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Successful Management of Chronic Postsurgical Pain Following Total Knee Replacement

Lakshmi Vas, MD, Nishigandha Khandagale, MD, and Renuka Pai, Diplomate in Anaesthesia

Interventional Pain Management, Ashirvad Institute for Pain Management and Research, Mumbai, Maharashtra, India

Reprint requests to: Lakshmi Vas, MD, Ashirvad Institute for Pain Management and Research, Plot. No. 117, Shubh Ashirvad, Road No. 5 Hindu Colony, Dadar East, Mumbai, Maharashtra 400 014, India. Tel: 91-(22)-24121070; Fax: 91-22-24121071; E-mail: lakshmi@paincareindia.com; pairenuka@yahoo.co.in; drkhandagale@gmail.com.

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Abstract

We report reversal of chronic postsurgical pain (CPSP) along with functional restoration after total knee replacement (TKR) in two patients, using a combination therapy that included ultrasonography-guided pulsed radiofrequency (PRF) of nerves supplying the knee to provide pain relief, along with dry needling (DN) to relax myofascial triggers/bands that caused painful stiffness and restricted movement of muscles acting across the knee. Both patients showed demonstrable pain relief, as evidenced by changes in pain as assessed on the Numeric Rating Scale (patient 1: 4–9/10 [pre-treatment] to 0–3/10 [6 months post-treatment]; patient 2: 5–9/10 to 0–4/10), Oxford Knee Score (patient 1: 17 to 40; patient 2: 12 to 39), Self-Administered Leeds Assessment of Neuropathic Symptoms and Signs score (patient 1: 16 to 0; patient 2: 18 to 0), and Patient Health Questionnaire-9 score (patient 1: 17 to 2; patient 2: 20 to 2). The selection of the PRF-and-DN combination for treating post-TKR CPSP was based on a new idea that CPSP is a neuromyopathic phenomenon involving both sensory and motor neuropathy. It has evolved from our experience of 8 years. Physiotherapy worked synergistically with DN, optimizing muscle performance and pain relief.

Key Words. Neuropathic Pain; Neuromyopathy; Chronic Postsurgical Pain; Pulsed Radiofrequency; Dry Needling; Myofascial Triggers

Introduction

Chronic postsurgical pain (CPSP) occurring after total knee replacement (TKR) is attributed to neuropathy when surgery-related causes are ruled out. Our 8-year experience with post-TKR CPSP has led to the development of a combination of therapies based on the idea that CPSP is a neuromyopathic phenomenon rather than being purely neuropathic. We report the details of our treatment using two meticulously documented case studies to demonstrate the efficacy of our approach in relieving pain as well as disability in this difficult condition.

Methods

The second author documented patients' history and examination findings and their scores on various outcome measures such as the Numeric Rating Scale (NRS) [1], the Self-Administered Leeds Assessment of Neuropathic Symptoms and Signs scale (S-LANSS) [2], the Oxford Knee Score (OKS) [3], and the Patient Health Questionnaire-9 (PHQ-9) [4]. The NRS was used to document pain at rest, on standing, during walking, and during stair climbing on a scale of 0–10 (0 being "no pain" and 10 being the "worst experienced pain"). S-LANSS values > 12 (from a range of 0–24) were predictive of neuropathic pain. The OKS, a 12-item self-administered joint-specific questionnaire, was used to grade knee osteoarthritis with scores from 0 to 48, with 0 being the worst and 48 being the best outcome for pain and

function. The PHQ-9 was used to assess the intensity of depressive symptoms on a scale of 0 to 27, with 0 indicating a lack of depressive symptoms and values between 20 and 27 indicating severe depressive symptoms.

Both patients were treated with a combination of 1) ultrasonography-guided pulsed radiofrequency (PRF), 2) dry needling (DN), 3) physiotherapy, and 4) medication.

Ultrasonography-guided PRF of the nerve supply of the knee was performed based on the findings of a cadaveric dissection study undertaken to develop an anatomical basis for nerve blocks in post-TKR CPSP [5,6]. All procedures were performed in an operation theater. PRF was applied to the saphenous, tibial, and common peroneal nerves and the peripatellar, subsartorial, and popliteal plexuses (Figure 1). A linear 6–13-MHz transducer (SonoSite MSK; SonoSite, Bothell, WA, USA) was used to guide the placement of a 10-cm 22-gauge radiofrequency (RF) cannula with a 10-mm active tip, connected to an RF generator (Cosman G4; Cosman Medical, Inc., Burlington, MA, USA). Sensory (0.6 V at 50 Hz) and motor (2.0 V at 2 Hz) stimulation confirmed the nerve location. Two milliliters of 2% lidocaine was injected before PRF application for 8 minutes at 40°C.

DN was initiated 1 month after the PRF treatment. Under ultrasonographic guidance, 40–100-mm-long 32-gauge needles were introduced to a depth of 2–3 mm in the muscles acting across the knee (quadriceps, hamstrings, adductors, sartorius, gracilis, gastrocnemius, and popliteus). Individual needles were then advanced deep into the muscle in 2–3 mm increments over 2–3 minutes, left in situ for 30 minutes, and then removed. DN was scheduled twice weekly in the first month and weekly in the second month, then tapered off gradually over next 2 months.

Physiotherapy included stretches initially and, later, strength building with antigravity exercises and weight training. Transcutaneous electrical nerve stimulation, interferential current therapy, and taping around the patella were also utilized.

Medications included paracetamol (500 mg), chlorzoxazone (250 mg), and pregabalin (50 mg) twice daily throughout the treatment.

Both patients had received similar medications and physiotherapy prior to our treatment. Pre- and post-PRF outcome measures were documented immediately after PRF and again at 0.5, 1, 3, and 6 months.

Case 1

A woman of 74 years presented with CPSP 4 months following TKR. She had rest and nocturnal pain (4/10 NRS)

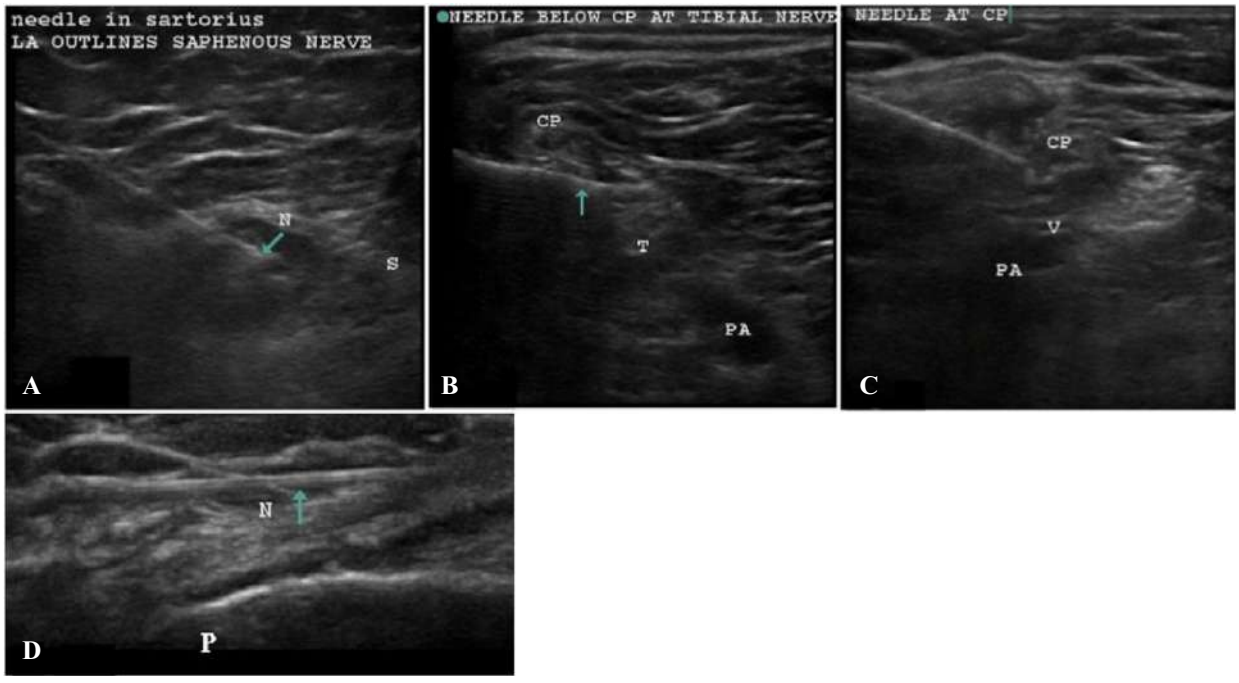

Figure 1 (A) Ultrasonography-guided saphenous-nerve pulsed radiofrequency (PRF) at lower end of thigh. (B) Ultrasonography-guided tibial nerve PRF. Arrow showing needle at tibial nerve. CP, common peroneal nerve; T, tibial nerve, PA, popliteal artery. (C) Ultrasonography-guided common peroneal nerve PRF. Needle at common peroneal nerve (CP). V, popliteal vein; PA, popliteal artery. (D) Ultrasonography-guided peripatellar PRF. Needle (N) above patella (P).

in the lateral aspect of the left knee, which increased (7/10 NRS) on walking up to 20 minutes, and further (9/10 NRS) on stair climbing. Physiotherapy, daily pregabalin (75 mg) administration for a month, oral steroids (prednisolone [Wysolone]; Prednisolone, Wyeth Lederle, India), and two injections of methylprednisolone acetate (Depo-Medrol; Pharmacia India Ltd., Gurgaon, Haryana, India) by her surgeon had failed to relieve the pain. A second opinion had ruled out a surgical cause for pain. Examination found the left knee to be swollen, red, and 2°C warmer than the unoperated knee. Flexion became painful at 50°C. OKS was 17, indicating severe osteoarthritis; S-LANSS score was 16, indicating neuropathy; and PHQ-9 score was 17, indicating moderately severe depressive symptoms.

Case 2

A man of 74 years presented with post-TKR CPSP 12 months after surgery. He had continuous sharp pain (5/10 NRS) in the right knee that was aggravated (9/10 NRS) on any movement, along with shocklike sensations on coughing. He was unable to stand, walk, or sleep 6 months after surgery despite biweekly physiotherapy. A spontaneous osteoporotic fracture of the T12 vertebra (treated conservatively) and hypostatic pneumonia, along with a residual cough, worsened his condition further. A history of peptic ulcers precluded administration of non-steroidal anti-inflammatory drugs, and paracetamol had failed to relieve his pain. A surgical cause for the pain had been ruled out. On examination, he found it difficult to walk even a few steps with a walker. The entire right extremity was swollen and dark compared with the left. Knee flexion to 80° was painful. His OKS was 12, indicating severe osteoarthritis; S-LANSS score was 18, indicating neuropathy; and PHQ-9 score was 20, indicating severe depressive symptoms.

Results

Both patients reported 50–60% pain relief immediately after PRF and volunteered that stiffness was reduced on standing and walking, with a feeling of lightness. However, both had intermittent inflammatory symptoms in the form of swelling, warmth, and redness that subsided 1 month after DN. Subsequent assessments are shown in Figure 2. At 6 months, both patients expressed satisfaction with the treatment and a willingness to undergo a repeat application of PRF and DN if necessary.

Discussion

Patient satisfaction, functionality, and quality of life after TKR do not appear to correlate well to a perfectly positioned prosthesis in about 19–43% of patients who develop CPSP [7]. Macrae criteria for CPSP [8] include pain persisting for more than 2 months after surgery after excluding other possible causes for pain and preexisting pains. The predictors of CPSP include TKR at a younger age, female gender, surgical factors, nerve injury during surgery, psychosocial factors, and individual or patient-related factors. The paucity of evidence-based data

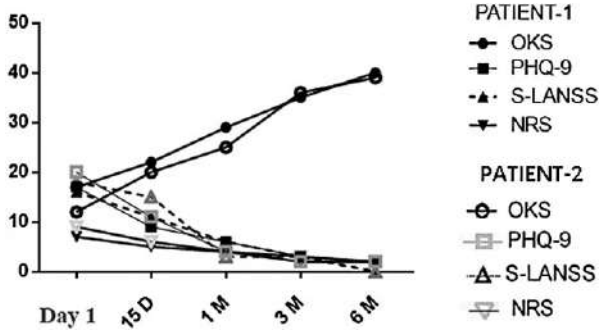

Figure 2 Outcome measures of both patients. D, days; M, months; OKS, Oxford Knee Score; PHQ-9, Patient Health Questionnaire-9; S-LANSS, Self-Administered Leeds Assessment of Neuropathic Symptoms and Signs; NRS, Numeric Rating Scale.

makes the management of post-TKR CPSP particularly challenging.

Pain is a feature of CPSP anywhere in the body, but post-TKR CPSP is characterized by muscle stiffness that detracts from the efficacy of TKR. Joint mobility confirmed by the surgeon on the operating table and experienced by patients as free ambulation in the early postoperative period is lost with the onset of CPSP. We propose that the stiffness associated with post-TKR CPSP is because of motor nerve involvement manifesting as a neuromyopathy rather than just a neuropathy. We have developed a treatment algorithm that addresses the neuropathy with PRF and addresses the myopathy that causes muscle stiffness that restricts joint movements with DN (Figure 3). In both the patients, PRF relieved CPSP pain but presumably had little effect on the preexisting myofascial triggers generated in accordance to Hilton's law, which states that "all of the motor efferent nerves serving muscles that act on the joint carry afferent branches from the capsular elements" [9]. We utilized DN primarily to address this essential but hitherto neglected aspect of CPSP of TKR.

PRF has been reported to produce transient endoneural edema, but not neuritis-like reactions, motor deficits, or Wallerian degeneration with the risk of deafferentation pains, which are associated with CRF performed at 80°C [10,11]. PRF delivers RF current in 20-millisecond high-voltage bursts with a "silent" phase (480 milliseconds), which allows time for heat elimination, maintaining the target tissue temperature below 42°C. The rapidly changing electrical field has been surmised to alter the transmission of pain signals through a pathway involving *c-Fos*, an immediate early gene. PRF of the entire nerve supply of the knee presumably relieved pain from all tissues around the knee to provide sustained reduction of peripheral sensitization and its consequent central sensitization [12,13]. The reduction of pain, as evidenced by the NRS at rest and S-LANSS scores documented at 15 and 30 days, encouraged both the patients to

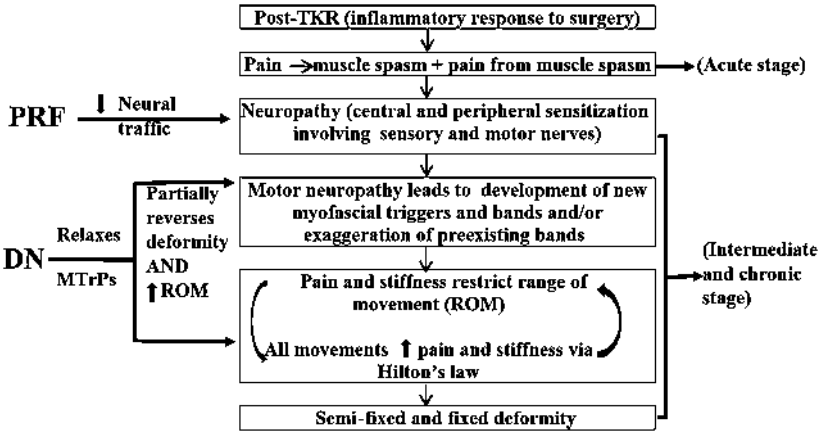

Figure 3 Treatment algorithm based on our proposed pathophysiology for post-TKR CPSP. TKR, total knee replacement; CPSP, chronic postsurgical pain, PRF, pulsed radiofrequency; DN, dry needling; MTrPs, myofascial trigger points; ROM, range of movement.

attempt activities hitherto impossible. The post-PRF pain relief allowed the first patient to care for her husband, a cancer patient. However, redness, warmth, and pain in the lateral aspect of the knee kept recurring in the first month. Ultrasonography revealed an effusion of sterile transudate beneath the lower end of the vastus lateralis (VL) (Figure 4). We surmised that myofascial triggers/bands (MTrPs) had shortened the VL, causing friction with the underlying tissues that manifested as an inflammatory response. The role of MTrPs in myofascial conditions has been documented by several authors [14–16]. We reasoned that DN, a technique with a documented efficacy in releasing MTrPs [17–19], could relax the VL and reduce friction, thereby relieving the inflammation. Reduction of warmth, redness, and pain immediately after DN confirmed that the cause of recurrent pain and stiffness was indeed myofascial. Subsequent biweekly DN along with myofascial release of VL and patellar kinesiotaping reversed the inflammatory manifestations within 4 weeks, allowing patient 1 to resume her activities as a cancer caregiver. Our second patient had suffered consequences of CPSP and was bedridden with hypostatic pneumonia and osteoporotic fracture. Relief of CPSP allowed up to 20 minutes' walking and improvement of his chest congestion. Five months after recovery from CPSP, pain in his unoperated left knee was the main factor limiting his activities.

The additive effects of PRF, DN, and physiotherapy provided a window of opportunity for strengthening and endurance training of the quadriceps and hamstring muscles, whose weakness typically persists up to 1 year after surgery [20]. The recurrent triggering of stiffness and pain by activity could be resolved with DN to achieve a gradual, pain-free improvement in the performance of the prosthesis with 30–35° increase in knee flexion in both patients. The PHQ-9 score highlighted the psychological impact of long-term pain on the quality of life hitherto missed by the brief knee issue-centric consultations. Sustained pain relief and improved joint functionality led to a resumption of personal, professional, and social responsibilities essential for self-esteem.

Conclusion

We present a new proposal that post-TKR CPSP is a neuromyopathy involving both motor and sensory nerves. The limitations of this study were that it included only two patients and was not a controlled study to assess the

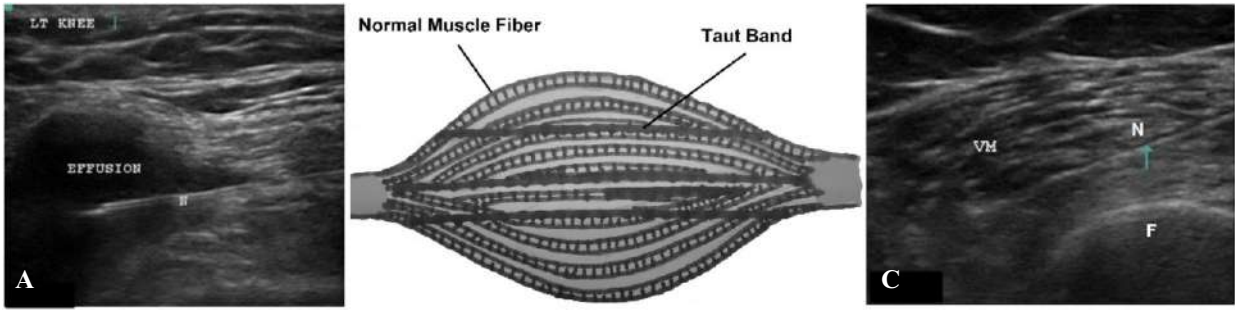

Figure 4 Case 1. (A) Effusion seen deep to vastus lateralis. N, needle inside the effusion. (B) Schematic representation of chronic muscle spasm leading to muscle shortening due to shortening of the taut bands. (C) Ultrasonography-guided dry needling of vastus medialis (VM). Arrow shows needle (N). F, femur.

relative benefits of each of the four different treatment modalities. However, the above proposal and the efficacy of an integrated approach utilizing PRF, DN, and physiotherapy merit further examination.

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