

## Percutaneous Radiofrequency Facet Rhizotomy for Cervical Dorsal Ramus Syndrome

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**Objective :** Radiofrequency facet rhizotomy(RFFR) has been widely performed for treatment of chronic neck pain caused by cervical dorsal ramus syndrome(CDRS). To evaluate the therapeutic effectiveness of RFFR in the patients with CDRS, we analyzed patients with various cervical pathologic conditions.

**Methods :** The therapeutic results in forty-four patients who underwent RFFR for CDRS from January, 2000 to December, 2002 were analyzed according to the underlying pathologic conditions causing CDRS. The pathologic conditions were sprain (33 cases), herniated nucleus pulposus (6), foraminal stenosis (4), and compression fracture (1). The therapeutic results were evaluated one month after the operation and graded as excellent, good, fair or poor. Treatments were considered successful if the therapeutic results were graded as either excellent or good.

**Results :** The overall success rate in all patients was 72.7%. The success rate for treatment of cases with cervical sprain was 87.9%, but treatment of cases with herniated nucleus pulposus, foraminal stenosis, and fracture showed unsatisfactory results (mean success rate was 27.3%). Some patients complained of transient hypesthesia (4 cases) or transient dull pain at the electrode insertion sites (2 cases).

**Conclusion :** RFFR is an effective and safe treatment for CDRS caused by cervical sprain, regardless of the patient's age, the duration of the symptoms, and the presence of radiating pain.

**KEY WORDS :** Chronic neck pain · Cervical dorsal ramus syndrome · Radiofrequency facet rhizotomy.

### Introduction

Various therapeutic interventions for chronic neck pain are now available, but the choice of the best treatment for optimal management is very complicated<sup>1,3)</sup>. Radiofrequency facet rhizotomy(RFFR) is one of the management options for the patients with cervical pain that is unaffected by medical and physical therapy<sup>1,3)</sup>. In many patients, the chronic neck pain is caused by irritation of the cervical dorsal ramus, and this is referred to as cervical dorsal ramus syndrome(CDRS).

Over the past several years, the indications of radiofrequency treatment have been expanded to include a variety of chronic pain syndromes. While hundreds to thousands of patients are now being treated by RF world-wide, the efficacy of RF treatment is still in debate in terms of mode of action, technique, and safety<sup>4,5)</sup>.

In this study, we describe the clinical characteristics of cervical

dorsal ramus syndrome and the effects of RFFR on CDRS patients with different underlying pathologic conditions.

### Materials and Methods

#### Patient populations

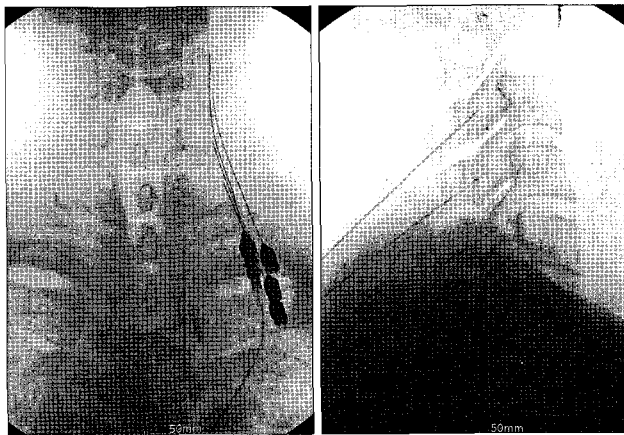
From 51 patients who received RFFR between January, 2000 and December, 2002, 44 patients were followed up and included in this study. The cervical pathology included sprain (33 patients), herniated nucleus pulposus (6), foraminal stenosis (4), and compression fracture (1).

All 41 patients failed to show reductions of pain in the neck, shoulder, and arm with medication (NSAIDs, muscle relaxants, etc.) and physiotherapy for at least one month. One of the important positive criteria for candidates of RFFR is more than a 50% relief of pain after administration of local anesthetics to the medial branch. We performed RFFR in the patients

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**Fig. 1.** Anteroposterior and lateral view of cervical spine during radiofrequency facet rhizotomy : The tip of needle is positioned at the center of pillar.

with sprain, HNP, stenosis, and compression fracture who were not surgically indicated. We also performed RFFR in the patients with surgical lesions who had refused operation or were in a medically high risky group. After RFFR treatment, we performed continuous medical therapy. Exclusion criteria for patients in this study included personality disorder, prior RF treatment, preexisting sensory or motor deficit, and coagulopathies.

**Administration of local anesthetics to the branch**

The needle position for the unilateral or bilateral C4-C7 median branches was along the vertical line that connects the greatest anteroposterior diameter of the articular pillar but remains dorsal to the foramen. The skin puncture was made with a 22-gauge spinal needle. Then, 3cc of the anesthetic agents (2% mepivacaine HCL 20cc + depomedrol 40mg) were injected for blockade. When the patient's pain was relieved by more than 50%, he or she became a candidate for the RFFR.

**The radiofrequency facet rhizotomy**

A Radionics RFG-3B lesion generator system (Radionics, Inc., Burlington, MA, USA) was used as a radiofrequency generator. All procedures were performed with the SMK-C10 cannula (Radionics, Inc., Burlington, MA, USA).

RFFR was performed on the patient lying prone under aseptic conditions. No sedatives or analgesics were used. The image-intensifier was placed to obtain an anteroposterior pillar view, with the target point in the center of the monitor to avoid distortion of the image. A needle was placed on the skin surface so that the tip was exactly over the target point. The skin was then anesthetized with 1% lidocaine. The electrode was inserted along the parasagittal plane, tangential to the lateral margin of the articular

pillar, and was directed toward the target point under image-intensifier control.

During insertion, care was taken to keep the tip of the electrode just medial to the lateral margin of the articular pillar until the bony resistance on the dorsal surface of the pillar was detected. This ensured that the electrode was not over-inserted. When the back of the pillar was contacted, the electrode was laterally moved in small increments, until a loss of bony resistance was sensed and the electrode gently slipped forward, tangential to the pillar. The depth of insertion was then adjusted using a lateral view. When the target point was reached, the position of the electrode was confirmed and recorded on anteroposterior and lateral films (Fig. 1).

A stimulation current was applied. At one volt, patients felt pain or paresthesia and at two volts, there was a spasm or contraction of the muscle of the neck. At that point, a radiofrequency lesion was made at 90°C for 60 seconds.

**Outcome measures**

We evaluated the pain intensity one month after the RFFR and compared it with the pre-RFFR pain. We defined the treatment as a success if the pain was reduced more than 50%, or as a failure if the pain was reduced less than 50%. We analyzed the success rate according to the patient's cervical pathology, age, sex, duration of symptoms and presence of radiating pain.

**Statistical analysis**

Statistical significance was determined using analysis of variance(ANOVA) and t-tests. P-value less than 0.05 was considered statistically significant.

**Results**

We included 44 patients with CDRS in this study (21 males and 23 females). The mean age of the patients was 41.2 ± 14.2 (19 to 74). The median duration of the symptom was 12.6 ± 21.6 month(2 months to 10 years). The median duration of the follow-up period was 340.9 ± 232.2 days (1 month to 2 years). All patients primarily complained of neck and shoulder pain and occipital headache. Seventeen patients (38.6%) complained of radiating pain on the arm,

**Table 1.** Pathological conditions and the results after radiofrequency facet rhizotomy

Conditions	Number (%)	Success	Fail	Success rate (%)
Sprain	33 ( 75.0)	29	4	87.9*
Stenosis	4 ( 9.1)	2	2	50
Herniated nucleus pulposus	6 ( 13.6)	1	5	16.7
Compression fracture	1 ( 2.3)	0	1	0
Total	44 (100 )	32	12	72.7

\*: P value < 0.01

**Table 2.** Results of radiofrequency facet rhizotomy according to the age, sex, symptom duration and presence of radiating pain

	Success	Fail	Success rate (%)	p value
Age				0.30
<60	31	10	76	
≥60	2	1	67	
Sex*				0.02
Male	12	9	57	
Female	20	3	87	
Symptom duration				0.25
<6 month	17	7	70.8	
6~12 month	8	2	80	
>12 month	7	3	70	
Radiating pain				0.86
Presence	12	5	70.6	
Absence	20	7	74.1	

\* P-value less than 0.05 was considered statistically significant

elbow, wrist, and/or hand. The number of the patients with sprain was 33, stenosis was 4, HNP was 6 and compression fracture was 1 (Table 1).

The overall success rate for the patients was 72.7%. The success rate was 87.9% with sprain, 50% with stenosis, 16.7% with HNP and 0% with compression fracture. There was a statistically significant difference in the success rate between sprain and other underlying pathologic conditions (87.9% versus 27.3%;  $p < 0.01$ ) (Table 1).

The success rate was 74.1% in the group without radiating pain and 70.6% in the group with radiating pain ( $p = 0.86$ ). In patients younger than 60 years of age, the success rate was 76%, and in patients over 60 years of age, the success rate was 67% ( $p = 0.30$ ). The duration of the symptoms did not affect the clinical outcome ( $p = 0.25$ ). The female group showed a better success rate than the male group (87% vs 57%;  $p = 0.02$ ) (Table 2). In the successful group, no patient had a recurrence of his or her symptoms for 3 months after RFFR. However, among the 29 patients who were followed for more than 3 months after treatment, 9 patients had a recurrence of their previous symptoms, but because the intensity of pain was tolerable in these patients, none received the procedure again.

Four patients (9.1%) developed hypesthesia and weakness of the neck and shoulder. Two patients (4.5%) developed dull pain at the injection site. Both of these symptoms disappeared completely within 3 days after onset.

## Discussion

The common source for chronic neck pain is the facet (zygapophysial) joint. The pain can be resulted from poor posture, lack of fitness, degenerative changes, and various injuries and often persists for several months<sup>2</sup>. Percutaneous RFFR is a useful and minimally invasive procedure in which selected

nerves are thermally lesioned with electrodes to destroy their ability to conduct pain<sup>6</sup>. It has been used for more than two decades and has a number of advantages over more invasive procedures when performed by experienced physicians on carefully selected patients.

The use of radiofrequency or thermocoagulation procedures dates back to the 1950s, but the first clinical application of an RF lesion in spinal facet pain was reported in 1975 by Shealy<sup>3,10</sup>. Since then, modifications and improvements in both equipment and operative techniques have made RF procedures safer and more effective. Several distinct procedures are used for the control or treatment of pain from various conditions, but RFFR (also called facet denervation, facet neurotomy, facet coagulation, or facet rhizolysis) facet joint pain is by far the most common. In 2006, Shin et al.<sup>11</sup> reported that radiofrequency neurotomy of cervical medial branches was successful in reducing chronic neck pain for at least 6 months in 68% of patients included in the study.

The procedure, which has been described in detail elsewhere<sup>3-6,10,12,13</sup>, involves the insertion of an insulated probe and generation of heat by electric current to create a lesion that destroys the target tissue and interrupts sensory conduction. The target nerves can be coagulated very precisely with minimal risk of damaging other structures. Morbidity and mortality are very low and no serious adverse effects<sup>12</sup> were observed.

Despite being widely used for treatment of facet-originated pain, RF facet neurotomy should only be performed by an experienced physician in carefully selected patients who meet specific criteria. Our selection criteria included patients who did not have a reduction in pain of the neck, shoulder and arm after pharmacotherapy with/without physiotherapy for at least one month and who obtained more than a 50% improvement in pain relief after administration of local anesthetics at the medial branch.

The relief obtained from radiofrequency medial branch neurotomy should not be expected to be permanent. Coagulation denatures the proteins of the peripheral nerve, thereby preventing nociceptive conduction along the nerve<sup>16</sup>, but as long as the ganglion of that nerve remains intact the nerve will regenerate. Once the nerve heals, conduction is re-established, and pain recurs. Destruction of the ganglion is not recommended, due to the risk of side effects and complications of deafferentation in the territory of the entire spinal nerve. Repetition of medial branch neurotomy to reinstate relief is therefore a more attractive prospect in terms of possible side effects<sup>5</sup>. Although the medial branch can regenerate after denervation, natural relief still persists, and the true indication criteria for repeated procedure is narrow. During the follow-up period (1 to 24 months) of our series, none of the patients needed to have the procedure repeated.

Therapeutic outcomes of the patients with combined lesions (stenosis, HNP, compression fracture) were less favorable than those for patients with a sprain ( $p < 0.01$ ) (Table 1). The difference in success rate is thought to be due to the differences in the pain mechanism. In a sprain, pain is evoked by irritation, not by compression of the nerve, but in stenosis, HNP, and compression fracture, the pain is evoked mostly by mechanical nerve compression. Patients complained that the pain worsened with spinal motions (flexion, hyperextension, and/or extension-rotation) and local paravertebral tenderness or percussion tenderness, which are frequently seen in dorsal ramus syndrome. Although the patients with combined lesions also had these symptoms, these pathologies originate from the spinal structure as well as the facet joint, and RFFR is less effective in these patients. But the size of our study was too small to analyze in detail. At present, we have several successful cases in which RFFR was performed on mild compression fractures of the thoracolumbar junction.

In addition to the small size of our study group, another limitation of our study was the pain scoring system. Precise and sufficient pain evaluation was not possible due to this being a retrospective study. The Visual analog scale (VAS)<sup>8,9)</sup>, McGill pain questionnaire<sup>15)</sup>, SF-36<sup>14)</sup> and Oswestry disability index<sup>1)</sup> are widely used for pain evaluation. The percentage scoring method<sup>6)</sup> which was used in this study compares pre-RFFR with post-RFFR effect but has disadvantages for measuring pain severity and character. The pain severity and character may influence measurement of the RFFR effect and outcome, so further study utilizing other pain evaluating methods is needed. In addition, Sapir et al.<sup>7)</sup> have shown that litigation affects a patients prognosis in a whiplash injury, therefore, further analysis of the effect of litigation on the success of RFFR treatment is necessary.

## Conclusion

**RFFR** is an effective and safe treatment option for the patients with CDRS, regardless of the patient's age, the duration of the symptoms, and the presence of radiating pain. Specifically, neck pain due to a cervical sprain is most effectively treated with RFFR.

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## Commentary

This is an article analyzing the follow-up result of radiofrequency facet rhizotomy (RFFR) of 44 patients with cervical dorsal ramus syndrome (CDRS) for 3 years in the same institute. I agree with the authors' conclusion that RFFR is an effective and safe treatment for patients of CDRS associated with chronic intractable neck sprain. Although there was relieved more than a 50% relief of pain after administration of local anesthetics in patients with neck pain from stenosis, herniated nucleus pulposus or compression fracture, the results of RFFR for them was not satisfactory. So this RFFR is carefully selected for the patients of stenosis, herniated nucleus pulposus or compression fracture in spite of successful diagnostic block.

This paper showed only one month follow-up result after the RFFR. The analysis of further long term result of RFFR is necessary. Anyway I appreciate the authors' honest analysis of their data in this paper.

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