Technical Note

Novel Single Puncture Approach for Simplicity 3 Sacral Plexus Radiofrequency Ablation: Technical Note

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Radiofrequency (RF) ablation of the lateral sacral plexus has been used for the treatment of sacroiliac joint pain including as an adjunct to other palliative therapies for the treatment of painful osseous metastasis. The treatment goal is targeted ablation of the dorsal lateral branches of S1-S4. Though several techniques have been described, the Simplicity III (Neurotherm, Middleton, MA) system allows for ablation to be achieved with a single RF probe by utilizing a multi-electrode curved RF probe to create a continuous ablation line across all sacral nerves.

In the standard approach, there is sequential introduction of a spinal needle along the desired ablation tract for local anesthesia followed by separate placement of the ablation probe. Though fluoroscopic guidance is utilized, multiple needle passes increase the risk of complication such as bowel perforation or probe insertion through a neural foramen. It may also extend procedure time and increase radiation dose.

We illustrate a technique for Simplicity III RF ablation of the dorsal sacral plexus using a modified Seldinger approach for treatment of a patient with sacroiliac joint pain due to osseous renal cell carcinoma metastasis. The desired ablation tract is initially anesthetized via a hollow micropuncture needle. The needle is then exchanged for a peelaway sheath. The RF probe is inserted through the peelaway sheath thus ensuring the probe is placed precisely along the previously anesthetized tract allowing the procedure to be completed using a single percutaneous puncture.

We believe that this approach decreases the risks of bowel perforation, patient discomfort as a result of multiple percutaneous punctures, and procedure time.

Key words: Simplicity 3, sacral plexus ablation, image-guided approach, modified Seldinger, chronic sacral pain, thin wall introducer needle

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Radiofrequency (RF) ablation of the lateral sacral plexus for denervation of the sensory innervations to the sacroiliac joint is a therapeutic intervention for sacroiliac joint pain. Though frequently used to treat sacroiliac joint pain related to fracture, joint sprain, spondyloarthropathy, or crystal arthropathy (1,2), it has also been used as an adjunct to other palliative therapies for treatment of painful osseous metastasis (3).

RF ablation utilizes an ablation probe or probes placed near the dorsal sacral foramina targeting the dorsal lateral branches of S1-S4. Several techniques have been described to achieve this ablation with varying degrees of success (2,4-7). Previous techniques in-

clude both traditional and cooled RF ablation, both of which utilize multiple needles placed per side under fluoroscopy to lesion the sacral lateral branches, as well as the L4 and L5 dorsal rami. The Simplicity III (Neurotherm, Middleton, MA) (8) is a multi-electrode curved RF probe which allows for creation of a continuous ablation line across all sacral nerves using a single RF probe. Traditionally, the procedure is performed by initially anesthetizing the aimed track of the Simplicity III probe with a spinal needle and 1% buffered lidocaine. The spinal needle is withdrawn and the Simplicity III probe is then inserted and advanced along the desired tract under fluoroscopic guidance (9). The Simplicity III probe has 3 active areas along its electrode that can generate 2 bipolar lesions and 3 monopolar lesions that overall create a 9 x 52.5 mm lesion (Fig. 1). This standard technique has 2 significant drawbacks. First, since the anesthetizing spinal needle and the probe are introduced separately and sequentially, there is risk with each of the 2 placements of passing through a sacral foramen and perforating the bowel. Second, since the anesthetizing needle and the probe are placed separately there is a risk that the probe will not be placed precisely along the anesthetized tract that the needle followed.

We describe performance of Simplicity III RF ablation of the dorsal sacral plexus using a modified Seldinger approach. A hollow micropuncture needle is utilized to anesthetize the desired probe tract followed by exchange of the needle for a peelaway sheath over a wire. The RF probe is then inserted into the peelaway sheath allowing for a single puncture approach and safe and accurate placement of the probe along the desired, previously anesthetized tract. Our approach allows for placement of the RF probe along the anesthetized tract via a single puncture site.

Case Illustration

A 51-year-old man with metastatic renal cell carcinoma to the sacrum initially presented with sciatica type pain radiating down the right gluteal region and right leg in December 2012. Pelvis magnetic resonance imaging (MRI) demonstrated a T1 hypointense enhancing tumor in the bilateral sacrum extending to the S3 level (Fig. 2).

He underwent radiation therapy for sacral metastasis after which he reported worsening buttock and lower extremity pain. He continued to need analgesic therapy and had worsening pain symptoms in the sev-

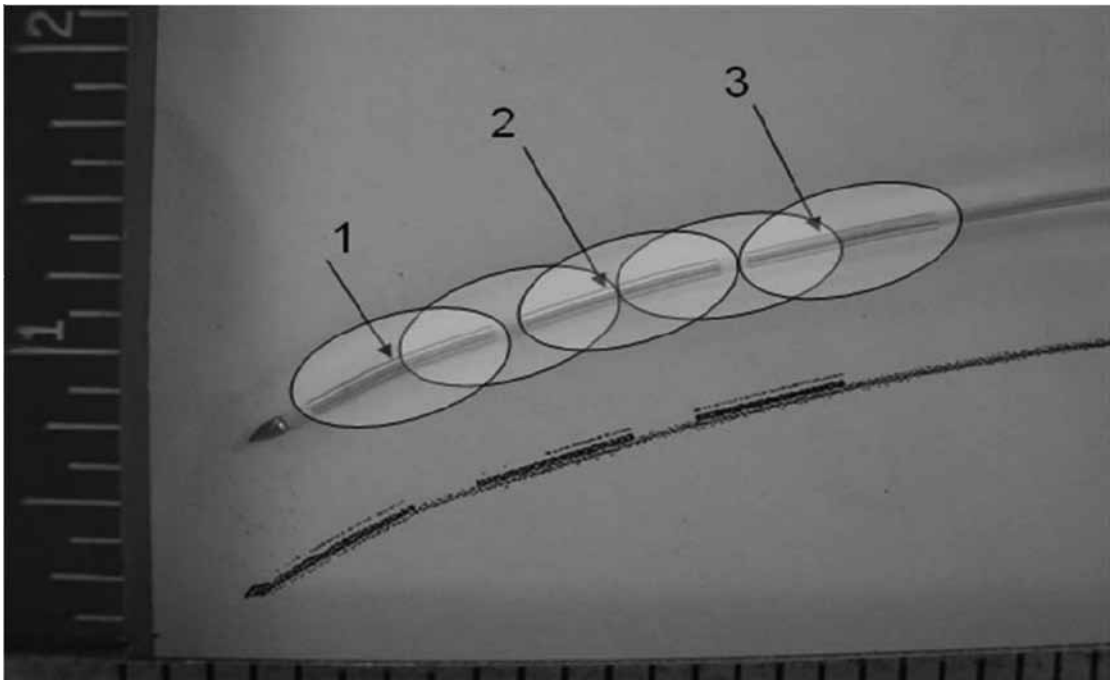

Fig. 1. Simplicity III electrode using NT1100 NeuroTherm® generator's unique algorithm to create 5 lesions along its length. Figure taken directly from Simplicity III Manual (8).

Fig. 2. *Contrast enhanced axial T1 weighted MRI of the sacrum shows a minimally enhancing T1 hypointense infiltrative lesion in the sacrum with extension to the right sacral iliac joint.*

Fig. 3. *The projected trajectory was mapped using the ZeegoDyna CT and the desired skin entry site confirmed with a Kelly clamp.*

eral months prior to our treatment. He had associated diagnoses of hypertension and diabetes.

A right-sided anesthetic block of the L5, S1, and S2 right side dorsal ramus provided greater than 50% pain reduction. With these encouraging results, we elected to perform a right dorsal sacral plexus RF ablation for treatment of his sacroiliac joint pain prior to any more invasive therapies such as sacroplasty. The patient underwent the procedure as stated in the technical note. The pain persisted and he underwent a sacroplasty 3 months later for his sacral insufficiency fracture with resolution of his pain.

Technical Note

A right S1-S4 lateral nerve branch RF denervation procedure was performed utilizing the Simplicity III multi-electrode RF probe introduced through a peelaway sheath. Briefly, after administration of moderate sedation, the patient was placed in the prone position on the fluoroscopy unit and the right buttock prepped to include the gluteal fold and upper posterior thigh in the procedure field.

Using the Siemens Zeego fluoroscopy unit (Siemens AG, Erlangen, Germany), a DYNA CT acquisition was performed. The target site and trajectory were identified and used to activate the automap feature (Fig. 3).

Under fluoroscopic guidance, a 21G 15 cm thin wall introducer (B. Braun Interventional Systems Inc., Bethlehem, PA) micropuncture needle was introduced and local anesthesia infiltrated along the desired tract for Simplicity III RF probe placement (on the dorsal aspect of the sacrum medial to the sacroiliac joint and lateral to the sacral foramina; Fig. 4). With the needle in place, a 0.018 inch V-18 control wire (Boston Scientific Corp, Natick, MA) was introduced. With the wire in place, the needle was exchanged for a 0.018 inch platform 6 Fr peelaway introducer sheath (Cook Medical Inc., Bloomington, IN); prior to sheath placement a 6 Fr dilator was used to spread open the soft tissues along the tract. Once the peelaway sheath was positioned correctly, the wire and sheath dilator were removed leaving just the peelaway component within the soft tissue tract (Fig. 5). Through the peelaway, the Simplicity III RF probe was introduced and advanced into position for treatment. With the Simplicity III RF probe in place, the sheath was removed ("peeled off") leaving just the Simplicity III RF probe in the soft tissue tract (Fig. 6). The probe was connected to the apparatus in a standard manner. Per standard protocol, lesioning was then carried out by using the Simplicity III pre-programmed steps which are 85°C for 1.5 minutes at each of 5 steps (8), with impedance in the range of 100 to 300 ohms. Upon completion, the probe was removed and hemostasis secured with compression and the site dressed in standard manner.

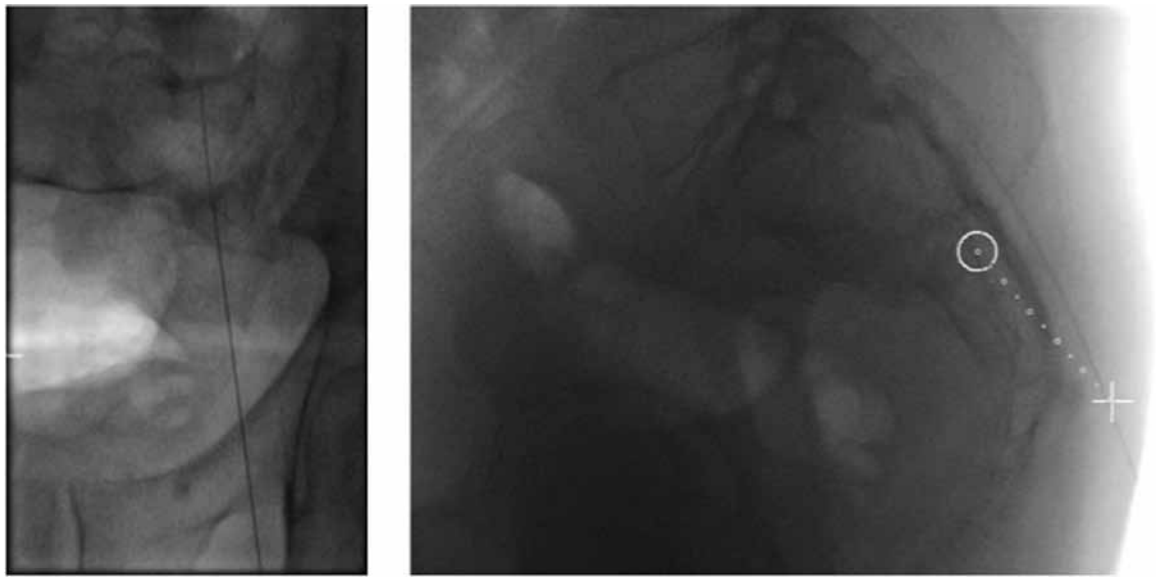

Fig. 4. *Anteroposterior and lateral fluoroscopic image of the micropuncture needle along the desired RF probe tract.*

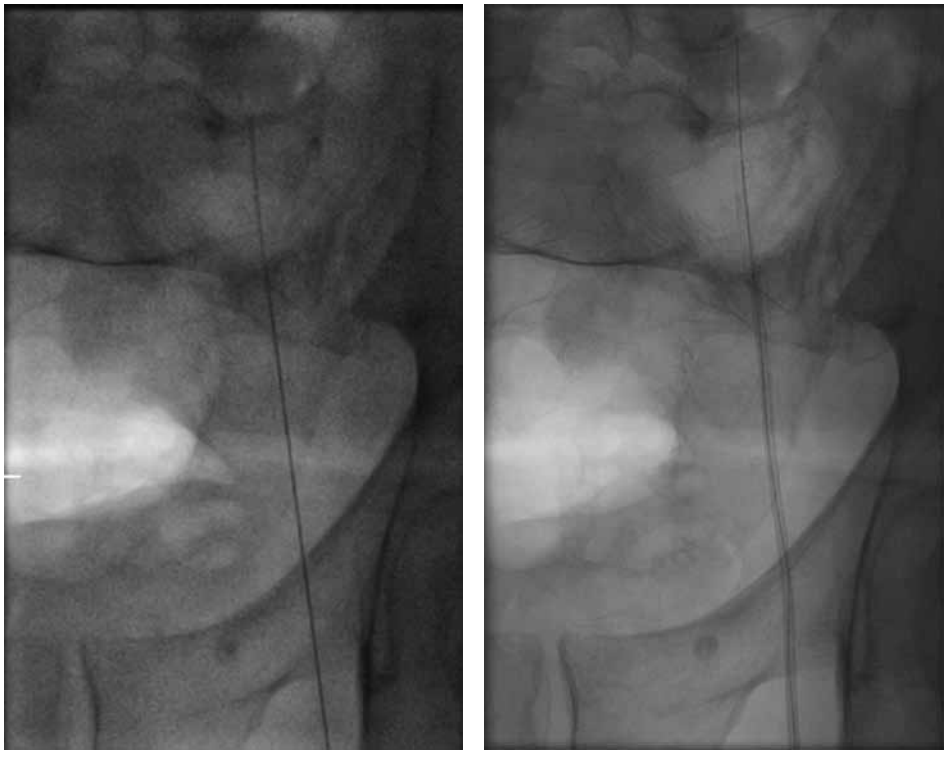

Fig. 5. *The 21G micropuncture needle was exchanged over a 0.018 Spartacore wire over a 6 Fr peelaway sheath. Fluoroscopy confirms adequate position of the sheath.*

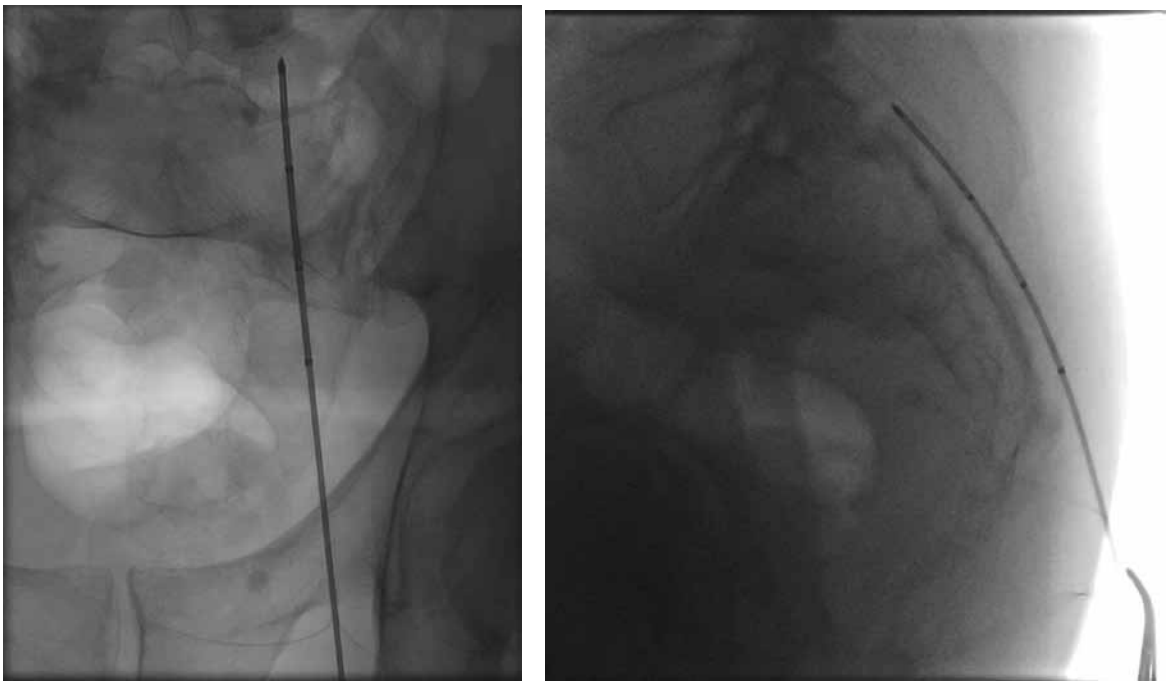

Fig. 6. *Fluoroscopic image confirms adequate positioning of the Simplicity III RF probe.*

Discussion

We have described a technique for RF ablation for sacroiliac joint pain utilizing an adaption of the modified Seldinger approach allowing for the use of a single soft tissue tract for placement of the RF probe along the previously anesthetized tract.

RF ablation of the dorsal lateral sensory innervation to the sacroiliac joint is an increasingly common therapeutic option for treatment of persistent sacroiliac joint pain. Frequently used for the treatment of patients without identifiable lesions on MRI, the reported success rates range from 35% to 67% of patients reporting a $\geq$ 50% reduction in pain at 3 – 6 months (2,10) with one prospective, randomized, sham-controlled study by Cohen et al (11) reporting > 50% improvement in pain in 89% of patients at 9 months. A recent case report by Ramasubba and Cohen (1) also suggests that RF ablation may be beneficial for the treatment of sacroiliac joint pain related to osseous metastasis, similar to our patient. Both traditional and cooled RF ablation have been shown to have similar, positive results in a recent retrospective analysis (12). The primary difference between cooled and traditional RF ablation is the larger size of the lesion generated with cooled RF ablation which theoretically should allow for higher success in ablating sacral nerves. The lesions created by the Simplicity III system are on par with the 8 – 10 mm lesions created by cooled RF ablation. Schmidt et al (9) reported a case series of 60 patients using the Simplicity III probe that found greater than 50% pain relief at 6 weeks for 71.4% of patients, 54.4% at 6 months, and 15.6% at one year. These results compare favorably with traditional and cooled RF ablation methods, despite the study's significant limitations.

Though a variety of techniques and approaches have been described for sacral plexus RF ablation, the Simplicity III RF probe is particularly well suited for the technique we describe. The Simplicity III has the advantage over other approaches that use multiple RF probes for a single treatment by obtaining a large ablation area with the placement of a single probe. Theoretical complications include being unable to ablate each sacral nerve with a single probe if the nerves lay at varying heights from the sacrum. Other complications include placement of the probe anterior to the sacrum and into the pelvic cavity which can be avoided with proper fluoroscopic technique. One other technical consideration when performing RF ablation is appropriate probe placement to achieve both adequate ablation and prevention of undesired nerve damage if the

probe traverses the sacral neural foramen. In our procedure, we describe anesthetization of the desired probe tract with a hollow needle through which a wire can be inserted to preserve our initial access. The needle is then exchanged for a peelaway sheath through which the RF probe is placed so that the desired (and anesthetized) tract access is preserved and the procedure can be performed via a single percutaneous needle pass. We believe that this approach will decrease the risk of bowel perforation during the procedure, will decrease the risk that the ablation probe is not placed precisely along the anesthetized tract, and will allow the procedure to be performed more quickly.

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