# Ultrasound-Guided Epidural Steroid Injections: A Narrative Review of Pathology-Specific Evidence Gaps

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## Background

Epidural steroid injections (ESIs) are among the most commonly performed interventional pain procedures in the United States. Under fluoroscopic (FL) guidance, ESI efficacy varies substantially by underlying spinal pathology: strong evidence supports benefit in disc herniation-related radiculopathy and weaker evidence exists for spinal stenosis. Ultrasound (US) guidance has emerged as a radiation-free alternative with comparable outcomes and reduced procedure time compared to FL guidance. However, whether US-guided ESI outcomes similarly vary across spinal pathologies has not been systematically examined. This narrative review evaluates the existing US-guided ESI literature to identify gaps in pathology-specific evidence.

## Methods

A comprehensive scientific literature search was conducted through specialized databases including MEDLINE, EMBASE, PubMed, and Cochrane Library from 2015-2026. The search terms used to retrieve relevant literature were "ultrasound-guided" AND "epidural steroid injection" AND ("radiculopathy" OR "spinal stenosis" OR "degenerative disc disease" OR "post-laminectomy").

**Disclosures & Ethics**

- **COI:** Authors declare no conflicts of interest.
- **IRB:** Exempt per OBH policy (devoid of patient identifiable data).
- **Off-Label:** No off-label drug or unapproved device use described.

## Results / Evidence

| Study | Year | Design | N | Spinal Region | Pathology | Approach | Comparator | Key Findings |
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| **Evansa et al.** | 2015 | RCT | 112 | Lumbar | Mixed degenerative disease | Interlaminar | FL-guided | No difference in VAS or ODI at 1 and 3 months |
| **Yang et al.** | 2016 | RCT | 80 | Lumbar | Radiculopathy (disc herniation) | Transforaminal | FL-guided | Equivalent VAS reduction; shorter procedure time with US |
| **Zhang et al.** | 2019 | Prospective pilot | 15 | Cervical | Radiculopathy | Transforaminal | None (single-arm) | Sustained pain relief in 11/15 patients at 6 months |
| **Cui et al.** | 2022 | RCT | 156 | Cervical | Radiculopathy | Selective nerve root block | FL-guided | Non-inferior NRS at 1, 3, and 6 months |
| **Plaikner et al.** | 2023 | RCT | 39 | Sacral (S1) | S1 radiculopathy | Periradicular (S1 nerve) | CT-guided | Comparable VAS reduction at 1 month; shorter procedure time (4.4 vs 6.5 min) with US |
| **Zhao et al.** | 2023 | RCT | 164 | Lumbar | Radiculopathy (disc herniation) | Transforaminal | FL-guided | Non-inferior VAS/ODI; fewer vascular punctures with US |
| **Yue et al.** | 2023 | RCT | 430 | Cervical | Radiculopathy (herniated disk/spondylosis) | Transforaminal | CT fluoroscopy-guided | Non-inferior contrast dispersion (92.1% vs 95.8%); comparable NRS/NDI at 1 and 3 months |
| **Kimura et al.** | 2023 | Systematic review & meta-analysis | 8 RCTs (962 pts) | Cervical/Lumbar | Mixed (radiculopathy predominant) | Mixed | FL/CT-guided | Comparable pain outcomes; shorter procedure time and lower radiation with US |
| **Ahmed et al.** | 2023 | Meta-analysis | 7 studies | Lumbar | Radiculopathy | Mixed | FL-guided | No significant difference in pain reduction or functional outcomes |
| **Miranda et al.** | 2026 | Systematic review & meta-analysis | 7 studies (1,104 pts) | Cervical | Radiculopathy | Transforaminal | FL-guided | Comparable analgesic efficacy; lower vascular injection risk with US |

## Discussion and Conclusions

Current evidence supports US-guided ESI efficacy primarily in radiculopathy secondary to disc herniation. The pathology-dependent efficacy hierarchy well-established under FL guidance remains unexamined under US guidance. Notably, the ACR-ASNR-ASSR-SIR-SNIS Practice Parameter (2025) acknowledges that US has "significant limitations based on pathology" yet cites no pathology-specific outcome data to guide patient selection. As US adoption increases in the field of physiatry/pain medicine, pathology-specific selection criteria are needed. Future RCTs should stratify outcomes by spinal diagnosis, particularly on stenosis, degenerative disc disease, and post-surgical pain populations.

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