

Lumbar Facet Medial Branch Nerve Radiofrequency Ablation (RFA)-A Review of Newer RFA Devices

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ABSTRACT

Background: Lumbar spondylosis with associated facet joint degeneration is a common cause of lower back pain. This causes debilitating lower back pain and referred dermatomal lower limb pain. Standard conservative treatment with analgesics, and a physiotherapy rehabilitation programme can resolve this condition in many patients. For persistently symptomatic patients, various interventional treatment modalities have been developed with different degrees of success. Common 1st line intervention treatment would be facet joint steroid injections, nerve blocks for pain relief. For severe pain symptoms, medial branch nerve-facet joint radiofrequency ablation(RFA) has shown good medium-term results. The common sized needles used include 20G diameter needles with a 10mm length active lesioning tip.

There are different types of the RF needles and probe systems. The interventional techniques have also been controversial. Variability in lumbar vertebral bone anatomy, medial branch nerve course is also an issue. This can result in inaccurate targeting, and the variable clinical results. Different needles and probes developed include the basic straight needle cannula-probe, multi-tined probes, cooled RF probes, and angled Sidekick 2 type cannula-probes®, with a separate lumen for the probe to emerge. These newer probes aim to generate a larger RF lesion size. This would include more of the medial branch nerve in the lesion for better long-term pain relief.

Objectives: The purpose of our study is to compare the clinical results of the above devices, and also present our personal experience with 2 different RF devices ('Sidekick' type needles vs straight needles, both similar in length, diameter), but with the 'Sidekick' generating a larger lesion.

Methods: In our study, we searched PubMed and Medline for relevant studies on lumbar facet joint radiofrequency ablation. We also reviewed the author's personal prospective series on facet joint-medial branch nerve radiofrequency ablation (RFA) from 2024 to 2026. The primary outcome measures for success were improvement in Visual Analogue Scores (VAS) by 50% at 3 months and at 6 months post-procedure. Other outcome measure indices included the Oswestri Disability Index (ODI), and the incidence of neurological lower limb side effects/complications.

Study Results and Discussion: RF devices such as the conventional straight needle needle-probe, multi-tined probes, cooled RF devices were studied. Promising improvements in pain VAS scores range from 51.7% to 55% using these devices. Some aim to generate a larger diameter spherical RF lesion. Another more recent lesioning technique involves inserting 2 needles, placed on either side to encompass the medial branch nerve for a larger lesion volume.

From our personal prospective series of 44 patients, comparing the standard straight 20G RF needle, vs the 'Sidekick 2' probe, our results showed good improvements in VAS scores. In the first group of patients which were treated with the standard 20G needle, there

were 22 patients, treated from January 2024 onwards. The average age of the patients was 55 years. There were 8 female and 14 male patients. The second group was treated with the newer 20G, angled needle tip needle(Boston® ‘Sidekick 2’). There were 22 patients, treated from September 2025 onwards. Eleven were male and 11 were female patients. The average age of patients was 54 years. The results of the VAS pain scores were assessed at 3 and 6 months post-procedure. A successful outcome was a reduction in the VAS pain score by 50%. In the ‘Sidekick’ group, there was improved results, 75% improved versus 65% in the standard straight RF needle group. The difference was statistically significant($p<0.05$). In both the 2 groups, there was 1 case(4.5%) of transient leg numbness with dermatomal pain. This improved after 1 month of treatment with medication. There were no incidence of neurological defects in both groups. No patients subsequently needed lumbar spine surgery such as fusion.

Conclusion: In conclusion, lumbar facet joint RFA has an important role in the treating lower back pain. Various RF needles and probes have been developed to increase the lesion size with a view to improve efficacy. The newer ‘Side-kick’(Boston Scientific®) device shows promising results and can be considered in selected patients. Patients with a high BMI, variable lumbar facet anatomy, and those with recurrence facet joint syndrome pain can benefit from this device.

Keywords

Lumbar spondylosis, Lumbar facet joint degeneration, Radiofrequency ablation (RFA), Medial branch nerve Facet joint pain, Chronic low back pain.

Introduction

The burden of lower back pain affecting patients around the world is significant. The pattern of back pain can be of various types. These include a localised facet joint pattern, radicular type, discogenic type, or a combination of them. The prevalence has been studied and can range from 25% to as high as 40% in adults [1,2]. This condition not only affects the health of patients, but also presents an economic burden due to lost days of work [3].

One of the more common anatomical sources of lower back pain is from the facet joint (zygapophyseal ‘z’ joints). These are part of the dorsal column of the spine and play an important role in stabilising the spine in its range of motion. The main innervation of this joint is by the medial branch lumbar nerves. Several studies have found this to be a substantial contributor of lower back pain in the population [4,5].

History of Radiofrequency Ablation for pain and Early Studies

The first use of RF for neurogenic causes of pain was in the 1930s, for treatment of refractory Trigeminal Neuralgia [6]. Dr M Kirschner, a German Surgeon used a percutaneous electrode to deliver thermal energy to the trigeminal ganglion to treat this condition successfully.

In 1975, Dr C N Shealy, an American Neurosurgeon pioneered the use of RF facet ablation under fluoroscopic image guidance. He also worked together with Radionics® and utilised a RFA system which used large 14G and 16G needle electrodes. For this technique with larger diameter needles, the main issue was the patient’s pain when placing the electrodes. Thus the procedure had to be performed under general anesthesia [6,7]. In his series of 207 patients, the mean follow-up was 31 months. Adequate pain relief was found in 79% of patients. This technique was found to be safe, with no complications reported.

Subsequently more studies were performed. Dr N Bogduk showed that the nerves responsible for the facet joint source of

pain were the dorsal rami of the lumbar medial branch nerve [6]. This technique was known as percutaneous lumbar medial branch neurotomy in 1979.

In a systematic review study, by Lee CH et al in 2017, a review of 7 randomised controlled trials was done. The total number of patients involved were 454. Patients who underwent facet RFA were compared to sham patients/epidural block patients. It was found that at 12 months follow-up, there was significant reduction in lower back pain in the RFA intervention group [8].

In 2020, another systematic review study by Schneider BJ et al was done. This showed the benefits and safety of medial branch nerve RFA for the facet joint source of pain [9]. It also compared various intervention techniques including the perpendicular needle approach to the medial branch nerve, and the parallel approach. It was found the best results occurred with rigorous patient selection, positive medial branch block results and the parallel RF electrode technique. In this group, 56% of patients had 100% pain relief at 6 months.

The above early experience and studies were mostly performed with straight needles and standard RF probes. The purpose of this current review is to assess the evolution of the various needle devices to perform medial lumbar medial branch nerve RFA. The author’s personal experience with these devices is also presented.

Methods

This study involves the analysis of relevant Pubmed, Medline published articles on percutaneous lumbar RF intervention for spondylosis. Relevant studies on lumbar facet joint radiofrequency ablation for facet related pain were reviewed. The different RF cannula types reviewed included the standard straight needle type, cooled-RF type, and multi-tined cannula type. The primary outcome measures for success was improvement in Visual Analogue Scores (VAS) by 50% at 6 months or more post-procedure. Secondary outcome measures such as the Oswestry Disability Index (ODI) were also reviewed. In addition, the author’s personal experience with facet joint medial branch nerve RFA using two different RF needle types is described. By this, the author seeks to determine if the newer needle radiofrequency ablation devices can be considered a good treatment option in alleviating facet joint related pain.

Study Results and Discussion

Challenges and Controversy

There has been some controversy as to the efficacy of facet joint-medial branch nerve radiofrequency ablation. A Cochrane database review by E Mass et al, of randomised trials was done in 2015. This involved a review of 12 randomised studies, and only moderate evidence of pain relief was found over the long term when compared to placebo patients. The evidence was also found not to be of high quality.

Other research studies have also reported variable improvement outcomes in pain relief and functional improvement. The average percentage of patients with significant pain reduction from these studies post-procedure range from 51.7% to 76.6% [10,11].

The need for improved RF Needles, and Technology

The challenges faced to deliver targeted RF energy along the medial branch nerve are due to a few factors. Anatomical variability in vertebral bone includes: facet joint hypertrophy, differing lumbar lordosis, and facet joint orientation [12,13]. From the L1-2 facet joint to the L5-S1 joint, the oblique angle can increase from 18 degrees to 38 degrees. Due to these variations in vertebral anatomy, the target medial branch nerve may only be lesioned partially, or even missed. When only a small segment of the nerve is lesioned, early reinnervation of the facet joint can occur, leading to recurrence of pain symptoms.

The medial branch nerve itself also can have variable anatomy [14]. The nerve usually runs amongst the root of the superior articular (SAP) and transverse process (TP). The nerve then runs dorsally, caudally, under the mamillary ligament. It then gives rise to smaller articular branches which provide sensory innervation to the facet joint. The distance of the bifurcation of the spinal nerve dorsal ramus into the medial branch and lateral branch (which has motor supply to the multifidus muscles) measured from the superior border of the transverse process root can be variable. The average distance measured ranges from 1.9mm to 3.6mm [13,14].

Hence the development of difference interventional techniques and needles, which can create a larger lesion size to incorporate the targeted medial branch nerve.

Different needle shapes and geometry are used in facet radiofrequency ablation. The commonest needle-cannula used is the straight needle, usually 20G or 18G. The lumbar vertebral 'eye of the scotty-dog' is commonly used as a reference point using the 'gun-barrel approach'. The nerve is conventionally targeted from where it emerges from under the mamillary ligament. The RF probe inserted creates a target lesion circumferentially around the active tip (approximately 5-6mm in diameter). Usually the lesion does not extend distal to the needle tip further into tissue. Some interventionalists prefer a curved needle tip (usually with a 10-15 degree bend). This may be useful for access into difficult to reach target anatomy for example L5-S1 level with prominent posterior iliac crest anatomy which can obstruct the traditional

straight needle [6]. For both the above needles, they must be placed parallel with the medial branch nerve to achieve a longer nerve lesion length.

An alternative to the standard straight RF probe is a multi-tined cannula [6,10]. A 18G three tined cannula with a 5mm active tip has been used (Diros-Avanos technology) [15]. This method also uses a perpendicular approach to the lumbar medial branch nerve. This is used in a "co-axial" method which is different from the trajectory of using the traditional straight needle. When the RF needle abuts the lumbar bone periosteum, the tines are deployed using image-intensifier fluoroscopy. The RF lesion protocol used was 80-90 degrees C, for one and a half to two and a half minutes [10]. The lesion RF lesion diameter ranges from 7.3-8.8mm diameter). Using the method, there was reasonable success for patients, 51% success at 12 months. There was a significant reduction in analgesic medications (eg.opioids), with 75% patients stopping opioid medication.

Another type of RF electrode design is the cooled-tip electrode (Avanos®).The electrode has a thermocouple to provide temperature controlled RF lesioning. The electrode tip has water-cooling, and this can prevent tissue charring at the tip area. A slower and larger lesion is generated with tissue temperature usually at 60 degrees C [13]. This technique allows for a larger RF lesion size, for example in the treatment of the genicular nerves of the knee joints. A point to note is the lesion extends distal to the tip of the needle [6,16,17]. Up to 2.5mm distal to the needle tip, tissue heating also occurs with lesioning. The diameter of the lesion ranges from 8-10mm in size. The shape for the lesion produced with this method is different, being spherical, versus an ellipsoid lesion with a conventional straight needle [17]. As the RF lesion extends distal to the needle tip, potential thermal damage to the ventral motor ramus can occur if the needle tip is placed too ventral. This method has been used widely, with a randomised trial by McCormick et al [18] in 2023 showing good results. In this trial, 32 patients were studied. Outcomes were reviewed at 3,6,12 months, with ODI and NPRS pain scores determined. The results showed 70% improvement in the RF group versus 25% in the facet joint injection block group at 3 months post-intervention. However, this reduced to 55% and 45% improvement in pain score in the RF intervention group at 6 and 12 months respectively.

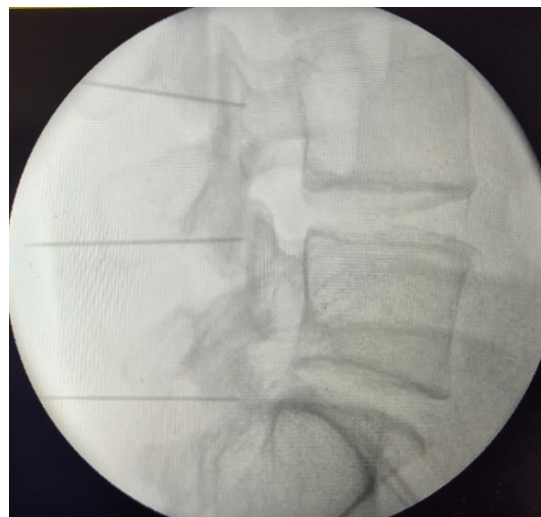
A two-needle technique to target the medial branch nerve has been developed, with a study published in 2020 by Chapman et al [13]. This involved the usage of 20G needle with a 10mm active tip. The technique involved placing the 2 needles, 1 slightly cranial, and another caudal to the standard anatomical path of the medial branch nerve. The needles are placed 6mm apart to create a wider RF lesion, approximately 11 millimetres in width, with monopolar lesioning energy. With a standard RF generator, only 2 facet joints can undergo lesioning simultaneously as each machine usually has 4 channels. A limitation of this method would be the additional time needed for the extra needle placement, and cost of the extra needles usage.

A newer needle design is the SideKick 2 needle(Boston Scientific). This needle has a slightly curved needle tip, with the RF probe extending out straight through it via a direct opening. The design enables the creation of a larger elliptical RF lesion [6,19,20,21]. This lesion size is up to 2 times that of a conventional straight needle(up to 8mm diameter), 12mm in length. The needle is also coated with silicone, enabling a smoother passage through the spine soft tissue, muscle. For the standard 20G RF needle, the lesion size created ranges from 4-6mm in diameter, and 10-12mm in length along the needle.

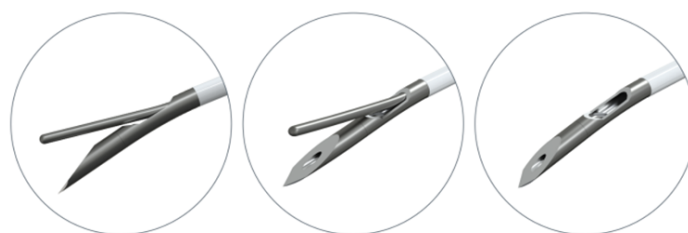
The author (TR) reviewed his own personal experience with 2 lumbar medial branch nerve RF needle types. This involved 44 patients, reviewed prospectively. The first group of patients were treated with the standard 20G, 10 centimeter length straight needle. The active tip was 10 millimeters in length(Boston Scientific). There were 22 patients in this group treated from January 2024 onwards. The average age of patients was 55 years old. There were 8 female and 14 male patients. They were diagnosed with a facet syndrome of pain clinically, and with correlation to MRI radiological findings. Patients were treated medically with a course of analgesic medications including NSAIDs, oral opioids, and a course of spine physiotherapy. The patients with persistent lumbar pain symptoms were offered lumbar facet steroid injections/blocks and lumbar facet-medial branch nerve RFA.

The intervention for the second group was with the newer 20G, 10 centimeters length angled tip needle (Boston® ‘Sidekick’). There were 22 patients in the SideKick-2 group, treated from September 2025 onwards. Eleven were male and 11 were female patients. The average age of patients was 54 years. Patients were all seen in the spine clinic by the author, and underwent lumbar intervention in the operating theatre under C-arm fluoroscopy. The results of the Visual Analogue Score (VAS) pain scores were assessed at 3 and 6 months post-procedure. A successful outcome was a reduction in the VAS pain score by 50% at 6 months. The results showed that there was successful improvement in 75% of patients treated. This was better than the group of patients treated with the standard straight RF needle in which there was also a significant improvement in 65% of patients. The difference between the groups was statistically significant ($P < 0.05$). In both the 2 groups, there was 1 case (4.5%) each of transient leg numbness with dermatomal pain. This improved after 1 month of treatment with low dose gabapentin medication. There were no cases of neurological defects occurring in both groups. None of the study group patients subsequently needed lumbar spine surgery such as lumbar fusion.

This series of the author shows good results with this newer RF needle. The larger lesion diameter size generated is more likely to encompass the entire medial branch nerve, and also make allowances for minor lumbar anatomical variabilities [12].

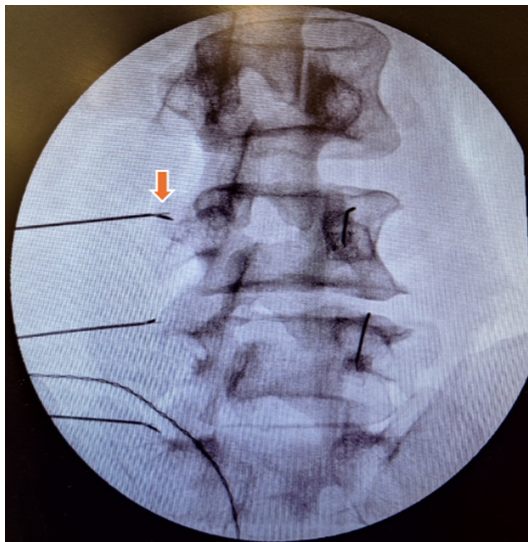


A conventional straight 20G needle targeting the medial branch nerves of L4-5-S1 levels.



The newer Sidekick-2 needles have an angled tip, with the RF probe emerging from a lumen proximal to the bevelled tip. This generates a larger diameter RF (up to 8mm in diameter).





The RF electrode probe emerging from the cannula needle tip (at the left L4 level).

Indications where such special RF Devices can be of use

In patients with a higher body mass index (BMI>30), such patients have more adipose tissue around the RF needle tip which can possibly decrease the efficacy of medial branch nerve RFA [22]. This was found in a study on Austrian patients, using the Cooled RF needle technology, when such patients were found to have lower effectiveness of RFA treatment at 1 year post-procedure. Animal studies have shown that when there is more fatty-adipose tissue around the RF needle, the RF lesion size generated is smaller. Possibly this is due to a lower thermal conductivity of fat compared to muscular tissue [23]. In this group of patients, the Sidekick 2 needle can create a larger lesion size.

A RF probe which can generate a larger lesion size would also be useful in patients with challenging/variable lumbar spine anatomy such as those with severe facet joint hypertrophy, previous spinal laminectomy.

In patients with recurrent facet joint pain after a previous RF ablative procedure, a repeat RF procedure with a larger lesion size technique may be a good option. This will ensure the longest length of the medial branch nerve is included in the lesion volume. In studies, repeat lumbar facet RFA procedures have been found to have a beneficial effect in reducing analgesic and opioid medication usage [24]. The Sidekick 2 can be considered in these cases.

Study Limitations

This study has several limitations. Firstly, some of the evidence gathered comes from retrospective and non-randomised trials. This can result in non-definitive data gathered.

Different RF protocols were also sometimes used by spine interventionalists, and hence comparisons in study results can be challenging. In the future, larger scale trials will be able to address the efficacy of such percutaneous RF intervention.

Conclusion

In our review study, RFA targeted at the facet joint-medial branch nerve has an important role in the treatment of lower back pain. This is a useful treatment modality for patients who wish for a minimally invasive percutaneous treatment option, and do not have neurological deficits requiring surgical decompression.

Various RF needles and probes have been developed to increase the RF lesion size and improve intervention efficacy. The newer 'Side-kick2' device shows promising results and can be considered in selected cases such as in high BMI patients, abnormal vertebral anatomy, and patients with recurrent facet joint syndrome pain. From our series, promising improvement in VAS pain results have been shown, as high as 75%, with no complications such as neurological deficits. Further improvements in RF medical product technology can be expected in the future, and larger scale trials will also help evaluate these.

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