Narrative Review

Efficacy of Pulsed Radiofrequency Stimulation in Patients with Peripheral Neuropathic Pain: A Narrative Review

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Disclaimer: This work was supported by the 2017 Yeungnam University Research Grant (Level 2).

Manuscript received: 09-24-2017
Revised manuscript received: 11-22-2017
Accepted for publication: 12-14-2017

Free full manuscript: www.painphysicianjournal.com

Background: Recently, clinicians have been applying pulsed radiofrequency (PRF) stimulation on various peripheral nerves to manage patients' peripheral neuropathic pain.

Objectives: To review the literature on the use and efficacy of PRF for controlling peripheral neuropathic pain.

Study Design: This is a narrative review of relevant articles on the effectiveness of PRF for peripheral neuropathic pain.

Methods: A PubMed search was conducted for papers published from January 1, 1980 to August 31, 2017 that used PRF to treat peripheral neuropathic pain. The key search phrase for identifying potentially relevant articles was [PRF AND pain]. The following inclusion criteria were applied for the selection of articles: 1) patients' pain was caused by peripheral nervous system disorders; 2) PRF stimulation was applied on the peripheral nerve; and 3) after PRF stimulation, follow-up evaluation was performed to assess the reduction in pain. Review articles were excluded.

Results: A total of 468 articles were found to be potentially relevant. After reading the titles and abstracts of the papers and assessing them for eligibility based on the full-text articles, 63 publications were finally included in this review. For radicular pain from spinal diseases, the evidence supports that PRF is an effective treatment. Similarly, PRF appears to be effective for postherpetic neuralgia and occipital neuralgia. On the other hand, for trigeminal neuralgia, the results of previous studies indicate that PRF is not appropriate for managing trigeminal neuralgia and less effective than conventional RF. However, data on the use of PRF for pudendal neuralgia, meralgia paresthetica, carpal tunnel syndrome, tarsal tunnel syndrome, and Morton's neuroma, is lacking and thus the efficacy of PRF in these peripheral nerve disorders cannot be determined at this time.

Limitations: This review did not include studies indexed in databases other than PubMed.

Conclusions: This review will help guide clinicians in making informed decisions regarding whether PRF is the appropriate option for managing the various peripheral neuropathic pain conditions in their patients.

Key words: Pulsed radiofrequency, peripheral neuropathic pain, radicular pain, postherpetic neuralgia, trigeminal neuralgia, occipital neuralgia, pudendal neuralgia, meralgia, carpal tunnel syndrome, review

Pain Physician 2018; 21:E225-E234

Pulsed radiofrequency stimulation (PRF) is increasingly being applied to alleviate several types of pain including neuralgia, joint pain, and muscle pain (1-5). This technique works by delivering an electrical field and heat bursts to targeted nerves or tissues via a catheter needle tip without damaging these structures (6-8). Conventional radiofrequency (CRF) thermocoagulation exposes target nerves or

tissues to continuous electrical stimulation and ablates the structures by increasing the temperature around the tip of the RF needle (9). In contrast to CRF, PRF applies a brief electrical stimulation, followed by a long resting phase; thus, PRF does not produce sufficient heat to cause structural damage (10). During the PRF procedure, the catheter needle tip is placed near the targeted nerves, and then advanced towards the nerves until patients report a tingling sensation and/or dysesthesia at a voltage less than 0.2 to 0.5 V. The tissue temperature is maintained at or below 42°C on average.

Although the mechanisms of PRF remain unclear, various researchers have been working toward revealing the underlying processes. In 2009, Erdine et al (11) evaluated ultra structural lesions in sensory nociceptive axons following exposure to PRF by using electron microscopy. They asserted that PRF produced selectively larger lesions in the smaller principal sensory nociceptors such as the C and Aδ fibers than in the larger nonpain related sensory fibers such as Aδ fibers. Hagiwara et al (12) showed that PRF activates the noradrenergic and serotonergic descending pain inhibitory pathways and inhibits excitatory nociceptive C-fibers. In 2013, Cho et al (13) found decreased microglial activity in the spinal dorsal horn after applying PRF to the dorsal root ganglion (DRG). Because microglia can cause chronic neuropathic pain by releasing various cytokines and chemokines that are related to pain signaling, the authors proposed that the downregulation of microglia may prevent the development of chronic neuropathic pain. In addition, Vallejo et al (14) found that pro-inflammatory cytokines, such as tumor necrosis factor-α and interleukin-6, were reduced after PRF was applied.

Here, the literature was reviewed to establish the effectiveness of PRF for various peripheral neuropathic pain conditions.

Methods

The MEDLINE database (PubMed) was searched for articles published from January 1, 1980 to August 31, 2017 by using the following key phrase: [PRF AND pain]. The following inclusion criteria were applied for the selection of articles: 1) patients' pain was caused by peripheral nervous system disorders; 2) PRF stimulation was applied on the peripheral nerve; and 3) after PRF stimulation, follow-up evaluation was performed to assess the reduction in pain intensity. Review articles were excluded.

Results

The primary literature search yielded a total of 468 potentially relevant papers. After reading the titles and abstracts of the articles and assessing them for eligibility based on the full-text articles, 63 publications were finally included in this review. Among the included studies, PRF was applied for radicular pain from cervical spinal diseases in 13 studies (1,15-26) and lumbar spinal diseases in 17 studies (2,15,19,20,27-38), respectively. PRF was applied for postherpetic neuralgia in 6 studies (39-44), trigeminal neuralgia in 14 studies (45-58), occipital neuralgia in 4 studies (59-62), pudendal neuralgia in 4 studies (63-66), meralgia in 4 studies (67-70), carpal tunnel syndrome in 2 studies (71,72), and other disorders in 2 studies (73,74).

Discussion

Radicular Pain from Spinal Disease

Cervical or lumbosacral radicular pain is defined as pain perceived as arising from the upper or lower extremities that is caused by irritation of the spinal nerve roots (75,76). Approximately 83 in every 100,000 people are known to suffer from cervical radicular pain (77), whereas lumbosacral radicular pain is more frequent, occurring in 10 to 25% of the general population (78). Mechanical compression of the nerve root and chemical inflammation produce radicular pain in patients with disc herniation and spinal stenosis, which are the two most common causes of radicular pain (79,80). To manage radicular pain, oral medications and epidural steroid injections, among other modalities, have been used (81,82). However, the pain in some patients persists despite these treatments. Additionally, steroid injections have some potential adverse effects, including major ones such as suppression of the pituitary-adrenal axis, hyperadrenocorticism, hyperglycemia, myopathy, and osteoporosis, as well as minor ones, such as flushing, sweating, and nausea (83,84). Therefore, as an alternative to epidural steroid injections, many clinicians are using PRF to alleviate the radicular pain caused by spinal disease.

Indeed, various studies have tried to demonstrate the efficacy of PRF as a treatment for spinal disease-related radicular pain. Regarding patients with cervical radicular pain, 13 studies were identified that evaluated the ability of PRF, when applied to the DRG, to reduce the upper extremity pain that is induced by a herniated disc or spinal stenosis (1,15-26). All of these previous studies demonstrated successful treatment outcomes after PRF.

Among the 13 studies that examined patients with cervical radicular pain, 4 were randomized controlled trials (RCTs) (18,19,22,24). The 2007 study by Van Zundert et al (22) showed that the PRF group achieved a better treatment outcome than did the sham group. In 2016, Lee et al (19) found that patients' cervical radicular pain was significantly alleviated at 2, 4, 8, and 12 weeks after PRF and that the effects of PRF were similar to those of transforaminal epidural steroid injection (TFESI). Interestingly, a 2017 study by Wang et al (24) reported that compared to PRF or TFESI alone, the combination of PRF and TFESI resulted in better treatment outcomes. In the same year, Halim et al (18) performed either PRF or percutaneous nucleoplasty in patients with cervical herniated discs and found that both groups had significantly reduced pain at 1 month after each procedure and that the effects were sustained for at least 3 months. However, no difference in the pain-reducing effects of the 2 treatments was observed. These RCTs show that PRF can successfully reduce cervical radicular pain and its effect is similar with other commonly used procedures.

The other 9 studies, which included 3 observational prospective studies (16,17,26), 5 retrospective studies (15,20,21,23,25), and one case study (1), also showed that PRF effectively reduced pain when applied to the DRG. Interestingly, in the 2017 case study by Chang (1), 2 patients underwent bipolar PRF treatment for chronic cervical radicular pain that was refractory to monopolar PRF and repeated TFESIs. The refractory pain in both patients was reduced from visual analog scale (VAS) scores of 6 and 7 before treatment to VAS scores of 2 at 6 months after bipolar PRF.

Additionally, so far, 16 studies have evaluated the effects of PRF to the DRG in patients with lumbosacral radicular pain induced by herniated discs or spinal stenosis (2,15,19,20,27-38). Among the 16 studies, 5 were RCTs (2,19,28,33,34), 3 were prospective observational studies (30,36,37), 7 were retrospective studies (15,20,27,29,32,35,38), and one was a case study (31). Although the degrees of pain relief were presented differently in each study, generally, lumbosacral radicular pain was successfully reduced after applying PRF to the DRG.

Of the RCTs, the 2008 study by Simopoulos et al (34) compared the effects of PRF with those of CRF. They reported that 70% of patients in the PRF group had pain reductions of > 20 to 30% after the procedure and that the effects lasted for ~3.2 months. On the other hand, after CRF, 82% of patients exhibited pain reductions of > 20 to 30%, and the average duration of the analgesic effect was 4.4 months. In 2014, Shanthanna et al (33) analyzed data from 31 patients with herniated lumbar discs, spinal stenosis, and post lumbar surgery syndrome and reported that 6 of the 16 patients in the PRF group and 3 of the 15 patients in the placebo group showed a 50% decrease in the VAS score after treatment. Moreover, in 2015, Koh et al (28) evaluated 61 patients with spinal stenosis and found that the number of patients who showed a 50% decrease in the VAS score was higher after combined treatment with PRF and TFESI than it was after TFESI alone at 2 and 3 months after each procedure. In 2016, Lee et al (19) found that patients' lumbosacral radicular pain was significantly reduced during the 3 month follow-up period after PRF and that the treatment outcomes of PRF were similar to those of TFESI. Finally, in 2017, Chang et al (2) found that bipolar PRF was more effective for managing lumbosacral radicular pain than was monopolar PRF. These RCTs present that PRF can effectively control lumbosacral radicular pain and combined therapy with TFESI or bipolar PRF is recommendable for enhancing treatment outcome after PRF.

Collectively, the outcomes of the reviewed studies revealed that PRF is a beneficial treatment option for patients with either cervical or lumbosacral radicular pain.

Postherpetic Neuralgia

Although the exact discriminative time point for postherpetic neuralgia has yet to be standardized, a patient is generally considered to have postherpetic neuralgia when the pain persists for 30 to 180 days after the eruption of the acute zoster rash (41). Postherpetic neuralgia affects 10 to 15% of patients with an acute herpes zoster infection, which can impair their quality of life owing to pain (43). So far, various procedures and medications have been applied, but no single best treatment for postherpetic neuralgia has been identified. Recently, PRF has emerged as a safe and potentially effective treatment for postherpetic neuralgia.

In clinical settings, PRF treatment has occasionally been applied to manage postherpetic neuralgia. Our literature search revealed that 6 previous studies attempted to obtain objective evidence of the clinical usefulness of PRF for controlling postherpetic neuralgia (39-44). For patients with postherpetic neuralgia, the DRG is considered an appropriate target for PRF stimulation because latent varicella zoster initiates reactivation in the DRG (41). In 2008, Kim et al (43)

prospectively applied PRF to the DRG in 49 patients with intractable postherpetic neuralgia. The mean pretreatment VAS score of the patients was 7.2, whereas at one month after PRF treatment, the VAS score had decreased to 3.4, indicating that the patients experienced great pain relief; additionally, the effects persisted for 3 months after PRF treatment. In 2015, an RCT of 128 patients by Pi et al (44) utilized ultrasound guidance to compare the effects of PRF stimulation on the area adjacent to the DRG to those of oral medication alone. The analyses demonstrated a significant reduction in the VAS scores in both groups at 2 weeks, 1 month, and 2 months after treatment, but the improvement rate was significantly higher in the PRF group. Moreover, between the PRF and oral medication only groups, the PRF group showed better sleep quality and lower morphine consumption. In 2017, 2 retrospective comparative studies (41,42) found that after applying PRF to the DRG, the pain intensity significantly decreased and that the effects were maintained during the subsequent 3 and 6 months, respectively. More specifically, the study by Kim et al (41) showed that applying PRF to the DRG reduced the pain more than did a continuous epidural infusion of 0.187% ropivacaine. The other retrospective comparative study found that the effects of PRF on the DRG were greater in patients with acute herpes zoster than they were in patients with postherpetic neuralgia after the acute phase (42). Conclusively, these previous studies indicate that PRF on the DRG is an effective treatment option for postherpetic neuralgia and its effect is superior to oral medication or epidural infusion of anesthetics.

However, in patients with thoracic postherpetic neuralgia, DRG targeting has potential complications, as it may damage the artery of Adamkiewicz or cause pneumothorax; thus, some authors performed PRF stimulation on the intercostal nerve at the angulus costae. For example, a 2003 RCT by Ke et al (40) compared the effects of PRF on the intercostal nerve at the angulus costae to those of a sham procedure. Reductions in pain severity and improvements in physical and mental function were observed in the PRF group, but not in the sham group. In the same year, Akkaya et al (39) conducted PRF on the intercostal nerve under the guidance of ultrasound in a patient with postherpetic neuralgia and observed that the VAS score decreased from 7 before treatment to 1 after treatment; furthermore, the pain reduction was maintained throughout the 6 month follow-up period. Thus, for the prevention of potential complications after PRF on the DRG, PRF on the intercostal nerve under the guidance of ultrasound might be an effective and safe alternative technique for alleviating thoracic postherpetic neuralgia.

Trigeminal Neuralgia

Trigeminal neuralgia is defined as sudden, usually unilateral, severe, and brief, but recurrent, stabbing pain along one or more branches of the trigeminal nerve (54). It usually lasts from several seconds to minutes and severely limits an individual's quality of life.

One of the most effective procedures for managing trigeminal neuralgia is CRF, thus it has been widely applied in patients with this condition (46,56). However, this procedure is neurodestructive and may induce several adverse effects, including sensory loss, dysesthesia, anesthesia dolorosa, and corneal anesthesia (46). As an alternative, clinicians have proposed that PRF treatment of the Gasserian ganglion be used to control trigeminal neuralgia, since it has fewer adverse effects. Although the 3 case studies identified during our search reported that PRF effectively reduced pain in patients with trigeminal neuralgia (53,54,56), the reviewed RCTs, and retrospective and prospective observational studies, concluded that PRF was not effective for managing trigeminal neuralgia (46,48-50,58). For example, in 2007, Erdine et al (46) compared the effects of PRF to those of CRF in 40 patients with trigeminal neuralgia. Whereas 19 of the 20 patients in the CRF group had significant reductions in pain, only 2 of the 20 patients in the PRF group demonstrated pain reductions at 3 months after the PRF procedure. Likewise, a 2013 study by Kim et al (49) retrospectively evaluated the effects of PRF in 26 patients with trigeminal neuralgia and found that their pain was not significantly reduced after treatment. In 2014, Fang et al (48) performed a prospective observational study with 20 patients with trigeminal neuralgia and revealed that 13 of the patients (65%) showed poor treatment outcomes at 2 weeks after PRF. After switching to CRF, the pain of the 13 patients who were unresponsive to PRF was significantly reduced. Overall, based on the outcomes of these previous studies, it can be concluded that PRF is not as effective as CRF for patients with trigeminal neuralgia.

Among the studies identified in our search, 3 of the RCT studies evaluated the combined treatment of PRF and CRF. The study by Yao et al (57) found less recurrence of trigeminal neuralgia after CRF combined with PRF when compared with CRF alone. However, in the other 2 studies (50,58), the effectiveness of the combination treatment was not superior to that of

CRF treatment alone. It should be noted though that both Yao et al (57) and Zhao et al (58) found that the combination of CRF and PRF reduced the occurrence of complications.

In addition, 3 of the reviewed studies showed that the high-voltage and extended duration of PRF tend to improve treatment outcome and reduce pain in patients with trigeminal neuralgia (47,52,55). Based on the results of these studies, we think that the voltage and duration might be the important parameters affecting the treatment outcome of PRF, thus efforts for finding the most appropriate parameters of PRF stimulation are needed in the future.

Occipital Neuralgia

Occipital neuralgia is characterized by paroxysmal, nonthrobbing, shooting, or stabbing neuropathic pain in the dermatomes of the greater occipital nerve (GON) and/or lesser occipital nerve (LON) (85). Pressure over the GON or LON can elicit the pain. Moreover, dysesthesia or hypoesthesia may accompany the pain in the affected area.

To date, 4 studies have evaluated the pain-reducing effects of PRF on the occipital nerve (59-62). Overall, these studies showed that the treatment outcomes of PRF on the GON were favorable. In a case report published by Navani et al (61) in 2006, PRF was applied to the GON for 4 minutes in a patient with occipital neuralgia that was unresponsive to medication, transcutaneous electrical nerve stimulation, and GON blockade with a local anesthetic and steroid. The authors found that after the procedure the patient's 70% pain reduction was sustained for 4 months. Afterwards, the PRF procedure was repeated, which resulted in an additional 5 months of 70% pain relief. The 2010 study by Vanelderen et al (62) prospectively recruited 19 patients with occipital neuralgia who then underwent PRF on the GON and/or LON. The patients' mean VAS score, which was 7.5 before treatment, was significantly reduced to 3.5 at 1 and 2 months post-treatment and 3.9 at 6 months post-treatment. In 2012, Huang et al (60) retrospectively recruited 102 patients who received PRF on the GON and/or LON as treatment for their occipital neuralgia. Fifty-two patients (51%) reported > 50% pain reduction and its effects were sustained for at least 3 months. The most recent study was an RCT published in 2015 by Cohen et al (59) comparing the effects of PRF on occipital neuralgia with those of GON blockade with steroids in 81 patients with occipital neuralgia or migraine with occipital neuralgia. The 42 patients who received PRF showed greater pain reductions than did the 39 patients who received the steroid injections, and the effects of PRF persisted for at least 6 months. The favorable outcomes of the previous PRF studies suggest that PRF can be an effective treatment option for controlling occipital neuralgia.

Pudendal Neuralgia

Pudendal neuralgia is characterized by severe sharp pain along the area innervated by the pudendal nerve, which is aggravated by sitting and relieved by standing (86). Frequently, its occurrence is associated with the entrapment or irritation of the pudendal nerve at several points along its course between the sacrotuberous and sacrospinalis ligaments (87). For the management of pudendal neuralgia, oral medication or pudendal nerve block is commonly used (65). However, if these treatments cannot successfully control pain related to pudendal neuralgia, clinicians have limited options to manage the pain conservatively. In the clinical setting, it was proposed that PRF stimulation can be used to control pudendal neuralgia.

Our literature search revealed 3 case reports and one prospective observational study showing that the application of PRF to the pudendal nerve effectively reduced the pain associated with pudendal neuralgia (63-66). In 2014, Masala et al (64) prospectively enrolled 30 patients with pudendal neuralgia that was refractory to other conservative treatments. After the computed tomography-guided PRF treatment, the pain of the 26 patients who completed the study, as measured with the VAS, was greatly reduced. Compared to before PRF treatment, patients had 83% and 79% pain relief at 6 months and 1 year after the procedure, respectively. Similarly, in 2016, Hong et al (63) conducted ultrasound-guided PRF in 2 patients with pudendal neuralgia and found that their pre-treatment VAS scores of 8 had decreased to 2 and 3 at 3 weeks after treatment and that the reductions were sustained for at least 10 and 6 months, respectively. Furthermore, Ozkan et al (65) and Petrov-Kondratov et al (66) reported the successful application of PRF in one patient with pudendal neuralgia each under the guidance of ultrasound and fluoroscopy, respectively. Although these previous reports support the utility and efficacy of PRF for pudendal neuralgia, 3 of the 4 above mentioned publications were case reports. Therefore, additional prospective clinical studies should be conducted to clarify the clinical effects of PRF in patients with pudendal neuralgia.

Meralgia Paresthetica

Meralgia paresthetica is a condition characterized by tingling, numbness, and burning pain in the lateral thigh. It is a sensory mononeuropathy of the lateral femoral cutaneous nerve, which is frequently caused by focal entrapment of this nerve as it passes through the inguinal ligament (88). Its incidence is known to be approximately 4.3 per 10,000 persons (89). Although most patients with meralgia paresthetica achieve successful pain relief after conservative treatment modalities, such as weight loss, oral medications, and nerve blocks with local anesthetics and/or steroids (90), the pain may persist in some patients. In such cases, some clinicians have tried to manage refractory pain using the PRF procedure.

Our search identified one retrospective study and 3 case studies reporting positive pain-reducing effects of PRF on the lateral femoral cutaneous nerve (67-70). The 2016 retrospective study by Lee et al (69) reviewed the charts of 11 patients with medically intractable meralgia paresthetica. At the 1, 3, and 6 month follow-up evaluations after PRF, the included patients' average pain severity was reduced by more than 80% compared to the pain severity before treatment. In addition, at 6 months after the procedure, all of the recruited patients showed > 50% pain reduction and the pain in 7 patients was completely alleviated. Regarding the 3 case studies, all of the patients whose pain were refractory to other conservative treatments were free of pain at the follow-up evaluations (67,68,70). Despite the excellent outcomes of patients who received PRF on the lateral femoral cutaneous nerve in the previous studies, further research on the effects of PRF in patients with meralgia paresthetica should be performed. To our knowledge, no prospective studies using this technique have been conducted in this patient group.

Carpal Tunnel Syndrome

Carpal tunnel syndrome is a condition that occurs owing to compression of the median nerve in the carpal tunnel (71). It is the most common peripheral nerve entrapment neuropathy, with an incidence of 7% in women and 1% in men (91). The symptoms of carpal tunnel syndrome include pain, numbness, and tingling in the thumb, index finger, middle finger, and the thumb side of the ring finger (92). To manage the pain related to carpal tunnel syndrome, night splints and oral medications are initially applied. If these treatments fail to control the pain, steroid injections can be used before the patient ultimately undergoes an operation (93). However, the use of steroid injections is limited owing to the potential adverse effects (83,84). Thus, other treatment options are needed.

One such option that can be tried before surgery is PRF. A 2015 RCT by Chen et al (71) compared the effects of ultrasound-guided PRF plus night splints, with those of night splints alone in patients with carpal tunnel syndrome (n = 18 patients per group). The combined therapy of PRF and night splints resulted in better pain reduction and a stronger finger pinch compared to treatment with night splints alone. The authors also noted that the patients' mean VAS score had decreased from 5.4 before treatment to 1.1 at 3 months after PRF. In 2007, Haider et al (72) utilized PRF treatment in a patient with carpal tunnel syndrome that recurred despite the fact that the patient had undergone 2 surgical treatments 6 and 10 years prior. Owing to post-surgical scarring at the wrist, the authors performed PRF treatment on the median nerve at the elbow level. During the 3 month follow-up period, a 70% reduction in pain was reported.

Despite the favorable treatment outcomes in the previous studies, for clarifying the usefulness of PRF in carpal tunnel syndrome, additional prospective clinical trials are encouraged with larger subject population and sham-controlled treatment.

Other Disorders

In addition to the above disorders and conditions, PRF has been used to treat tarsal tunnel syndrome and Morton's neuroma (73,74). Tarsal tunnel syndrome is induced by the entrapment of the posterior tibial nerve under the tarsal tunnel behind the medial malleolus (94,95). Patients with tarsal tunnel syndrome have numbness, paresthesia, and burning pain on the sole of the foot. Although surgical outcomes for tarsal tunnel syndrome are known to be good (95), conservative treatments, such as posterior tibial nerve block and PRF stimulation, can be tried prior to the surgical treatment. In 2014, Chon et al (73) conducted ultrasound-guided PRF on the posterior tibial nerve behind the medial malleolus in 2 patients with tarsal tunnel syndrome. After PRF, the VAS scores of both patients decreased from 8/9 to 2/3 at the 12 and 8 month follow-up evaluations, respectively.

Morton's neuroma is a benign neuroma of an intermetatarsal plantar nerve and commonly involves digital nerves of the second and third intermetatarsal spaces (96). Patients with this condition experience numbness, paresthesia, and burning pain down the interspaces of

the involved toes. Our literature search identified a 2015 study by Deniz et al (74), in which PRF was prospectively performed on 20 patients with Morton's neuroma under the guidance of ultrasound. The included patients' pain caused by Morton's neuroma was not relieved by conservative treatments such as changing shoes, altering the shoe soles, adding metatarsal pads, oral medication, or injections with a local anesthetic and/or steroid. Twelve of the patients (60%) had > 50% pain relief at the 6 month follow-up evaluation after PRF.

Although the aforementioned studies imply that PRF is beneficial for these conditions, more-definitive evidence on the effects of PRF on tarsal tunnel syndrome and Morton's neuroma is needed.

Conclusion

This review shows that PRF can be a beneficial treatment option without serious complications for some peripheral neuropathic pain disorders. In the 63 studies reviewed, no devastating complications were reported. For radicular pain from spinal diseases, there is compelling evidence supporting that PRF is an effective treatment option. Likewise, PRF for postherpetic neuralgia and occipital neuralgia appears to be a valid therapeutic strategy. However, for wider application of PRF for these disorders, a larger number of well-designed RCTs supporting the positive effects of PRF on pain reduction are needed. PRF does not seem to be appropriate for managing trigeminal neuralgia; it was found to be less effective than CRF. Moreover, regarding pudendal neuralgia, meralgia paresthetica, carpal tunnel syndrome, tarsal tunnel syndrome, and Morton's neuroma, evidence on the efficacy of PRF in these peripheral nerve disorders is lacking. To clarify the utility of PRF in these disorders, further well-conducted studies will be necessary in the future. This narrative review will help guide pain physicians in making informed decisions for their patients about whether PRF treatment is a suitable option for managing the peripheral neuropathic pain that is associated with various conditions.

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