**DESCRIPTION**

Pulsed bursts of radiofrequency current are applied to disrupt nerve tissue in an effort to relieve pain at a lower temperature than conventional radiofrequency treatments.

**Background**

Percutaneous radiofrequency (RF) denervation is a procedure used to treat certain types of neck or back pain originating in facet joints. The goal is long-term pain relief. However, the nerves regenerate, and repeat procedures may be required. RF therapy may be performed using either conventional continuous RF current, which is considered the current standard of care for RF denervation, or pulsed RF current. In conventional continuous RF therapy, probe tip temperatures reach at least 60°C and are intended to produce long-term pain relief through coagulation of tissue. Pulsed radiofrequency (PRF), which consists of short bursts of current, is suggested as a possibly safer alternative to thermal radiofrequency. Temperatures for PRF do not exceed 43°C at the probe tip and do not heat the tissue enough to cause coagulation. In addition, with PRF, tissues may cool between pulses. It is postulated that with PRF denervation transmission across small unmyelinated nerve fibers is disrupted but not permanently damaged, while large myelinated fibers are not affected.

A variety of terms may be used to describe RF denervation (e.g., rhizotomy, rhizolysis, neurolysis, neurotomy, lesioning). In addition, the structures to which the RF energy is directed may be referred to as facet joint, facet nerves, medial nerve or branch, median nerve or branch, segmental nerves, dorsal ramus, or dorsal root ganglion.
MEDICAL POLICY CRITERIA

NOTES:

- This policy does not address conventional percutaneous radiofrequency facet denervation which may be considered medically necessary for the treatment of facet joint pain that is not responding to conservative treatments.
- This policy addresses only pulsed radiofrequency procedures that are performed to achieve facet joint denervation; clinical records should clearly document that the pain being treated originates from the facet joint(s), verified by nerve block, and that the goal of the treatment is facet joint denervation.

Pulsed radiofrequency lesioning of spinal structures (e.g., dorsal root ganglion; medial branch nerve) is considered **investigational** for the treatment of pain from any cause in any level of the spine, including but not limited to the following:

A. Cervicobrachialgia
B. Cervicogenic headache
C. Degenerative conditions such as spondylosis, spondylolisthesis, or degenerative disc disease
D. Facet joint or zygapophyseal joint arthropathy
E. Failed back surgery syndrome (FBSS)
F. Herniated intervertebral disc
G. Nerve root compression
H. Neuropathic spinal pain
I. Radiculopathy, radiculitis, or radicular pain
J. Scoliosis
K. Spinal stenosis
L. Trauma or injury

SCIENTIFIC EVIDENCE

The principal outcome for treatment of pain is symptom relief and improved functional level. Relief of pain can be subjective depending on the validity of the measurement tool used. Randomized controlled trials (RCTs) are desirable to control for the placebo effect and determine whether any treatment effect provides a significant advantage over the placebo. In addition, well-designed studies comparing pulsed radiofrequency (PRF) therapy with conventional continuous radiofrequency (RF) therapy are important to determine the overall effectiveness of this therapy for the treatment of chronic spinal pain.

**Systematic Reviews**
Chua (2011) evaluated four RCTs that compared PRF of spinal structures with sham intervention or with conventional continuous RF thermocoagulation.\[1\] The authors considered the evidence for PRF of the dorsal root ganglion “compelling” for treatment of cervical radicular pain, but found the evidence for PRF for lumbosacral pain to be of low methodological quality. The following is a summary of these key RCTs:

- One small RCT comparing pulsed RF to sham treatment was identified in the literature review. Van Zundert and colleagues randomized 23 patients (of 256 screened) with chronic cervical radicular pain.\[2\] Success was defined as at least 50% improvement on global perceived effect (GPE), at least 20% reduction in pain on visual analog scale (VAS), and reduced pain medication use measured three months after treatment. Nine out of 11 patients in the treatment arm and four out of 12 in the three out of 12 in the sham group achieved at least 20% reduction in pain on VAS (P=0.02). At six month follow-up, more patients in the treatment group reduced their use of pain medication, but the difference was not significant. There was a trend toward more positive outcomes in the pulsed RF group on quality of life scores. The authors conclude that pulsed RF may provide pain relief for a limited number of carefully selected patients. These findings must be confirmed in larger studies before drawing conclusions regarding the efficacy of pulsed RF.

- Tekin and colleagues randomized sixty patients with lumbar facet joint pain, 20 each to conventional RF, pulsed RF and a control group (local anesthetic only).\[3\] Outcome measures were pain on VAS and Oswestry Disability Index (ODI) scores. Mean VAS and ODI scores were lower in both treatment groups than in controls post-treatment; however the reduction in pain was maintained at six- and twelve-month follow-up only in the conventional RF group. The number of patients not using analgesics and patient satisfaction were highest in the conventional RF group.

- A randomized, double blind, prospective trial by Kroll and colleagues compared the efficacy of continuous versus pulsed in the treatment of lumbar facet syndrome in an RCT with 50 patients.\[4\] Outcome measures, pain on visual analog scale (VAS) and Oswestry Low Back Pain and Disability Questionnaire (OSW), were administered at baseline and three months after treatment and relative percentage improvement compared between groups. No significant differences in the relative percentage improvement were noted between groups in either VAS (p = 0.46) or OSW scores (p = 0.35). Within the percutaneous RF group, comparisons of the relative change over time for both VAS (p = 0.21) and OSW scores (p = 0.61) were not significant. However, within the continuous RF group, VAS (p = 0.02) and OSW scores (p = 0.03) changes were significant. The authors conclude that though there was no significant difference between continuous and pulsed RF in the long-term outcomes, there was greater improvement over time in the continuous RF group.

- Simopoulos et al. randomized 76 patients with chronic refractory lumbosacral radicular pain to one of two groups who received either PRF alone or PRF followed immediately by continuous RF.\[5\] Two months after the procedure 70% and 82%, respectively, reported successful reduction of pain. These effects were lost by eight months in most patients. The between-group difference was not significant. The authors concluded that additional RCTs are required to determine the effectiveness of PRF.

The authors concluded that the lumbosacral RCTs were either of poor quality or that participants returned to their initial pain intensity eight months after the study. The authors noted the results of the cervical RCT were compelling, but the RCT itself concluded larger studies are needed.

**Randomized Controlled Trials**

In addition to the RCTs summarized above, several recent RCTs have been published. Halim (2016) evaluated the efficacy of percutaneous nucleoplasty (PCN) compared to pulsed radio frequency (PRF) in patients with contained cervical disk herniation.\[6\] The trial evaluated 34 patients with radicular pain.
from a single contained cervical disk herniation. A health survey, visual analog scale (VAS), and the Neck Disability Index (NDI) were completed one, two, and three months after treatment. Data was collected for treatment satisfaction and complications. The PCN group (n = 17, mean age 52 years, 10 female/7 male) was treated at C5 to C6 (8 cases) or C6 to C7 (9 cases). The PRF group (n = 17, mean age 50 years, 8 female/9 male) was treated at C3 to C4 (1 case), C5 to C6 (10 cases), or C6 to C7 (6 cases). At three months, the PRF group was not superior to the PCN group in pain improvement.

Wang (2016) evaluated 62 patients in a randomized comparative trial to determine the efficacy between cervical nerve root block (CNRB), pulsed radiofrequency (PRF), and CNRB plus PRF for cervical radicular pain.[7] The patients were randomized into three groups and received either CNRB, PRF, or CNRB with PRF. A numeric rating scale (NRS) was used to measure pain intensity, and global perceived effect (GPE) was scored by the patient on a 7-point scale. A score of (-3) equaled much worse, (0) equaled no change, and (+3) equaled total improvement. The outcomes were evaluated at one week, one month, three months, and six months. Side effects and complications were noted. The combination therapy yielded statistically significant lower NRS and higher GPE, than either CNRB or PRF alone. There were no statistically significant differences in NRS or GPE between the CNRB and PRF groups.

Jena (2016) evaluated a comparative randomized, double-blind trial, for management of low back pain.[8] Forty patients with chronic discogenic low back pain received continuous radiofrequency (CRF) plus intradiscal triamcinolone or pulsed radiofrequency (PRF) plus intradiscal triamcinolone. Outcome data included immediate as well as long-term pain relief, over six months using visual analog scale (VAS), the Oswestry Disability Index (OSI) and straight leg raising test. The results indicated that the CRF group had statistically significant improved pain and straight leg raise.

Lee (2016) evaluated the comparative effectiveness of pulsed radiofrequency (PRF) administered to a targeted dorsal root ganglion (DRG) and transforaminal epidural steroid injections (TFESI) for the treatment of radicular pain due to disc herniation.[9] The RCT included 193 patients who received TFESI (2ml of 0.125% bupivacaine and 5mg dexamethasone) for spinal radicular pain. Patients who presented with a visual analogue scale (VAS; 0-10mm) of > 4 and an Oswestry Disability Index (ODI) or Neck Disability Index (NDI) > 30%, after the first TFESI were administered either PRF or an additional TFESI. The additional procedures were randomly allocated to 38 patients (PRF group n=19; TFESI group n=19) and given within 2-6 weeks after the first TFESI. These 38 patients were re-evaluated at two, four, eight, and twelve weeks. No statistically significant differences in effectiveness were noted at any follow-up time period, between the two groups.

Arsanious (2016) evaluated a double-blinded, RCT, that determined if post-procedural pain scores and post-procedural oral analgesic use would be reduced in patients receiving pulsed dose radiofrequency (PDRF), immediately followed by continuous thermal radiofrequency ablation (RFA) versus continuous RFA alone, for zygapophaseal joint disease.[10] Fifty-five patients were included in this study. The results noted patients receiving PDRF prior to continuous thermal RFA had less post-procedural pain and reduced analgesic requirements, during the first 24 hours. Arsanious et al. noted a study size of 55 patients provided statistically significant data, but that long-term follow-up and studies with a larger population would be beneficial.

Koh (2015) evaluated a comparative RCT in which patients with lumbar spinal stenosis were given both pulsed radiofrequency (PRF) and transforaminal epidural injection (TFEI) or TFEI alone, for chronic refractory lumbar radicular pain.[11] Sixty-two patients were randomized to either group. The primary outcome was defined as: 1) ≥50% or 4-point pain reduction in the numerical rating scale (NRS) without an increase in the Oswestry disability index (ODI) or medication quantification scale (MQS), or mean score <4 in the global perceived effect (GPE) scale; or 2) ≥30% or 2-point pain reduction in NRS with a simultaneous decrease in ODI, MQS, or ≥6 points in the GPE scale. The authors concluded that TFEI provided short-term pain relief, but that the group who had PRF administered in addition to TFEI showed statistically significantly improved treatment results.
versus the group that received TFEI alone. Although this RCT showed statistically significant improvement for patients that received PRF and TFEI, larger comparative studies are needed with longer follow-up timeframes.

**Nonrandomized Studies**

The remaining evidence is limited to a small number of nonrandomized case series\textsuperscript{[12-15]} and retrospective reviews\textsuperscript{[16,17]} that are difficult to compare due to heterogeneity of participants, definitions of success, and procedure techniques. Evidence from nonrandomized studies are considered unreliable due to no randomization, lack of a comparator group, small sample size, and heterogenous study populations.

**Clinical Practice Guidelines**

*American Pain Society (APS)*

In 2009, the APS published an evidence-based clinical practice guideline on nonsurgical interventions for low back pain addressed RF therapy but did not differentiate between continuous and pulsed RF denervation techniques.\textsuperscript{[18]} The guideline states that “there is insufficient (poor) evidence from randomized trials (conflicting trials, sparse and lower quality data, or no randomized trials) to reliably evaluate” a number of interventions including RF facet denervation.

*American Society of Anesthesiologists (ASA)*

The 2010 updated guidelines included recommendations related to conventional RF techniques but did not address pulsed RF.\textsuperscript{[19]}

*American Society of Interventional Pain Physicians (ASIPP)*

The 2013 updated evidence-based guidelines for interventional treatment for chronic back pain rated the evidence on pulsed RF therapy as “limited” based on only one RCT currently published.\textsuperscript{[20]} The guidelines include recommendations for conventional RF, but do not include pulsed RF for any indication.

*The American Academy of Orthopaedic Surgeons*

The American Academy of Orthopaedic Surgeons endorses the 2009 APS guidelines.\textsuperscript{[21]}

**Summary**

There is not enough research to know if or how well pulsed radiofrequency works to treat people with chronic pain. This does not mean that it does not work, but more research is needed to know. Therefore, pulsed radiofrequency lesioning of spinal structures at any spinal level is considered investigational for the treatment of pain from any cause.

**REFERENCES**

The June 2005 American Medical Association’s CPT Editorial Panel decision that the unlisted CPT code 64999 should be used for pulsed RF treatment remains current. The nerve destruction codes within the 64600-64681 code range are not appropriate for reporting therapies that are not destructive of the target nerve, including but not limited to pulsed radiofrequency.

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