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# RADIOFREQUENCY LESIONING OF HYPERTROPHIED LIGAMENTUM FLAVUM IN LUMBAR SPINAL STENOSIS – A REPORT OF TWO CASES

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**Background:** Lumbar spinal stenosis is a debilitating condition commonly seen in older adults. Hypertrophy of the ligamentum flavum significantly contributes to the pathology. Although epidural injections are commonly used when conservative measures fail, they often provide only transient relief. Radiofrequency lesioning of fibrotic tissue can result in a reduction in size. We report radiofrequency lesioning of the ligamentum flavum and the outcomes.

**Case Report:** We present 2 patients with neurogenic claudication due to lumbar spinal stenosis and ligamentum flavum hypertrophy. They had disabling back pain and bilateral leg pain that was not adequately relieved by medications. Both underwent image-guided radiofrequency lesioning of the ligamentum flavum. The patients experienced clinically significant improvement in pain and functional scores at 4 weeks after treatment.

**Conclusions:** Image-guided radiofrequency lesioning of hypertrophied ligamentum flavum may be a minimally invasive technique that provides symptomatic relief in patients with lumbar spinal stenosis who are poor surgical candidates.

**Key words:** Spinal stenosis, radiofrequency ablation, ligamentum flavum, case report

## BACKGROUND

Degenerative lumbar spinal stenosis (LSS) is a debilitating condition often seen in older adults. Clinical features include low back and buttock pain along with radiating pain in the lower limbs. The pain is usually aggravated by walking and relieved by rest and forward bending. Both anterior column structures (vertebral body and intervertebral disc) and posterior elements (facet joint hypertrophy and ligamentum flavum [LF]) are involved. Although stenosis can occur in the central canal, lateral recess, or neural foramina, the lateral recesses are often the principal compression site and can be debilitating (1). The LF forms the posterior boundary of the epidural space, and its thickening is usually secondary to the loss of intervertebral disc height, aggravated by facet joint hypertrophy and possible inflammation (2). Analgesics, physical therapy, and epidural injections may provide symptomatic improvement. Surgery is indicated in patients with severe symptoms and usually involves decompression and instrumented fixation (3). More recently, steroid injections into the LF in patients with LSS have been shown to produce marked improvement in symptoms (4).

Liquid chromatography and mass spectrometry of hypertrophic LF reveal loss of elastic fibers, increased collagen content, and altered lipid composition (5). A similar increase in arachidonic acid has also been observed in hypertrophic scar tissue (6). Fibrosis is the main pathology in LF hypertrophy (7). Radiofrequency (RF) current exhibits antifibrotic effects (8). RF current

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causes structural and functional changes in hypertrophied tissues including ligaments (9). We hypothesized that applying RF energy at low temperatures would reduce the size of hypertrophied LF, thereby providing symptomatic improvement in LSS. Two patients with severe LSS underwent RF lesioning of the LF under image guidance. This technique has not been reported elsewhere. The treatment yielded clinically significant functional improvement in both patients. Written informed consent was obtained from both patients. The institutional ethics board of Vinayaka Missions Research Foundation approved this study (Cr34/09/24).

## CASE REPORT

Patient 1 was a 73-year-old woman who presented with moderate to severe back pain and pain radiating predominantly to the right leg while walking (Visual Analog Scale [VAS], 8/10). She was a retired schoolteacher and had been leading an active life. She lived alone, and her pain and disability significantly interfered with her daily life. Two months earlier, she had received an interlaminar epidural steroid injection at another facility, which provided transient, albeit minimal, relief. She was taking optimal doses of nonsteroidal anti-inflammatory drugs (NSAIDs), tramadol, and gabapentin but reported inadequate pain relief. Her Swiss Spinal Stenosis Questionnaire (SSSQ) score was 44/55. Straight leg raise testing was positive, and she had axial tenderness at the L4-L5 level. The remainder of the physical examination was unremarkable. She was evaluated by the Department of Orthopedics, and magnetic resonance imaging (MRI) revealed severe LSS, an L4-L5 disc bulge, and LF hypertrophy (Fig. 1). A diagnosis of grade 3 LSS according to the Lee grading system was made (10). Surgical decompression and instrumented fixation were recommended. Because she was unwilling to undergo surgery, she was referred for pain management. The patient was informed of the experimental nature of the procedure and was presented with the available evidence and the possibility of adverse effects. She was also given the option of minimally invasive surgical procedures, but the cost and need to travel to a specialized tertiary care center made these options impractical for her. She was scheduled for LF RF lesioning under fluoroscopic guidance. The procedure was performed in the operating room under aseptic conditions. The patient was placed in the prone position. After sterile draping, the L5-S1 interspace was identified, and the L5 vertebra was squared by adjusting the craniocaudal tilt.

An 18-gauge Tuohy needle was inserted in the midline after local anesthetic infiltration, and the epidural space was identified using the loss-of-resistance (LOR) to air technique. The C-arm was turned to a lateral position, and 5 mL of iohexol contrast medium (Omnipaque; GE HealthCare) was injected to delineate the epidural space (Fig. 2A). At the L4-L5 level, 2 RF needles (Pajunk), 22-gauge and 10 cm long with a 0.5-mm active tip, were inserted just medial to the medial border of the facet joints. The 2 RF needles were positioned with their tips just posterior to the epidural space, within the LF (Fig. 2B). Absence of LOR confirmed intraligamentous positioning of the RF needle tips. After no response to sensory stimulation (2 mV, 50 Hz) or motor stimulation (2 mV, 2 Hz), 0.5 mL of 1% lidocaine was injected under considerable resistance. Conventional RF lesioning was performed at 45 °C for 90 seconds. Two additional lesions were performed after withdrawing the needle and directing it laterally, ensuring that the tip remained posterior to the epidural space. Postprocedure, the patient was monitored for sensory loss or motor weakness. VAS and SSSQ scores were measured at 1 week and 4 weeks. The patient was allowed to continue physical therapy and medications.

Patient 2 was a 70-year-old man with a similar clinical picture of LF hypertrophy, maximal at L4-L5, and neurogenic claudication in both lower limbs. A diagnosis of grade 3 LSS according to the Lee grading system was made. His VAS score was 8/10, and his SSSQ score was 47/55. He was a retired cricket coach and wished to lead an independent life. He was extremely apprehensive about surgery because his elder brother had become bedridden after spine surgery a decade earlier. He had also previously refused an epidural steroid injection because of possible adverse effects of steroid injections that he had read about online. The experimental nature of the procedure was explained to the patient, and other minimally invasive surgical options were also offered. The patient agreed to RF treatment. A slightly modified technique was used. The epidurogram was omitted. Two RF needles (20-gauge, 10 cm long, with a 5-mm active tip) were placed at the lateralmost part of the interlaminar window, and LOR was used to identify the epidural space. Once LOR was obtained, the needles were withdrawn by several millimeters so that their tips lay in the LF. RF lesions were performed with the same settings as in Patient 1 after confirming the absence of response to sensory and motor stimulation. The patient was followed up at 1 week and 4 weeks. At 3 months, both patients were interviewed by telephone.

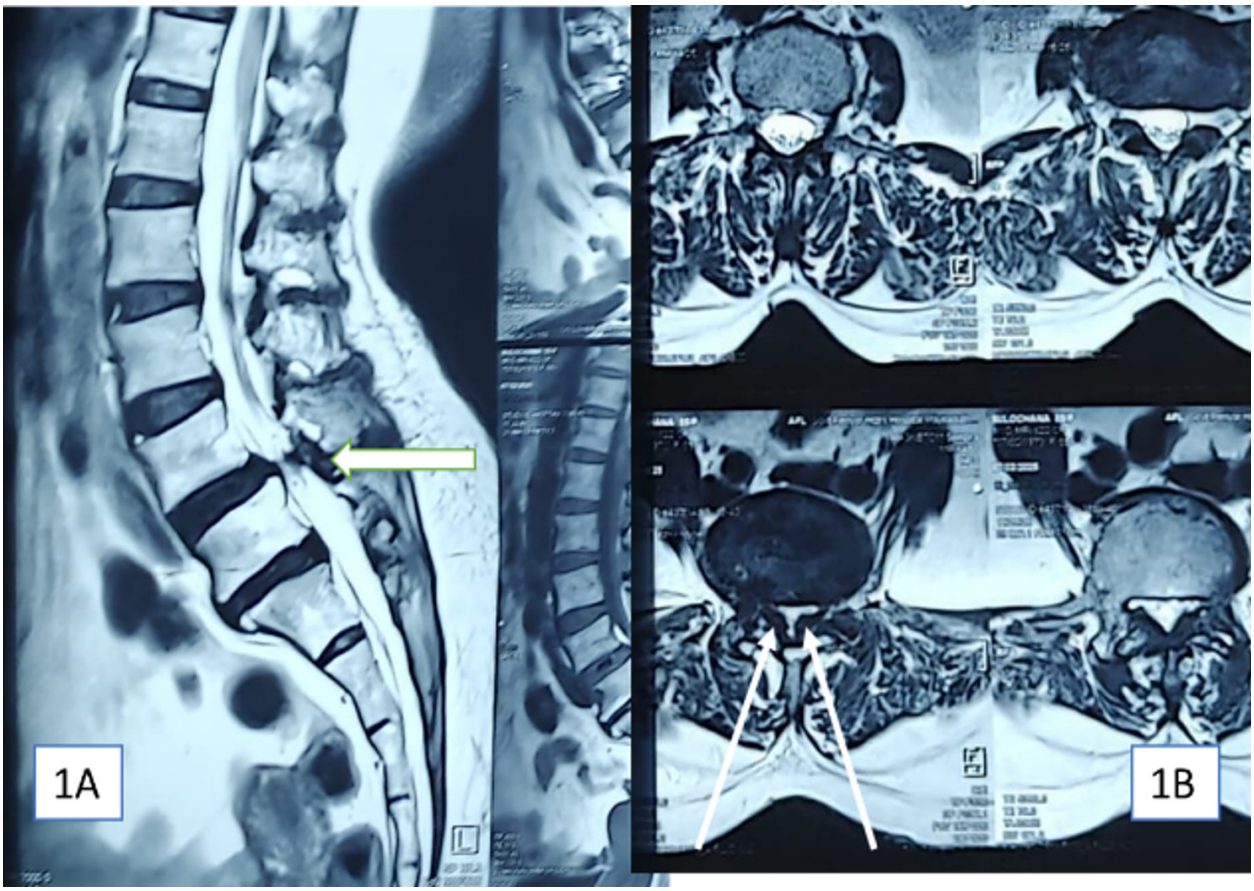


Fig. 1. (A) Sagittal T2-weighted image showing hypertrophied LF at L4-L5 (white arrow). (B) Axial image at L4-L5 showing severe LSS due to LF hypertrophy; white arrows show the trajectory of the RF needles.

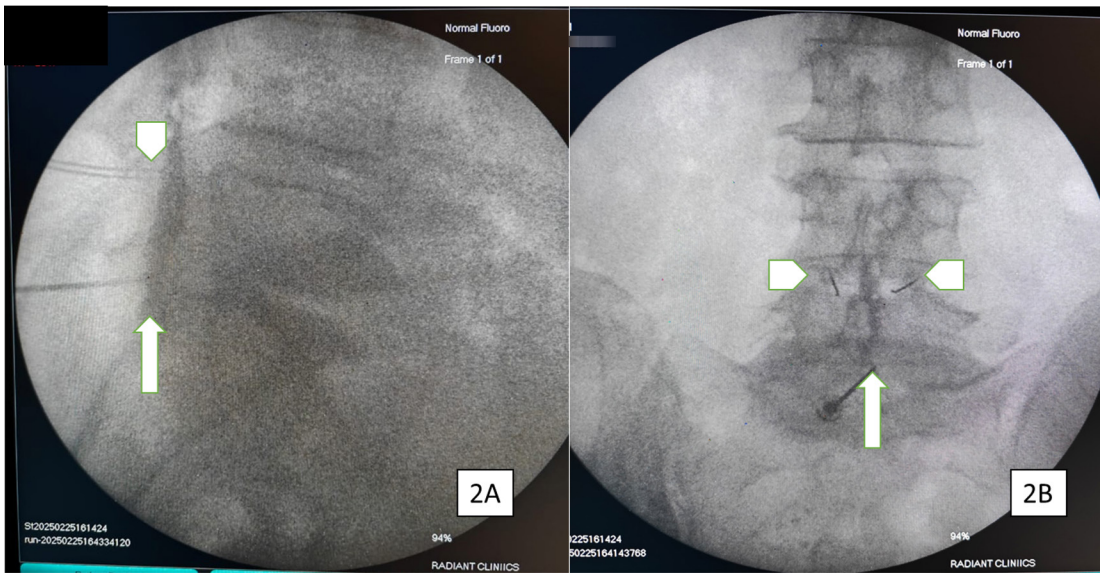


Fig. 2. (A) Lateral fluoroscopic view after epidural contrast injection from L5-S1 (white arrow), with RF needles at L4-L5 (arrowhead). (B) Anteroposterior view.

At 3 months, both patients were interviewed by telephone. Both patients tolerated the procedure well with minimal discomfort. They reported significant early (at 1 week) pain relief and functional improvement (Table 1). The treatment effect was judged as "somewhat satisfied" by both patients, with a score of 50% according to the SSSQ at 1 week and 4-week follow-up . At 3-month follow-up, Patient 1 opted for surgical decompression after her symptoms relapsed following a brief improvement whereas Patient 2 was able to continue his daily activities with "minimal discomfort" and occasional exacerbations for which he took analgesics. During a telephone conversation with the surgeon, it was noted that Patient 1 had "severe, widespread calcification" of all the spinal ligaments and bony encroachment of the spinal canal.

## DISCUSSION

The exact pathophysiology of LF hypertrophy is unknown; however, several factors, including age, mechanical stress, and disease factors, have been implicated. Fibrosis results from several growth factors and inflammatory mediators secreted by the surrounding tissues (7). Although injections of anti-inflammatory medications into the LF have demonstrated clinical benefit, this is the first report to demonstrate appreciable improvement in patients' pain and functional scores after RF treatment of hypertrophied LF. Compared with intralesional chemotherapy, RF treatment results in a more rapid reduction in scar size (11). RF treatment of ligaments has also been shown to accelerate wound healing in animal studies (12) and human anterior cruciate ligaments (9). The proposed mechanisms include increased heat shock protein 70 (HSP70) expression and decreased NF- kB activation (13). A reduction in LF thickness after RF treatment might reduce pain and improve functional outcomes in patients with LSS. Although concerns regarding nerve injury during RF lesioning near the spinal cord exist, the risks are minimized by accurate needle placement and sensory and motor testing before lesioning. Jacobson et al (14) has reported a similar technique using conventional RF lesioning of LF at 60 degrees, with a 58% success rate on long term follow-up. We have used a lesser temperature with comparable results.

Although minimally invasive lumbar decompression (MILD) is an attractive option for both patients, the cost of the procedure and expensive disposable kits made this option prohibitive. A recent meta-analysis showed MILD to be effective in patients with LF hypertrophy, with sustained benefits beyond 1 year (15). Surgical decompression is also associated with substantial rates of treatment failure, making patient selection important. In a study by Alhaug et al (16), 33.2% of patients who underwent surgery for LSS were considered treatment failures and an additional 21.6% were considered worsened. Age older than 70 years and duration of back pain longer than 12 months were strong predictors of failure; both of our patients are 70-year-olds and symptom duration exceeding 12 months. Hence, the RF procedure might be an acceptable option for these patients. Although Patient 2 remained comfortable at the 3-month mark, Patient 1 ultimately underwent surgical decompression after her symptoms relapsed. Notably, the pathology was not limited to LF in Patient 1. On retrospective review of the MRI, stenosis was more severe and was driven by both LF thickening and significant facet joint hypertrophy compared with Patient 2 (Fig. 3). Thus, RF lesioning of the LF alone provided only limited, transient relief.

### Limitation

One limitation of this report is the lack of repeat MRI because the patients were unwilling to undergo repeat imaging after reporting clinical improvement. A demonstrable decrease in LF thickness might provide

Table 1: VAS and SSS scores before and after treatment

| Parameter | Patient 1 | | | | Patient 2 | | | |
|---|---|---|---|---|---|---|---|---|
| | Baseline | 1 week | 4 weeks | 3 months | Baseline | 1 week | 4 weeks | 3 months |
| VAS | 8/10 | 4/10 | 6/10 | 4/10 | 8/10 | 5/10 | 5/10 | 6/10 |
| SSSQ Symptom and function | 80% (44/55) | 47.2% (26/55) | 54.5% (30/55) | 47.2% (26/55) Surgery done | 85.45% (47/55) | 50.9% (28/55) | 50.9% (28/55) | 54.55% (30/55) |
| SSSQ treatment satisfaction score | - | 50% 12/24 | 50% 12/24 | 45.83% 11/24 | | 50% 12/24 | 50% 12/24 | 50% 12/24 |

VAS – Visual Analog Score; SSS – Swiss Spine Stenosis Questionnaire

objective evidence of the technique's efficacy. As with all interventional procedures, a placebo effect cannot be ruled out.

## CONCLUSIONS

In conclusion, RF lesioning of hypertrophied LF might provide symptomatic relief in patients with LSS who are not suitable candidates for surgical decompression. The procedure may not be effective when stenosis is caused by factors other than LF hypertrophy. Large-scale trials are needed to provide further insight into this treatment modality.

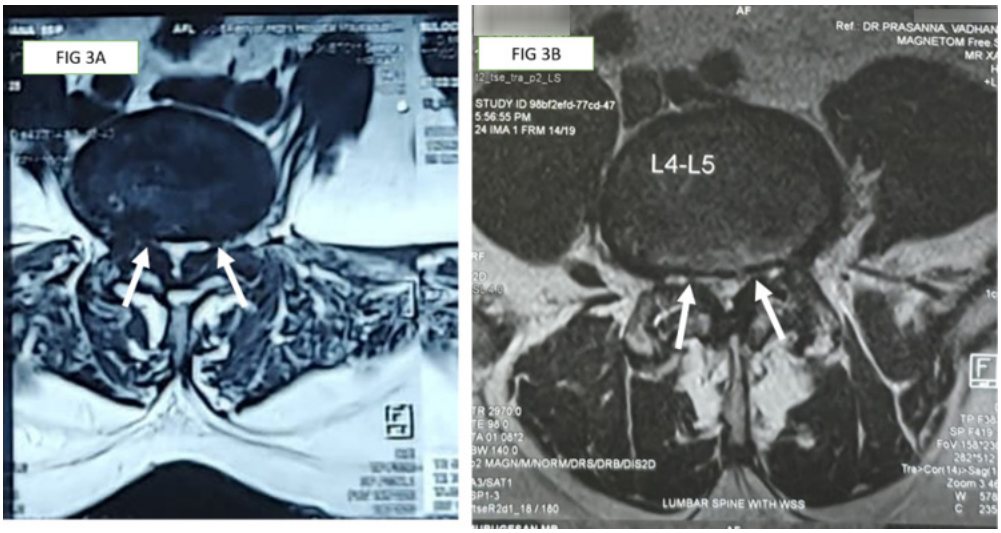


Fig 3. (A) Facet hypertrophy and subarticular stenosis, prominent in Patient 1. (B) LF hypertrophy in Patient 2 (white arrows).

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