal cord disease(s). As such, pain in these individuals was likely multifactorial and contributed to the negative outcomes. For patients with a long history of illness and extremely high VAS scores at initial consultation, caution for the risk of refractory disease is warranted. Early detection and treatment, therefore, are required to avoid the development of chronic pain.

Although, RFN treatment carries little to no risk for complications, further studies are required to improve this technique for creating a coagulation nest more effectively and less invasively.

5. Conclusion

RFN enabled selective block of pain transmission in the nerve fibers. In the present study, sustainable pain relief was achieved in 57 of 67 patients (85.1%). Conservative treatment using RFN, as described, was safe, non-invasive, and complication risk-free, and should be considered a treatment option preceding invasive fusion surgery.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to

Table 1
Effect of radiofrequency neurotomy (RFN) for general sacroiliac Joint pain, as assessed by several researchers.

Author	Number of cases	Intervention	°C/s	Outcome(s)
Vallejo et al	22	Puled RF	39 °C–42°C/	experienced good or excellent 73%
Ferrante et al	33	RFN	90°/90	at least a 50% decrease in VAS for a period of at least 6 months; 36.4%
Yin et al	14	RFN	80°/60	64% experienced a successful outcome for a period of at least 6 months
Bujis et al	38	RFN	80°/60	At 12 weeks, 34.9% complete pain relief and another 32.6% > 50% pain relief

influence the work reported in this paper.

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