

Evidence of Multifidus Changes Post-Lumbar Radiofrequency Ablation: A Narrative Review

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Introduction

- Among the multiple etiologies of chronic low back pain (CLBP), facet joint-mediated pain is notably prevalent.¹
- The lumbar facet joints receive their primary sensation innervation from the lumbar medial branch nerves (LMBN). However, this nerve also provides motor innervation to the multifidus.
- Lumbar medial branch radiofrequency ablation (LRFA) remains a widely used interventional treatment for facetogenic CLBP.²
- A Cochrane review found high quality evidence that LRFAs provide pain relief; however, there is lacking evidence that it improves function.³
- Because of the mutual innervation of the LMBN to both the facet joint and multifidus, there is concern for unintended multifidus denervation and subsequent multifidus dysfunction and atrophy.⁴
- Here, we present a narrative review of the available data on post-LRFA multifidus changes.

Goals

- Synthesize existing evidence on multifidus atrophy and dysfunction following LRFA
- Discuss the clinical relevance of these findings
- Identify possible need for further research on sequelae of LRFA

Methods

- A comprehensive literature search was conducted across Cochrane Library, Web of Science Core Collection, Scopus, PubMed, and MEDLINE using the search terms “multifidus” AND “radiofrequency.”

Inclusion Criteria	Exclusion Criteria
- Original peer-reviewed research - English language - Human studies - Study designs: randomized controlled trials, prospective/retrospective observational cohorts, case series, case reports - Outcomes assessing multifidus morphology or function post-LRFA	- Book chapters, letters to the editor, conference abstracts - Manuscripts in languages other than English - Non-human studies - Duplicate Data

Table 1. Inclusion and Exclusion Criteria for Selected Articles

Methods

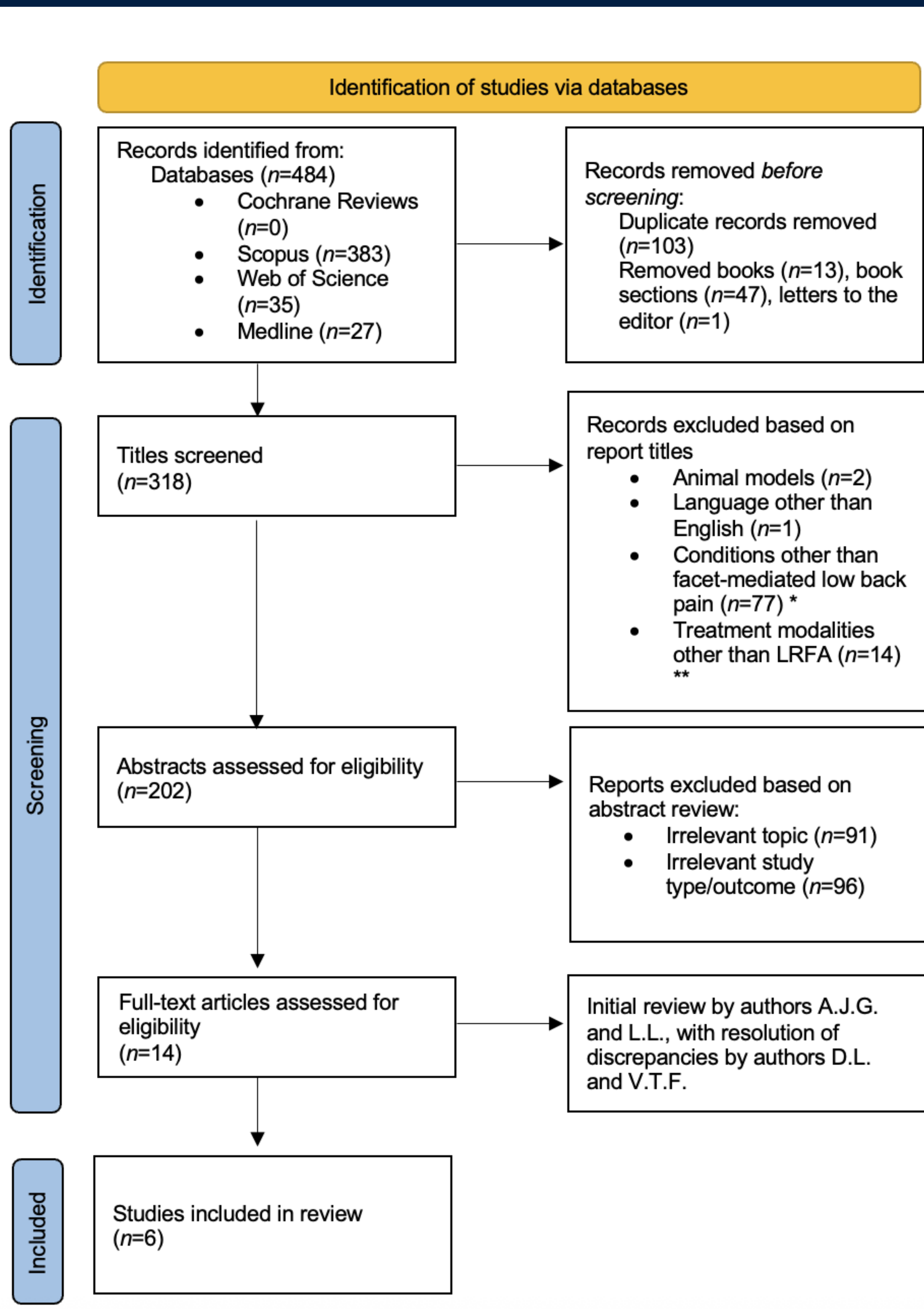


Figure 1. PRISMA Diagram PRISMA Diagram for Literature Review. *Conditions other than facet mediated low back pain included cervical/cervicogenic pain (n=20), whiplash (n=8), cancer/metastatic dis-ease/tumors (n=10), disc herniations/discogenic pain (n=26), sacroiliac joint pain and dysfunction (n=9), vertebral fractures including spondylolysis (n=4). **Treatment modalities other than LRFA included epidural steroid injections (n=4), endoscopic medial branch rhizotomy (n=2), dorsal root ganglion block (n=1), surgical interventions or post-surgical individuals (n=17).

Results & Discussion

Quality of Research

Dreyfuss et al.⁵
N=5 Prospective, cross-sectional cohort
Study Design

- Analyzed post-LRFA (mean = 21mo) MRIs only
- Blinded radiologists assessed post-procedure MRIs and were asked to determine the laterality of which side the LRFA was done based on the amount of atrophy seen

Conclusion:

- Concluded LRFA does not cause segmental atrophy of multifidus

Limitations:

- Lacks comparison of pre-procedure MRIs to post-procedure MRIs
- The radiologists should have determined the change of the multifidus muscle post-procedure in order to answer the research question of whether atrophy occurred.

Sadeghi et al.⁷
N=46 Prospective, cross-sectional cohort
Study Design

- Analyzed post-LRFA ultrasound shear wave elastography to evaluate shear modulus of the multifidus after LRFA (2 yrs)
- Higher shear modulus reflects greater tissue stiffness.

Conclusion:

- Concluded that compared w/healthy controls, the post-LRFA multifidus showed no increase in shear modulus indicating dysfunction and impaired contraction d/t LMBN denervation.

Limitations:

- Shear wave elastography cannot distinguish whether this decrease resulted from denervation-related dysfunction or true atrophy
- Thus, while this is a fair-quality study, the findings of Sadeghi et al. do not clarify whether multifidus atrophy occurs post-LRFA.

Böning et al.⁶
N=17 Prospective, longitudinal cohort
Study Design

- Main aim was to evaluate feasibility of performing LRFA under open MRI guidance instead of C-arm
- Analyzed pre- (1 week) and post-LRFA (6 mo) MRIs
- Using these MRIs, the authors manually measured multifidus volume using a 3D program software

Conclusion:

- Concluded that the volume of the multifidus increased following the procedure

Limitations:

- However, they do not specify what percentage of this volume is skeletal muscle vs fat infiltration.
- Therefore, the question of whether atrophy occurs post-LRFA remains unaddressed.

Smuck et al.⁸
N=27 Retrospective, longitudinal cohort
Study Design

- Analyzed pre- and post-LRFA (mean=7.5mo) MRIs
- Used a grayscale measurement to determine amount of fat infiltration in the multifidus
- Used untreated segmental levels within the same patient as controls
- Included patients who received 1-3 repeated LRFAs

Conclusion:

- Concluded there was reduced skeletal muscle cross sectional area following LRFA

Limitations: ***see discussion to the right

Oswald et al.⁹
N=20 Retrospective, longitudinal cohort
Study Design

- Analyzed pre- and post-LRFA (median =16.8mo) MRIs
- Used a computer software program to measure the relative muscle and fat volume of the multifidus
- Used contralateral side as control in unilateral LRFA cases but no controls for bilateral procedures

Conclusion:

- Concluded that the relative intramuscular fat volume of the multifidus did not change

Limitations: ***see discussion to the right

Guven et al.¹⁰
N=24 Retrospective, longitudinal case series with paired analysis
Study Design

- Analyzed pre- and post-LRFA (>=2 yrs) MRIs
- Used a computer software program to measure the relative muscle and fat volume of the multifidus
- Included patients who only received one unilateral LRFA

Conclusion:

- Concluded there was reduced skeletal muscle cross sectional area following LRFA

Limitations: ***see discussion to the right

- ***Variables that may have contributed to the different conclusions of Smuck, Oswald, and Guven:
- Variability in timing of post-LRFA MRIs, raising the question of when multifidus atrophy should be expected.
 - Inclusion of repeat MRI subjects may bias toward those with worsening symptoms/degeneration.
 - Control selection confounded by debate over multifidus innervation (monosegmental vs. polysegmental).

Conclusion

- The variability in study design, measurement parameters, sample size, methods, and conflicting results leaves the nature and extent of post-LRFA multifidus atrophy unresolved.
- The scarcity of high-quality research and the lack of standardized methods to evaluate post-procedural structural and functional changes underscore the need for well-designed prospective studies.

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Figure 2. Literature Review Results & Discussion By Article. Quality of research determined by the Newcastle-Ottawa quality assessment scale.¹¹ Conclusions in red report against the development of multifidus atrophy post LRFA; whereas conclusions in green report the development of multifidus atrophy post LRFA. Conclusions in gray are equivocal.