Does Lumbar Medial Branch Radiofrequency Neurotomy Cause Multifidus Atrophy?

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Myth: Lumbar medial branch radiofrequency neurotomy (LMBRFN) causes increased segmental spinal muscle atrophy due to multifidus denervation.

Fact: Presently, there is no conclusive published literature indicating that LMBRFN leads to increased multifidus atrophy relative to natural history. High-quality prospective studies with a natural history comparison group evaluating immediate pre-procedure as well as post-procedure longitudinal cross-sectional imaging are needed to accurately assess for any possible influence of LMBRFN on multifidus atrophy as well as the clinical relevance.

Lumbar medial branch radiofrequency neurotomy (LMBRFN) is a procedure commonly used to treat pain arising from the lumbar medial branch nerves that innervate the lumbar zygapophysial (facet) joint(s) [1-3]. Each lumbar facet joint is dually innervated from the lumbar medial branch at the same level and one level above the facet joint [4]. However, lumbar medial branches also innervate other nearby structures, including the interspinous ligament, supraspinous ligament, and paraspinal multifidus muscles [5]. The multifidus muscle is the largest and most medial muscle of the deep lumbar paraspinal muscles [6]. The multifidi are arranged in a segmental manner, arising from the spinous processes medially and attaching more laterally at the mammillary processes of more caudal vertebral segments, the aponeurosis of the erector spinae muscles, the posterior superior iliac spine, or the sacrum and dorsal sacral ligaments. As such, the multifidi generally span and influence stability at multiple lumbar vertebral levels [6,7]. There is some evidence that each lumbar multifidus muscle is innervated by lumbar medial branches from multiple vertebral segments [8]. One study of an L5 nerve root lesion demonstrated electromyographic spontaneous activity three levels cranial (L2) to the injury [9]. The lumbar multifidus muscle functions as the principal posterior spine stabilizer, and impairment of the multifidi has been associated with increased low back pain [10]. It has been proposed that denervation of the lumbar medial branch(es) through LMBRFN may lead to multifidus atrophy.

A 2009 prospective study examining multifidus atrophy after unilateral LMBRFN followed five patients for 17-26 months [11]. These patients underwent electromyography (EMG) sampling of the paraspinal muscles before and after LMBRFN. In this small study, at six weeks post-LMBRFN, all patients were found to have EMG-documented denervation of the lumbar paraspinal muscles. At 21 months post-procedure, all patients had MRIs of the lumbar spine that were reviewed by three radiologists who were blinded to the side of the LMBRFN procedure. Lumbar multifidus atrophy was documented in all cases; however, post-procedural MRIs were not compared to pre-procedural imaging. Therefore, it is unknown whether the observed atrophy was directly attributable to the LMBRFN. Furthermore, cross-sectional or volume-based measurements to quantify atrophy on the treated versus untreated side were not performed. Interestingly, the radiologists could not agree as to which side or level(s) had been treated. In fact, accurate consensus amongst the radiologists regarding the side and level of LMBRFN was achieved in only one patient. Ultimately, all patients were relieved of their chronic low back pain and did not request any additional therapy or service. No functional testing of the multifidus was evaluated.

A 2015 retrospective cohort study involving 27 patients examined the cross-sectional-area (CSA) of multifidus atrophy after a LMBRFN procedure [12]. These patients underwent pre- and post-procedural MRI studies. MR images were taken a mean 12.7 months before the procedures and 7.5 months after the procedures. Untreated multifidi at the contralateral segmental levels were used as controls for comparison. Mean multifidus CSA pre-treatment was 6.2 cm^2 and mean multifidus CSA post-treatment was 5.7 cm^2 compared to 5.9 cm^2 in the control multifidi. The observed decrease in multifidus CSA at the treated versus control side showed a trend but did not reach statistical significance ($p = 0.06$). No data regarding patient's pain or function after the procedure were provided. A possible confounding factor must be mentioned as baseline MRIs for pre- to post-treatment comparison occurred at various intervals (12.7 months on average) before LMBRFN, rather than immediately prior to treatment. Given that these patients had unilateral low back pain, asymmetric multifidus atrophy may have occurred to a greater extent on the painful side (that subsequently underwent treatment) compared to the non-painful side in the months prior to LMBRFN due to pain-inhibition and associated disuse. Prior research has demonstrated that patients with unilateral low back pain show greater multifidus atrophy on the painful side [13,14].

A 2023 single-site retrospective study analyzed the relative paraspinal autochthonous intramuscular adipose volume before and after RFN in 20 patients [15]. The authors report that the RFN procedure was performed in accordance with the technique described by the Spine Interventional Society (SIS) guidelines (20°oblique, 20-30° decline). Patients had received an MRI at a median of 0.8 ± 0.30 [0.2-1.1] years pre-RFN and an MRI at a median of 1.4 [0.9-2.6] years post-RFN. The volume of interest included mono- (Mm. rotatores), multi- (Mm. multifidi), and pluri-segmental (M. erector spinae) muscles at the disc level of interest. Adipose volume was calculated by comparing the same spinal level pre- and post-RFN. Additionally, unilateral procedures were compared to the non-treated sided for comparison of fat and muscle volume change. Furthermore, the investigators calculated the intramuscular adipose volume within the multifidus and rotatores muscles separately, as these muscles are solely innervated by the medial branch (unlike other adjacent paraspinal muscles). The authors found that the relative paraspinal adipose volume did not differ before and after RFN ((42 ± 16.3 [9-81]) versus (43 ± 22.8 [4-90]), percent; P=.726). When comparing the superficial paraspinal muscle (innervated by the lateral branch) versus the deep layer of the paraspinal muscles (innervated by the medial branch), before (P=.723) and after RFN (P=.805), no significant statistical difference was observed. Unilateral procedures did not show a significant difference in segmental intramuscular adipose volume when compared to the non-treated side before (P=.481) and after (P=0.578) RFN. There was no statistically significant difference in patients who met the responder definition for pain direction following RFN (P=.147) and those who did not meet this definition (P=.461). In this study, it should be noted that the authors used intraarticular facet infiltration as a diagnostic test to select patients and did not provide the number of facet levels that underwent LMBRFN. No functional testing of the multifidus was evaluated.

Summary and Conclusions

There has been minimal published research that addresses whether LMBRFN leads to multifidus atrophy relative to natural history.

- A small prospective study found that blinded radiologists could not reliably determine the laterality and level(s) of treatment with LMBRFN [11].
- A small retrospective study reported no significant difference in multifidus atrophy CSA post-unilateral LMBRFN compared to control levels [12].
- No study has evaluated the significance of repeat RFN on multifidus atrophy, or motor function and medial branch recovery.
- There is a dearth of evidence addressing clinical effectiveness for denervating more than three joints. The preponderance of current evidence has specifically investigated targeting of the lower lumbosacral levels (i.e., L4-S1) where there is traditionally believed to be a natural increase in muscular atrophy with age.
- It should be stated that given the nature of the LMBRFN procedure, some degree of multifidus denervation and atrophy is plausible. However, the degree of multifidus denervation and recovery as well as clinical relevance requires future high-quality study.

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