Technology Assessment

Technology Assessment Program

Pain Management Injection Therapies for Low Back Pain

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Erratum

In Table 1 and Appendix E1, patient characteristics, number analyzed, and pain scores were edited to reflect 24 month followup data for one trial publication.[1] In Table 1 and Appendix E1, a correction was made to note that imaging correlation was required for one trial (with two publications).[2, 3] The quality rating for this same trial was changed from fair to good in Table 1 to match the rating in Appendix E1.[2, 3] These edits do not affect the report conclusions.

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Pain Management Injection Therapies for Low Back Pain

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Key Informants

In designing the study questions, the Evidence-based Practice Center (EPC) consulted several Key Informants who represent the end-users of research. The EPC sought the Key Informant input on the priority areas for research and synthesis. Key Informants are not involved in the analysis of the evidence or the writing of the report. Therefore, in the end, study questions, design, methodological approaches, and/or conclusions do not necessarily represent the views of individual Key Informants.

Key Informants must disclose any financial conflicts of interest greater than $10,000 and any other relevant business or professional conflicts of interest. Because of their role as end-users, individuals with potential conflicts may be retained. The Task Order Officer and the EPC work to balance, manage, or mitigate any conflicts of interest.
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In place of a Technical Expert Panel, CMS provided input to the Key Questions and scope of the report.

Peer Reviewers

Prior to publication of the final evidence report, the EPC sought input from independent Peer Reviewers without financial conflicts of interest. However, the conclusions and synthesis of the scientific literature presented in this report does not necessarily represent the views of individual reviewers.

Peer Reviewers must disclose any financial conflicts of interest greater than $10,000 and any other relevant business or professional conflicts of interest. Because of their unique clinical or content expertise, individuals with potential non-financial conflicts may be retained. The Task Order Officer and the EPC work to balance, manage, or mitigate any potential non-financial conflicts of interest identified.

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Pain Management Injection Therapies for Low Back Pain

Structured Abstract

Objectives. Low back pain is common and injections with corticosteroids are a frequently used treatment option. This report reviews the current evidence on effectiveness and harms of epidural, facet joint, and sacroiliac corticosteroid injections for low back pain conditions.

Data Sources. A prior systematic review (searches through July 2008), electronic databases (Ovid MEDLINE, Scopus, and the Cochrane Libraries from January 2008 through October 2014), reference lists, and clinical trials registries.

Review Methods. Using predefined criteria, we selected randomized trials of patients with lumbosacral radiculopathy, spinal stenosis, nonradicular back pain, or chronic postsurgical back pain that compared effectiveness or harms of epidural, facet joint, or sacroiliac corticosteroid injections versus placebo or other interventions. We also included randomized trials that compared different injection techniques and large (sample sizes >1000) observational studies of back injections that reported harms. The quality of included studies was assessed, data were extracted, and results were summarized qualitatively and using meta-analysis on outcomes stratified by immediate- (1 week to ≤2 weeks), short- (2 weeks to ≤3 months), intermediate- (3 months to <1 year), and long-term (>1 year) followup.

Results. Seventy-eight randomized trials of epidural injections, 13 trials of facet joint injections, and one trial of sacroiliac injections were included. For epidural corticosteroid injections versus placebo interventions for radiculopathy, the only statistically significant effects were on mean improvement in pain at immediate-term followup (weighted mean difference [WMD] –7.55 on a 0 to 100 scale, 95% CI –11.4 to –3.74) (strength of evidence [SOE]: moderate), mean improvement in function at immediate-term followup when an outlier trial was excluded (standardized mean difference [SMD] –0.33, 95% CI –0.56 to –0.09) (SOE: low), and risk of surgery at short-term followup (relative risk [RR] 0.62, 95% CI 0.41 to 0.92) (SOE: low). The magnitude of effects on pain and function was small, did not meet predefined thresholds for minimum clinically important differences, and there were no differences on outcomes at longer-term followup. Evidence on effects of different injection techniques, patient characteristics, or comparator interventions estimates was limited and did not show clear effects. Trials of epidural corticosteroid injections for radiculopathy versus nonplacebo interventions did not clearly demonstrate effectiveness (SOE: insufficient to low).

Evidence was limited for epidural corticosteroid injections versus placebo interventions for spinal stenosis (SOE: low to moderate) or nonradicular back pain (SOE: low), but showed no differences in pain, function, or likelihood of surgery.

Studies found no clear differences between various facet joint corticosteroid injections (intra-articular, extra-articular [peri-capsular], or medial branch) and placebo interventions (SOE: low to moderate). There was insufficient evidence from one very small trial to determine effects of peri-articular sacroiliac joint corticosteroid injections injection (SOE: insufficient).

Serious harms from injections were rare in randomized trials and observational studies, but harms reporting was suboptimal (SOE: low).

Conclusions: Epidural corticosteroid injections for radiculopathy were associated with immediate improvements in pain and might be associated with immediate improvements in function, but benefits were small and not sustained, and there was no effect on long-term risk of surgery. Evidence did not suggest that effectiveness varies based on injection technique, corticosteroid, dose, or comparator. Limited evidence suggested that epidural corticosteroid injections are not effective for spinal stenosis or nonradicular back pain and that facet joint corticosteroid injections are not effective for presumed facet joint pain. There was insufficient evidence to evaluate effectiveness of sacroiliac joint corticosteroid injections.

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Pain Management Injection Therapies for Low Back Pain

Executive Summary

Background

Low back pain is one of the most frequently encountered conditions in clinical practice. Up to 84 percent of adults have low back pain at some time in their lives, and a national survey of U.S. adults in 2002 found that over one-quarter reported low back pain lasting at least a whole day in the previous 3 months.[1, 2] Although low back pain affects individuals of all ages, its prevalence peaks at 55 to 64 years of age and remains common in those 65 years of age and older.[3] Low back pain can have major adverse impacts on quality of life and function and is frequently associated with depression or anxiety. Low back pain is also costly. In 1998, total U.S. health care expenditures for low back pain were estimated at $90 billion.[4] Since that time, costs of low back pain care have risen substantially, at a rate higher than observed for overall health expenditures.[5] Low back pain is one of the most common reasons for missed work or reduced productivity while at work, resulting in high indirect costs; this makes the total costs associated with low back pain substantially higher than the direct health care costs.[6]

The prognosis of acute low back pain (an episode lasting less than 4 weeks) is generally favorable. Following onset of low back pain, most patients experience a rapid improvement in (and often a complete resolution of) pain and disability and are able to return to work.[7] In those with persistent symptoms, continued improvement is often seen in the subacute phase between 4 and 12 weeks, though at a slower rate than observed in the acute phase. In a minority of patients, low back pain lasts longer than 12 weeks, at which point it is considered chronic, and levels of pain and disability often remain relatively constant.[8] Such patients appear to account for the bulk of the burdens and costs associated with low back pain.[9, 10]

In the majority (>85%) of patients with low back pain, symptoms cannot be attributed to a specific disease or spinal pathology.[11] Spinal imaging abnormalities such as degenerative disc disease, facet joint arthropathy, and bulging or herniated intervertebral discs are extremely common in patients with low back pain, particularly in older adults. However, such findings poorly predict the presence or severity of low back pain.[12] Radiculopathy from nerve root impingement and spinal stenosis (narrowing of the spinal canal) each occur in about 4 to 5 percent of patients with low back pain and can cause neurological symptoms such as lower extremity pain, paresthesias, and weakness.[13, 14]

Multiple treatment options for subacute and chronic low back pain are available. Broadly, these can be classified as pharmacological treatments,[15] nonpharmacological treatments (e.g., exercise therapy, cognitive behavioral therapy, spinal manipulation, acupuncture, and others),[16] injection therapies,[17] and surgical treatments.[18] Injection therapies, the topic of this evidence review, include injections of medications to various structures in and around the spine (such as the epidural space, facet joints, intervertebral discs, and soft tissues).[17] The most commonly used medications in back injections are corticosteroids to reduce inflammation and local anesthetics for analgesia, though others (such as anti-tumor necrosis factor agents, clonidine, methylene blue, and ozone) have also been studied. Corticosteroid injections can be administered into the epidural space or in and around the facet joints. Other interventional therapies involve the

application of various types of energy to ablate pain-generating nerves, without the injection of medications.[17] Ablative therapies include radiofrequency denervation, intradiscal electrothermal therapy, percutaneous intradiscal radiofrequency thermocoagulation, and other procedures.

Between 1994 and 2001, use of epidural injections increased by 271 percent and facet joint injections by 231 percent among Medicare beneficiaries.[19] Total inflation-adjusted reimbursed costs (based on professional fees only) increased from $24 million to over $175 million over this time period. More recent data indicate continued rapid growth in use of spinal injection therapies among Medicare beneficiaries, with an increase of 187 percent in use between 2000 and 2008.[19]

Despite these dramatic increases, use of injection therapies for low back pain remains controversial. Systematic reviews of injection therapies have come to conflicting conclusions regarding the benefits of injection therapies,[17, 20-27] and clinical practice guidelines provide discordant recommendations regarding their use.[28-34] An important challenge in interpreting the evidence on injection therapies is the inconsistency of results across trials. Some of this inconsistency could be due to variability across studies in the methods used to select patients for inclusion, the specific injection techniques used, the comparisons evaluated, and the outcomes assessed.[17] For example, trials of epidural corticosteroid injections for radiculopathy differ in how they define radiculopathy, whether imaging correlation with symptoms is required to be eligible for inclusion, the specific findings on imaging required for eligibility, the duration of pain, and other factors. All of these factors, which impact how patients are selected for study inclusion, could affect outcomes related to the injection therapy. There has also been variability in methods used to approach the epidural space (e.g., interlaminar [via the interlaminar space in the spine], transforaminal [through the neuroforamen of the exiting nerve root], or caudal [through the sacral hiatus at the sacral canal]), the use of fluoroscopic guidance, the volume of injectate administered, the specific corticosteroid and dose used, the local anesthetic used, and the number of injections and levels injected.[23] In addition, trials have compared an epidural corticosteroid injection to an epidural saline injection, epidural injection of local anesthetic without corticosteroid, a soft tissue injection with local anesthetic and/or saline, no injection, or noninjection comparators.[35] Similarly, for trials of facet joint injections, diagnostic methods for identifying patients with presumed facet joint pain vary across studies, including use of single or double facet joint blocks, the type and dose of corticosteroid injected, and the location of the injection (e.g., intra-articular [into the facet joint] or peri-articular [around the facet joint]).[28] Although medial branch blocks, which are performed at the medial branch of the primary dorsal ramus nerves that innervate the facet joints were originally developed as a diagnostic test to determine presence of facet joint, they have also been evaluated as therapeutic facet joint injections using corticosteroid and/or local anesthetic.

All of these factors could introduce heterogeneity and make it difficult to determine whether negative results in a given trial are due to suboptimal patient selection, an ineffective therapy, or some combination of both factors.[17] Another challenge is that trials of injection therapies have frequently focused on short-term outcomes related to pain, rather than longer-term functional outcomes.

Given the continued growth in use of epidural, facet joint, and sacroiliac injections for low back pain and continued uncertainty regarding their role and optimal use, the purpose of this systematic review is to summarize the current state of evidence, identify and evaluate inconsistencies in the evidence on these therapies, and identify important research gaps.

Scope of Review and Key Questions

The Key Questions used to guide this report are shown below. The analytic framework (**Figure A**) shows the target populations, interventions, and outcomes that we examined.

Key Question 1. In patients with low back pain, what is the effectiveness of epidural corticosteroid injections, facet joint corticosteroid injections, medial branch blocks, and sacroiliac joint corticosteroid injections versus epidural nonsteroid injection, nonepidural injection, no injection, surgery or nonsurgical therapies on outcomes related to pain, function and quality of life?

Key Question 1a. How does effectiveness vary according to the medication (corticosteroid, local anesthetic) used, the dose or frequency of injections, the number of levels treated, or degree of provider experience?

Key Question 1b. How does effectiveness vary according to use of imaging guidance or route of administration (e.g., for epidural injections interlaminar, transforaminal, caudal for epidural injections and for facet joint injections intra-articular, extra-articular [peri-capsular] or medial branch injections)?

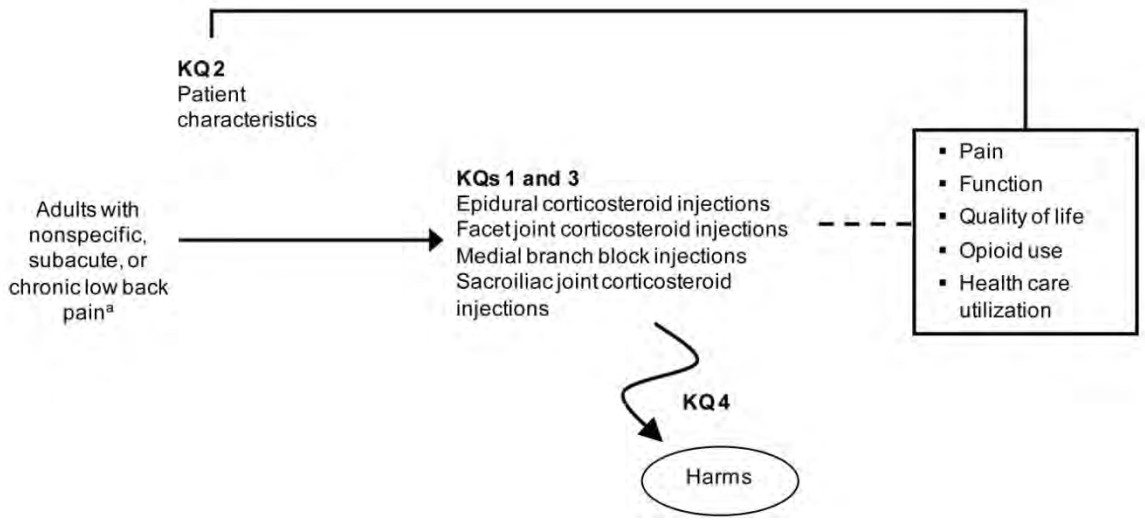
Key Question 2. In patients with low back pain, what patient characteristics predict responsiveness to injection therapies on outcomes related to pain, function, and quality of life?

Key Question 3. In randomized trials of low back pain injection therapies, how does effectiveness vary according to the control therapy used (e.g., epidural nonsteroid injection, nonepidural injection, no injection)?

Key Question 3a. How do response rates vary according to the specific comparator evaluated (e.g., saline epidural, epidural with local anesthetic, nonepidural injection, no injection, surgery, nonsurgical therapies)?

Key Question 4. What are the harms of epidural corticosteroid, facet joint corticosteroid injections, medial branch blocks, and sacroiliac joint corticosteroid injection compared to epidural nonsteroid injection, nonepidural injection, no injection, surgery, or nonsurgical therapies?

Figure A. Analytic framework for pain management injection therapies for low back pain



[a] Patients with nonradicular low back pain, low back pain with radiculopathy, and low back pain with spinal stenosis.

Objectives

Low back pain is common and injections with corticosteroids are a commonly used treatment option. This report reviews the current evidence on effectiveness and harms of epidural, facet joint, and sacroiliac corticosteroid injections for low back pain conditions.

Methods

The methods for this Technology Assessment follow the methods suggested in the Agency for Healthcare Research and Quality (AHRQ) Methods Guide for Effectiveness and Comparative Effectiveness Reviews.[36] All methods were determined *a priori*.

Input From Stakeholders

This topic was selected for review based on a nomination from the Centers for Medicare and Medicaid Services (CMS). The initial Key Questions for this Technology Assessment were developed with input from CMS staff. The Key Questions and scope were further developed with input from a group of stakeholders (Key Informants) convened for this report to provide diverse stakeholder perspectives and content and methodological expertise. The Key Informants consisted of experts in internal medicine, health services research, pain medicine, radiology, neurology, occupational medicine, and physical medicine and rehabilitation, as well as those representing the patient perspective. Key Informants disclosed financial and other conflicts of interest prior to participation. The AHRQ Task Order Officer and the investigators reviewed the disclosures and determined that the Key Informants had no conflicts of interest that precluded participation. A topic refinement document was then posted for public comment from December 17, 2013, through January 17, 2014 with the Key Questions and inclusion criteria. Based on

public comments, we further revised the scope. The protocol for this Technology Assessment was finalized prior to initiation of the review, and was posted on the AHRQ Web site.

Literature Search Strategy

A research librarian conducted searches in Ovid MEDLINE, the Cochrane Central Register of Controlled Trials, the Cochrane Database of Systematic Reviews, and the National Guideline Clearinghouse from 2008 through October, 2014 (see Appendix A for full search strategy). We restricted search start dates to January 2008, as there are multiple recent systematic evidence reviews directly addressing the Key Questions in the current review, including a good-quality review conducted by the same investigators of the current review that was commissioned by the American Pain Society (APS) and conducted searches through July 2008.[17] The APS review included all of the interventions addressed in the current review. We used the APS review and other systematic reviews[37] to identify studies published prior to 2008.

We also hand searched the reference lists of relevant studies and searched for unpublished studies in ClinicalTrials.gov. We did not solicit Scientific Information Packets for published and unpublished studies because the corticosteroid and local anesthetic drugs examined in this review are generic and the injections do not involve use of proprietary devices.

Literature searches will be updated while the draft report is posted for public comment and undergoing peer review to identify any new publications. Literature identified during the update search will be assessed by following the same process of dual review as all other studies considered for inclusion in the report. If any pertinent new literature is identified for inclusion in the report, it will be incorporated before the final submission of the report.

Study Selection

We developed criteria for inclusion and exclusion of articles based on the Key Questions and the populations, interventions, comparators, outcomes, timing, setting approach (Appendix B), in accordance with the AHRQ Methods Guide.[38] Articles were selected for full-text review if they were about epidural injections, facet joint injections, therapeutic medial branch injections, or sacroiliac injections with corticosteroids for radicular low back pain, spinal stenosis, or nonradicular low back pain, were relevant to a Key Question, and met the predefined inclusion criteria as described below. We excluded studies published only as conference abstracts, restricted inclusion to English-language articles, and excluded studies of nonhuman subjects. Studies had to report original data to be included.

To ensure accuracy, all excluded abstracts were dual reviewed. All citations deemed appropriate for inclusion by at least one of the reviewers were retrieved. Each full-text article was independently reviewed for eligibility for final inclusion by two team members. Discrepancies were resolved through discussion and consensus. A list of the included studies is available in Appendix C; excluded studies are shown Appendix D, with primary reasons for exclusion. Members of the review team were not involved in inclusion decisions for studies that they were authors on.

For epidural injections, we selected studies of adults undergoing epidural corticosteroid injections with radicular low back pain, spinal stenosis, nonradicular low back pain, or chronic postsurgical pain. We defined radiculopathy as presence of leg pain (typically worse than back pain), with or without sensory deficits or weakness, in a nerve root distribution. A number of studies used the term "sciatica," which we classified as radiculopathy. We included epidural injections performed via any approach, including the transforaminal, interlaminar, or caudal

techniques. We also included studies of injections performed via the transforaminal approach that targeted the affected nerve root but did not necessarily enter the epidural space ("periradicular" injections).

For facet joint and sacroiliac injections, we selected studies of adults undergoing corticosteroid injections in or around the facet or sacroiliac joints for nonradicular low back pain presumed to originate from the facet joints (facet injections) or sacroiliac joints (sacroiliac injections). We included injections into the joint (intra-articular) or around the joint (extra-articular [peri-articular]), as well as therapeutic medial branch blocks (injections at the site of the medial branch of the dorsal ramus nerves innervating the facet joints).

We excluded studies of patients younger than 18 years of age, pregnant women, and patients with back pain due to fracture, high-impact trauma, cancer, infection, or spondyloarthropathy. We excluded studies of noninjection ablative therapies such as intradiscal electrothermal therapy or radiofrequency denervation, other noninjection therapies such as nucleoplasty, and studies that involved injection of noncorticosteroid medications (such as ozone, antitumor necrosis factor medications, methylene blue, or clonidine) unless they were compared to a corticosteroid injection. Studies on the diagnostic accuracy of diagnostic blocks was outside the scope of the review, but we evaluated how use of diagnostic blocks to select patients impacted estimates of effectiveness.

We included studies of patients with symptoms of any duration prior to enrollment. We included studies that compared the injections of interest versus epidural nonsteroid injections, soft tissue injections, no injection, surgery, or noninjection, nonsurgical therapies. We classified epidural injections with local anesthetics or saline, soft tissue injections with local anesthetics or saline, and no injections as "placebo" interventions to distinguish them from "active" interventions such as epidural injections of other medications, other interventional procedures, surgery, or nonsurgical, noninterventional therapies. We also included studies that compared different injection techniques and corticosteroid doses.

Outcomes were pain, function, quality of life, opioid use, subsequent surgery, health care utilization, and harms, including bleeding, infection, neurological events, and systemic complications such as weight gain, diabetes, osteoporosis, and other endocrinological effects. We included outcomes measured 1 week or later after the injection.

We included randomized trials for all Key Questions. For harms, we also included large (sample size >1000 patients) treatment series of patients who underwent the injections of interest. We excluded case series and case reports. We reviewed reference lists of systematic reviews for potentially relevant references.

Data Extraction

We extracted the following information from included studies into evidence tables using Excel spreadsheets: study design, year, setting, country, sample size, inclusion and exclusion criteria (including age, sex, race, back pain condition, duration of pain, baseline pain, baseline function, prior therapies, imaging and diagnostic findings, and psychosocial factors), intervention characteristics (including type and dose of corticosteroid and local anesthetic, volume of injectate, number and frequency of injections, levels injected, injection approach, use of imaging guidance, and experience of the person performing the injection), characteristics of the control intervention, and results.

For studies of interventions, we calculated relative risks and associated 95 percent confidence intervals (CI) based on the information provided (sample sizes and incidence of outcomes of

interest in each intervention group). We noted discrepancies between calculated and reported results when present.

Data extraction for each study was performed by two investigators. The first investigator extracted the data, and the second investigator independently reviewed the extracted data for accuracy and completeness.

Assessing Quality

We assessed quality (risk of bias) for each study using predefined criteria. We used the term "quality" rather than the alternate term "risk of bias;" both refer to internal validity. Randomized trials were evaluated with criteria and methods developed by the Cochrane Back Review Group.[39] These criteria were applied in conjunction with the approach recommended in the chapter, Assessing the Risk of Bias of Individual Studies When Comparing Medical Interventions,[38] in the AHRQ Methods Guide. Two investigators independently assessed the quality of each study. Discrepancies were resolved through discussion and consensus. Members of the review team who were authors on included studies were not involved in quality rating of those studies.

Individual studies were rated as having "poor," "fair," or "good" quality. We rated the quality of each randomized trial based on the methods used for randomization, allocation concealment, and blinding; the similarity of compared groups at baseline; whether attrition was adequately reported and acceptable; similarity in use of cointerventions; compliance to allocated treatments; the use of intent-to-treat analysis; and avoidance of selective outcomes reporting.[39, 40]

Studies rated "good quality" are considered to have low risk of bias and their results are likely to be valid. Studies rated "fair quality" have some methodological shortcomings, but no flaw or combination of flaws judged likely to cause major bias. In some cases, the article did not report important information, making it difficult to assess its methods or potential limitations. The "fair-quality" (moderate risk of bias) category is broad and studies with this rating vary in their strengths and weaknesses; the results of some studies assessed to have moderate risk of bias are likely to be valid, while others may be only possibly valid. Studies rated "poor quality" (high risk of bias) have significant flaws that may invalidate the results. They have a serious or "fatal" flaw or combination of flaws in design, analysis, or reporting; large amounts of missing information (including publication of only preliminary results in a subgroup of patients randomized); or serious discrepancies in reporting. The results of these studies are at least as likely to reflect flaws in the study design as the differences between the compared interventions. We did not exclude poor quality studies *a priori*, but they were considered the least reliable when synthesizing the evidence, particularly when discrepancies between studies were present.

Treatment series of patients undergoing injection therapies were not formally rated because they already are known to have serious limitations due to the lack of a control group of patients who did not undergo injections.

Assessing Research Applicability

We recorded factors important for understanding the applicability of studies, such as whether the publication adequately described the study sample, the country in which the study was conducted, the characteristics of the patient sample (e.g., age, sex, race, type of back pain, imaging findings, duration or severity of pain, medical comorbidities, and psychosocial factors), the characteristics of the interventions used (e.g., specific corticosteroid, dose, technique, number or frequency of injections, and use of imaging guidance), and the magnitude of effects on clinical

outcomes.[41] We also recorded the funding source and role of the sponsor. We did not assign a rating of applicability (such as high or low) because applicability may differ based on the user of the report.

For interpreting the clinical importance of mean changes in outcome scores, we defined a minimum clinically important difference as an improvement in 15 points on a 0 to 100 pain scale, 10 points on the Oswestry Disability Index (ODI), and 5 points on the Roland Morris Disability Questionnaire (RDQ).[42] These thresholds were recommended in a report from a panel of 36 experts in the low back pain field following a review of the evidence.[42]

Evidence Synthesis and Rating the Body of Evidence

We constructed evidence tables summarizing study characteristics, results, and quality ratings for all included studies. We summarized evidence for each Key Question qualitatively using a hierarchy-of-evidence approach, where the best evidence was the focus of our synthesis for each Key Question.

We conducted meta-analyses to summarize data and obtain more precise estimates for outcomes and comparisons for which studies were homogeneous enough to provide a meaningful combined estimate.[43] Comparisons for which evidence was suitable for pooling were epidural corticosteroid injection versus placebo (epidural local anesthetic injection, epidural saline injection, soft tissue local anesthetic injection, soft tissue saline injection, needling with no injection, or no injection) for radiculopathy, epidural corticosteroid injection versus placebo for spinal stenosis, and transforaminal versus interlaminar epidural injections with corticosteroid for radiculopathy.

Outcomes were extracted and stratified by duration of followup as immediate (≤2 weeks), short term (2 weeks to ≤3 months), intermediate term (3 months to <1 year), and long term (>1 year). For each category, we used the longest duration data available. We analyzed two continuous outcomes: pain and function. For pain, we used pain as measured on a 0 to 10 or 0 to 100 visual analogue or numerical rating scale and converted all scores to 0 (no pain) to 100 (worst possible pain). We used data for leg pain when available; if leg pain was not specifically reported we used overall pain (leg pain is typically worse than back pain in patients with radiculopathy). For studies that assessed function using more than one measure, we prioritized the outcome used for pooling in the following order: the ODI (range 0 to 100), the RDQ (range 0 to 24), and other function scales. In the primary analyses, we combined weighted mean difference (WMD) for pain and standardized mean difference (SMD) for function. The mean difference was calculated using the change between the followup and baseline scores. We also conducted sensitivity analysis based on differences in scores at followup and estimates from analysis of covariance or other results that adjusted for other covariates if available; results were similar to the primary analyses and not reported further. When the standard deviation was missing, we imputed the missing value using the mean standard deviation from other studies in that analysis. For binary outcomes, we combined relative risks (RR) for pain and function "success" (e.g., ≥50% improvement in pain scores or ODI, or as otherwise defined in the trials), composite or overall measures of success (e.g., ≥50% improvement in pain and ≥50% function, or as otherwise defined in the trials), and rates of subsequent surgery. In addition, we pooled placebo response rates for the binary pain and function and mean difference in change scores for pain and function in the placebo group (as a measure of placebo response), stratified by the comparator used.

The studies were combined using the Dersimonian-Laird random effects method. We assessed the presence of statistical heterogeneity among the studies by using the standard Cochran's chi-square test, and the magnitude of heterogeneity by using the I^2 statistic.[44] When statistical heterogeneity was present, we performed sensitivity analyses by conducting meta-analysis using the profile likelihood method.[45] For the primary analyses of epidural injections versus placebo, we pooled across approaches (transforaminal, interlaminar, or caudal), but also stratified the results by approach. We performed sensitivity analyses by excluding poor quality studies and outlier studies. When the number of studies was relatively large (8 to 10),[43] we performed additional subgroup analyses and meta-regression based on the specific corticosteroid used, the corticosteroid dose (converted into prednisolone equivalents, for transforaminal ≥50 mg vs. <50 mg; for interlaminar and caudal, ≥100 mg vs. <100 mg), the local anesthetic used, the specific comparator (epidural injection with local anesthetic, epidural injection with saline, soft tissue injection with local anesthetic, soft tissue injection with saline, needling without injection, or no injection), the volume of injected (for transforaminal, >3 ml vs. ≤3 ml; for interlaminar, ≥10 ml vs. <10 ml; for caudal, ≥20 ml vs. <20 ml), the duration of symptoms (restricted to acute [symptoms ≤4 weeks]), whether imaging correlation was required for patient enrollment, whether enrollment was restricted to patients with herniated disc on imaging, use of fluoroscopic guidance, whether the intervention was limited to a single injection, whether patients with prior surgery were excluded, overall quality rating (good, fair, poor), whether the person performing the injection was blinded, and blinding of outcomes assessors and patients. For transforaminal injections, we also stratified studies according to whether the injection clearly entered the epidural space or targeted the nerve root ("periradicular") without clearly entering the epidural space. Similar analyses were performed for the analysis of transforaminal versus interlaminar injections when data allowed. A funnel plot was created and the Egger test performed for primary analyses across approaches (transforaminal, interlaminar, or caudal) with 10 studies to assess for small study effects.[46] All analyses were conducted using Stata/IC 13.0 (StataCorp LP, College Station, TX).

We assessed the strength of evidence (SOE) for each Key Question and outcome using the approach described in the AHRQ Methods Guide,[38] based on the overall quality of each body of evidence, based on the risk of bias (graded low, moderate, or high); the consistency of results across studies (graded consistent, inconsistent, or unable to determine when only one study was available); the directness of the evidence linking the intervention and health outcomes (graded direct or indirect); and the precision of the estimate of effect, based on the number and size of studies and confidence intervals for the estimates (graded precise or imprecise).

We graded the SOE for each Key Question using the four categories recommended in the AHRQ Methods Guide.[38] A "high" grade indicates high confidence that the evidence reflects the true effect and that further research is very unlikely to change our confidence in the estimate of effect. A "moderate" grade indicates moderate confidence that the evidence reflects the true effect and further research may change our confidence in the estimate of effect and may change the estimate. A "low" grade indicates low confidence that the evidence reflects the true effect and further research is likely to change the confidence in the estimate of effect and is likely to change the estimate. An "insufficient" grade indicates evidence either is unavailable or is too limited to permit any conclusion, due to the availability of only poor quality studies, extreme inconsistency, or extreme imprecision.

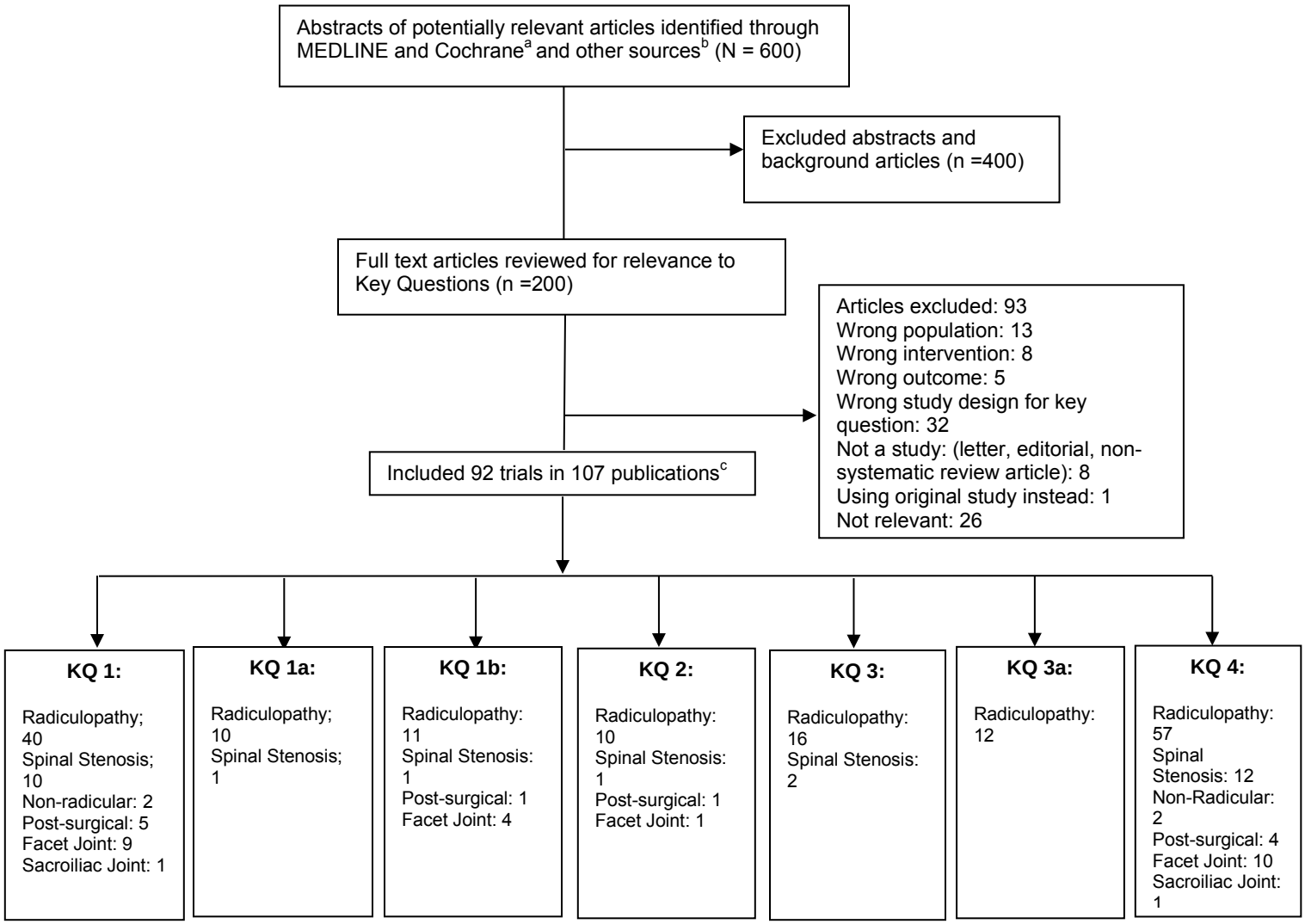
Peer Review and Public Commentary

Experts in low back pain and injection therapies, as well as individuals representing important stakeholder groups, have been invited to provide external peer review of this Technology Assessment. The AHRQ Task Order Officer will also provide comments and editorial review. To obtain public comment, the draft report was posted on the AHRQ Web site for 2 weeks. A disposition of comments report detailing the authors' responses to the peer and public review comments will be made available after AHRQ posts the final report on the public Web site.

Results

We included a total of 92 randomized trials (reported in 107 publications): 78 randomized trials of epidural corticosteroid injections, 13 trials of facet joint injections, and 1 trial of sacroiliac injections were included (Figure B).

Figure B. Literature flow diagram



[a] Cochrane databases include the Cochrane Central Register of Controlled Trials and the Cochrane Database of Systematic Reviews.
[b] Other sources include reference lists of relevant articles, systematic reviews, etc.
[c] Some studies are included for more than one Key Question.

For epidural corticosteroid injections versus placebo interventions for radiculopathy, the only statistically significant effects were on mean improvement in pain at immediate-term followup (WMD –7.55 on a 0 to 100 scale, 95% CI –11.4 to –3.74) (SOE: moderate), mean improvement in function at immediate-term followup when an outlier trial was excluded (SMD –0.33, 95% CI –0.56 to –0.09) (SOE: low), and risk of surgery at short-term followup (RR 0.62, 95% CI 0.41 to 0.92) (SOE: low). The magnitude of effects on pain and function was small, did not meet predefined thresholds for minimum clinically important differences, and there were no differences on outcomes at longer-term followup. Evidence on effects of different injection techniques, patient characteristics, or comparator interventions estimates was limited and did not show clear effects. Trials of epidural corticosteroid injections for radiculopathy versus nonplacebo interventions did not clearly demonstrate effectiveness (SOE: insufficient to low).

Evidence was limited for epidural corticosteroid injections versus placebo interventions for spinal stenosis (SOE: low to moderate) or nonradicular back pain (SOE: low), but showed no differences in pain, function, or likelihood of surgery.

Studies found no clear differences between various facet joint corticosteroid injections (intra-articular, extra-articular [peri-capsular], or medial branch) and placebo interventions (SOE: low to moderate). There was insufficient evidence from one very small trial to determine effects of periarticular sacroiliac joint corticosteroid injections injection (SOE: insufficient).

Serious harms from injections were rare in randomized trials and observational studies, but harms reporting was suboptimal (SOE: low).

Discussion

Key Findings and Strength of Evidence Summary

The key findings of this review are summarized in the summary of evidence table (**Table A**) below.

Table A. Summary of evidence

Key Question Outcome	Strength of Evidence Grade	Conclusion
Key Question 1. In patients with low back pain, what is the effectiveness of epidural corticosteroid injections, facet joint corticosteroid injections, medial branch blocks, and sacroiliac joint corticosteroid injections vs. epidural nonsteroid injection, nonepidural injection, no injection, surgery or nonsurgical therapies on outcomes related to pain, function and quality of life?		
Epidural injections for radiculopathy		
Epidural corticosteroid injections vs. placebo interventions		
Mean improvement in pain, immediate-term followup	Moderate	Epidural corticosteroid injections associated with greater improvement vs. placebo interventions (6 trials, WMD –7.55 on 0 to 100 scale, 95% CI –11.4 to –3.74, I2=30%)
Mean improvement in pain, short-term followup	Low	No difference (14 trials, WMD –3.94, 95% CI –9.11 to 1.24, I2=82%)

Key Question Outcome	Strength of Evidence Grade	Conclusion
Mean improvement in pain, intermediate-term followup	Low	No difference (4 trials, WMD –0.07, 95% CI –8.41 to 8.26, I2=82%)
Mean improvement in pain, long-term followup	Moderate	No difference (6 trials, WMD –0.86, 95% CI –3.78 to 2.06, I2=0%)
Successful pain outcome, short-term followup	Low	No difference (8 trials, RR 1.21, 95% CI 0.98 to 1.49, I2=67%)
Successful pain outcome, intermediate-term followup	Low	No difference (3 trials, RR 1.12, 95% CI 0.93 to 1.36, I2=41%)
Successful pain outcome, long-term followup	Moderate	No difference (4 trials, RR 1.10, 95% CI 0.94 to 1.28, I2=0%)
Mean improvement in function, immediate-term followup	Low	No difference, based on all trials (4 trials, SMD –0.75, 95% CI –1.62 to 0.11, I2=94%). Excluding an outlier trial eliminated statistical heterogeneity and resulted in a statistically significant effect favoring epidural corticosteroid injections (3 trials, SMD –0.33, 95% CI –0.56 to –0.09, I2=0%)
Mean improvement in function, short-term followup	Moderate	No difference (11 trials, SMD –0.03, 95% CI –0.20 to 0.15, I2=53%)
Mean improvement in function, intermediate-term followup	Low	No difference (5 trials, SMD –0.30, 95% CI –0.74 to 0.15, I2=86%)
Mean improvement in function, long-term followup	Low	No difference (7 trials, SMD –0.23, 95% CI –0.55 to 0.10, I2=82%)
Successful functional outcome, short-term followup	Low	No difference (6 trials, RR 1.01, 95% CI 0.74 to 1.38, I2=76%)
Successful functional outcome, intermediate-term followup	Low	No difference (2 trials, RR 1.18, 95% CI 0.89 to 1.57, I2=71%)
Successful functional outcome, long-term followup	Low	No difference (3 trials, RR 1.15, 95% CI 0.97 to 1.35, I2=0%)
Risk of surgery, short-term followup	Low	Epidural corticosteroid injections were associated with lower risk vs. placebo interventions (8 trials, RR 0.62, 95% CI 0.41 to 0.92, I2=0%), but the estimate was no longer statistically significant after exclusion of poor-quality trials (5 trials, RR 0.69, 95% CI 0.42 to 1.13, I2=0%)
Risk of surgery, intermediate-term followup	Low	No difference (1 trial, RR 0.56, 95% CI 0.12 to 2.68)
Risk of surgery, long-term followup	Moderate	No difference (14 trials, RR 0.97, 95% CI 0.75 to 1.25, I2=23%)
Successful composite outcome, short-term followup	Moderate	No difference (9 trials, RR 1.13, 95% CI 0.98 to 1.32, I2=3.5%)
Successful composite outcome, intermediate-term followup	Low	No difference (1 trial, RR 0.71, 95% CI 0.34 to 1.48)
Successful composite outcome, long-term followup	Low	No difference (2 trials, 1.04, 95% CI 0.81 to 1.34, I2=0%)
Epidural corticosteroid injections vs. other interventions		
Pain, function, surgery	Insufficient	There was insufficient evidence from two trials to determine effects of epidural corticosteroid injections vs. discectomy, due to methodological shortcomings in the trials
Pain function, surgery	Low	One trial found epidural corticosteroid injections associated with lower likelihood than MILD of achieving ≥ 25 point improvement in leg pain (RR 0.49, 95% CI 0.24 to 1.0), ≥13 point improvement in ODI (RR 0.34, 95% CI 0.34 to 0.95), and ≥5 point improvement in SF-36 (RR 0.34, 95% CI 0.12 to 0.95) through 2 years. There was no difference in risk of undergoing surgery (RR 0.45, 95% CI 0.09 to 2.19)

Key Question Outcome	Strength of Evidence Grade	Conclusion
Pain, function, surgery	Insufficient	There was insufficient evidence from one small (n=26), fair-quality trial to determine effects of epidural corticosteroid injections vs. epidural clonidine injection
Pain, function, analgesic use	Low	One trial found transforaminal epidural corticosteroid injection superior to etanercept on the ODI at 1 month (difference –16 on 0 to 100 scale, 95% CI –26.0 to –6.27). There were no differences on other outcomes, including pain and analgesic use
Pain, function	Low	One trial found no differences between epidural corticosteroid vs. autologous conditioned serum administered via the oblique interlaminar approach in improvement in pain or ODI scores after 22 weeks
Pain, function, surgery	Insufficient	There was insufficient evidence from two trials to determine effects of epidural corticosteroid injections vs. nonsurgical, noninterventional therapies due to methodological shortcomings in the trials and differences in the nonsurgical, noninterventional therapies evaluated
Pain, function	Low	One trial found transforaminal epidural corticosteroid injection with corticosteroid plus hypertonic saline associated with greater decrease in pain intensity through 4 months than a corticosteroid injection alone (difference from baseline –2.78 vs. –1.50 on 0 to 10 NRS, p=0.05), though the effect was smaller and no longer statistically significant at 6 months. There were no differences in global assessment or the ODI
Pain, function	Low	One trial found no difference between transforaminal epidural injection with corticosteroid versus corticosteroid plus low-dose clonidine in pain scores through 12 weeks in patients with subacute low back pain
Epidural injections for spinal stenosis		
Epidural corticosteroid injections vs. placebo interventions		
Mean improvement in pain, immediate-term followup	Low	Epidural corticosteroid injection was superior to placebo at intermediate-term followup (1 trial, WMD –22.0, 95 % –36.0 to –8.0)
Mean improvement in pain, short-term followup	Moderate	No difference (5 trials, WMD 0.62, 95% CI –2.87 to 4.11, I2=0%)
Mean improvement in pain, intermediate-term followup	Low	No difference (3 trials, WMD 3.73, 95% CI –0.81 to 8.26, I2=0%)
Mean improvement in pain, long-term followup	Low	No difference (1 trial, mean difference 4.00, 95% CI –2.87 to 10.9)
Successful pain outcome, short-term followup	Low	No difference (3 trials, RR 0.98, 95% CI 0.84 to 1.15, I2=0%)
Successful pain outcome, intermediate-term followup	Low	No difference (2 trials, RR 0.98, 95% CI 0.78 to 1.24, I2=0%)
Successful pain outcome, long-term followup	Low	No difference (3 trials, RR 0.97, 95% CI 0.74 to 1.28, I2=0%)
Mean improvement in function, immediate-term followup	Low	No difference (2 trials, SMD –0.32, 95% CI –0.85 to 0.22, I2=0%)
Mean improvement in function, short-term followup	Moderate	No difference (5 trials, SMD –0.03, 95% CI –0.31 to 0.26, I2=60%)
Mean improvement in function, intermediate-term followup	Low	No difference (3 trials, WMD 2.81, 95% CI –0.44 to 6.06, I2=0%)
Mean improvement in function, long-term followup	Low	No difference (2 trials, WMD 2.78, 95% CI –1.24 to 6.79, I2=0%)
Successful functional outcome, short-term followup	Low	No difference (3 trials, RR 0.91, 95% CI 0.70 to 1.18, I2=37%)

Key Question Outcome	Strength of Evidence Grade	Conclusion
Successful functional outcome, intermediate-term followup	Low	No difference (2 trials, RR 0.96, 95% CI 0.74 to 1.25, I2=0%)
Successful functional outcome, long-term followup	Low	No difference (2 trials, RR 0.95, 95% CI 0.71 to 1.26, I2=0%)
Successful composite outcome, short-term followup	Low	No difference (2 trials, RR 1.18, 95% CI 0.55 to 2.55, I2=80%)
Successful composite outcome, intermediate-term followup	Low	No difference (1 trial, RR 0.93, 95% CI 0.63 to 1.35)
Successful composite outcome, long-term followup	Low	No difference (2 trials, RR 1.16, 95% CI 0.76 to 1.78, I2=0%)
Risk of surgery, long-term followup	Low	No difference (1 trial, RR 0.76, 95% CI 0.38 to 1.54)
Epidural corticosteroid injections vs. other interventions		
Pain, function	Low	One trial found an epidural corticosteroid injection associated with lower likelihood of experiencing ≥2 point improvement in pain at 2 weeks vs. the MILD procedure, but the difference was no longer present at 6 weeks. There was no difference in function
Pain, function	Low	One trial found no differences between and epidural corticosteroid injection vs. intense physical therapy in pain intensity or functional outcomes at 2 weeks through 6 months
Pain, function	Low	One trial found epidural corticosteroid injection associated with worse leg pain than epidural etanercept injection at 1 month, with no difference in functional outcomes
Pain, function	Insufficient	There was insufficient evidence from one poor-quality trial to determine effects of epidural corticosteroid injections vs. epidural adhesiolysis
Epidural corticosteroid injections vs. placebo interventions for nonradicular low back pain		
Pain, function, opioid use	Low	Two trials found no differences between epidural corticosteroid injections and epidural local anesthetic injections in pain, function, or opioid use
Epidural injections for chronic postsurgical pain		
All outcomes	Insufficient	No trial compared an epidural injection with corticosteroid vs. a placebo intervention
All outcomes	Insufficient	Evidence from 4 trials was insufficient to determine effects of epidural corticosteroid injections vs. other interventions, due to methodological limitations, differences in the comparators evaluated, and small sample sizes
Facet joint injections		
Pain, function	Low	Two trials found no clear differences between an intra-articular facet joint injection with corticosteroid vs. saline in pain or function at 1 to 3 months
All outcomes	Insufficient	Evidence from one small, poor-quality trial was insufficient to determine effects of an intra-articular corticosteroid facet joint injection vs. medial branch local anesthetic injection
All outcomes	Insufficient	Evidence from one poor-quality trial was insufficient to determine effects of an extra-articular facet joint corticosteroid injection vs. intra-articular saline injection
Pain, function, opioid use	Low	Two trials found no differences between medial branch corticosteroid injection vs. medial branch local anesthetic injection in pain, function, or opioid use through 12 to 24 months

Key Question Outcome	Strength of Evidence Grade	Conclusion
Pain, function, quality of life	Low	One trial found no clear differences between an intra-articular facet joint versus an intramuscular corticosteroid injection in pain, function, or quality of life through 6 months
Pain, function, quality of life	Low	One trial found no differences between intra-articular facet injection with triamcinolone acetonide vs. hyaluronic acid in pain or function at 1 month or in health-related quality of life at 1 week
Pain, function, analgesic use	Low	One trial found no differences between intra-articular corticosteroid injection plus sham neurotomy vs. medial branch radiofrequency facet neurotomy plus local anesthetic injection in pain, function, or analgesic use at 6 months
Pain, quality of life	Low	One fair-quality trial found medial branch corticosteroid injection inferior to radiofrequency facet denervation on pain at 1, 6, and 12 months, with no differences in quality of life (1, 6, and 12 months), but results may have been confounded by differential use of diagnostic blocks to select patients for inclusion
Sacroiliac joint injections		
All outcomes	Insufficient	There was insufficient evidence from one small (n=24) trial to determine effects of peri-articular sacroiliac corticosteroid injection vs. local anesthetic injection
Key Question 1a. How does effectiveness vary according to the medication (corticosteroid, local anesthetic) used, the dose or frequency of injections, the number of levels treated, or degree of provider experience?		
Epidural injections		
Epidural corticosteroid injections for radiculopathy		
Effects of different corticosteroids: all outcomes	Low	Four trials that directly compared epidural corticosteroid injections for radiculopathy with different corticosteroids found few differences in outcomes including pain and function, but conclusions were limited by differences in the corticosteroids compared, doses, and some inconsistency
Effects of different local anesthetics: all outcomes	Insufficient	No trial directly compared effects of epidural corticosteroid injections with one local anesthetic vs. another
Effects of corticosteroid dose: all outcomes	Low	Six trials that directly compared epidural injections for radiculopathy using different corticosteroid doses found no clear differences in outcomes including pain and function
Effects of number of injections, number of levels injected, or provider experience: all outcomes	Low for number of injections, insufficient for number of levels and provider experience	No trial directly compared the effectiveness of epidural corticosteroid injections based on the number of injections, number of levels injected, or provider experience. Two trials found no association between receipt of more injections and better outcomes
Epidural corticosteroid injections for spinal stenosis		
Effects of corticosteroids: pain, claudication distance	Low	One trial found no clear differences between caudal epidural injection for spinal stenosis with methylprednisolone vs. triamcinolone in pain or claudication distance through 6 months, though results favored methylprednisolone

Key Question Outcome	Strength of Evidence Grade	Conclusion
Facet joint injections		
Effects of different corticosteroids, local anesthetics, doses, frequency or number of injections, or degree of provider experience	Insufficient	No trial of facet joint injections directly compared effects of different corticosteroids, different local anesthetics, different doses, different frequency or number of injections, or degree of provider experience. Indirect evidence was too limited to reach reliable conclusions
Key Question 1b. How does effectiveness vary according to use of imaging guidance or route of administration (e.g., for epidural injections interlaminar, transforaminal, caudal for epidural injections and for facet joint injections intra-articular, extra-articular [peri-capsular] or medial branch injections)?		
Epidural injections		
Use of imaging		
Effects of imaging guidance vs. no imaging guidance: All outcomes	Insufficient	No trial directly compared the effectiveness of epidural injections for radiculopathy performed with or without imaging guidance. Indirect evidence was not useful for evaluating effects of imaging guidance on estimates of effects because use of imaging guidance was highly associated with the epidural technique used
Effects of fluoroscopic plus Doppler vs. fluoroscopic imaging guidance: Pain, function	Low	One trial of caudal epidural corticosteroid injections for radiculopathy found no difference between fluoroscopic plus Doppler guidance vs. fluoroscopic guidance alone in pain or ODI scores through 12 weeks
Effects of imaging to guide epidural injection targets: Pain, function, medication use	Low	One trial found no difference between use of MRI vs. history and physical examination without MRI to guide epidural corticosteroid injection treatment and targets on pain, function, or medication use
Transforaminal vs. interlaminar corticosteroid injections		
Mean improvement in pain, immediate-term followup	Low	No difference (5 trials, WMD –10.1, 95% CI –24.8 to 4.6, I2=83%)
Mean improvement in pain, short-term followup	Low	No difference (3 trials, WMD –1.29, 95% CI –12.6 to 10.1, I2=54%)
Mean improvement in pain, intermediate-term followup	Low	No difference (2 trials, WMD –11.3, 95% CI –44.8 to 22.2, I2=87%)
Mean improvement in function, immediate-term followup	Low	No difference (4 trials, SMD 0.03, 95% CI –0.48 to 0.53, I2=68%)
Mean improvement in function, short-term followup	Low	No difference (3 trials, SMD 0.39, 95% CI –0.36 to 1.13, I2=74%)
Mean improvement in function, long-term followup	Low	No difference (1 trial, WMD –2.00, 95% CI –8.77 to 4.77)
Likelihood of undergoing surgery, intermediate-term followup	Low	There were no differences between transforaminal vs. interlaminar epidural corticosteroid injections for radiculopathy in risk of undergoing surgery at intermediate-term followup in two trials (RR 0.76, 95% CI 0.18 to 3.19 and RR 1.33, 95% CI 0.44 to 4.05)

Key Question Outcome	Strength of Evidence Grade	Conclusion
Comparisons of other approaches		
Epidural injections for radiculopathy		
Caudal vs. other approaches: Pain, function, depression	Low	One trial found the transforaminal epidural corticosteroid injections for radiculopathy associated with better pain outcomes than the caudal approach, with no differences in measures of function or depression, but no differences between the interlaminar vs. caudal approaches in measures of pain or depression
Oblique vs. standard interlaminar approaches: Successful composite outcome, surgery	Low	One trial found no differences between epidural corticosteroid injections for radiculopathy using the oblique interlaminar vs. standard interlaminar approaches in likelihood of achieving a successful outcome or undergoing surgery
Lateral parasagittal vs. standard interlaminar approaches: Pain, function	Low	One trial of epidural corticosteroid injections for radiculopathy found the lateral parasagittal interlaminar approach associated with greater likelihood of achieving >50% pain relief (RR 4.1, 95% CI 1.4 to 12) and greater improvement in pain and function than the standard interlaminar approach through 6 months; a second trial also reported results that favored the lateral parasagittal approach, but differences were smaller and not statistically significant
Lateral parasagittal vs. transforaminal approaches: Pain	Low	Two trials found no differences between epidural corticosteroid injections for radiculopathy using the lateral parasagittal vs. transforaminal approaches in pain or function through 6 or 12 months
Ganglionic vs. preganglionic transforaminal injections: Successful composite outcome	Low	One trial found transforaminal epidural corticosteroid injections for radiculopathy at the ganglionic vs. preganglionic approaches associated with a lower likelihood of a successful outcome at 1 month (RR 0.80, 95% CI 0.70 to 0.91), though differences were no longer present after 5 months
Epidural injections for spinal stenosis		
Transforaminal vs. interlaminar: Leg pain, function	Low	No trial randomized patients with spinal stenosis to different approaches for performing epidural corticosteroid injections. One trial in which epidural corticosteroid injections could be performed by the interlaminar or transforaminal approaches found that interlaminar corticosteroid injections were associated with greater improvement in leg pain and function vs. local anesthetic injections at 3 weeks, but there were no differences between transforaminal corticosteroid vs. local anesthetic injections
Facet joint injections		
Intra-articular facet joint corticosteroid injection: Pain	Low	One trial found intra-articular facet joint corticosteroid injection in patients with subacute low back pain selected on the basis of positive facet joint SPECT findings associated with lower pain intensity (3.2 vs. 5.4 on 0 to 10 NRS, $p<0.05$), greater likelihood of ≥50% pain relief (61% vs. 26%, RR 2.33, 95% CI 1.09 to 5.00), and better ODI score (12 vs. 23, $p<0.05$). versus medial branch injection at 12 weeks

Key Question Outcome	Strength of Evidence Grade	Conclusion
Intra-articular facet joint vs. medial branch corticosteroid injection for chronic low back pain (imaging findings not required): Pain	Low	One trial found intra-articular facet joint corticosteroid injection associated with higher likelihood of pain relief vs. medial branch injection at 1 month (RR 1.68, 95% CI 1.03 to 2.73), but results were no longer statistically significant at 3 months, and there was no difference in likelihood of experiencing good or excellent pain relief
Intra-articular vs. extra-articular (peri-capsular) facet joint corticosteroid injection: All outcomes	Insufficient	There was insufficient evidence from one poor-quality trial to determine effectiveness of intra- vs. extra-articular (peri-capsular) facet joint corticosteroid injections
Effects of imaging guidance vs. no imaging guidance: All outcomes	Insufficient	No trial directly compared the effectiveness of epidural injections for radiculopathy performed with or without imaging guidance
Effects of CT- vs. ultrasound imaging guidance: Pain	Low	One trial found no difference between CT- vs. ultrasound-guided intra-articular facet joint corticosteroid injections with betamethasone and local anesthetic in pain at 6 weeks
Key Question 2. In patients with low back pain, what patient characteristics predict responsiveness to injection therapies on outcomes related to pain, function, and quality of life?		
Epidural injections		
Effects of duration: Pain, function	Low	Five of six trials of patients with radiculopathy found no association between duration of symptoms and responsiveness to epidural corticosteroid injections
Effects of age, sex, anxiety/depression, opioid use, baseline function, presence of neurological abnormalities, previous episodes, or work status: Pain, function	Low	Trials or patients with radiculopathy found no association between age, sex, anxiety/depression, opioid use, baseline function, presence of neurological abnormalities, previous episodes, or work status and responsiveness to epidural corticosteroid injections
Effects of cause of radicular symptoms: Pain, function	Insufficient	There was insufficient evidence from 4 trials to determine effects of the cause of radicular symptoms on responsiveness to epidural corticosteroid injections for radiculopathy, due to inconsistent results
Effects of smoking status, body mass index, use of opioid therapies or other concomitant therapies: Pain, function	Insufficient	No study evaluated the association between smoking status, body mass index, opioid therapies, or other concomitant therapies on responsiveness to epidural corticosteroid injection therapies for radiculopathy
Effects of pain, function	Low	Based on meta-regression analyses of trials of epidural corticosteroid injections vs. placebo interventions for radiculopathy, there was no clear association between prior lumbar surgery, requirement for imaging correlation with symptoms, or requirement for presence of herniated disc on imaging and estimates of treatment effect
Effects of race: All outcomes	Low	One trial of patients with spinal stenosis found no interaction between race and responsiveness to epidural corticosteroid injections
Effects of pain, patient satisfaction	Low	One trial of patients with nonradicular low back pain found no differences between transforaminal versus interlaminar epidural corticosteroid injection in pain or a patient satisfaction index in the subgroup of patient with imaging findings of a herniated disc, but in patients with spinal stenosis effects on pain favored the transforaminal approach (1.79 vs. 2.19 on the 0 to 5 Roland pain score, $p<0.05$; likelihood of improving ≥2 points 51% vs. 31%, RR 1.64, 95% CI 0.98 to 2.76)

Key Question Outcome	Strength of Evidence Grade	Conclusion
Facet joint injections		
Effects of use of SPECT vs. no SPECT to identify targets for facet joint injections: Pain	Low	One trial found no difference between use of SPECT bone scans vs. no SPECT to identify targets for intra- and extra-articular facet joint corticosteroid injections in pain outcomes through 6 months
Sacroiliac joint injections	Insufficient	No evidence
Key Question 3. In randomized trials of low back pain injection therapies, how does effectiveness vary according to the control therapy used (e.g., epidural nonsteroid injection, nonepidural injection, no injection)?		
Epidural injections		
Effects of type of placebo intervention in patients with radiculopathy: Pain, function	Low	In trials of epidural corticosteroid injections vs. placebo injections for radiculopathy, there were no clear differences in estimates for improvement in pain or function, likelihood of a successful pain or functional outcome, or likelihood of undergoing surgery when trials were stratified according to the type of placebo intervention
Effects of type of control intervention in patients with radiculopathy: All outcomes	Insufficient	Trials of epidural corticosteroid injections vs. other interventions were too limited to determine effects on outcome estimates, due to variability in the interventions evaluated, small numbers of trials, and methodological limitations
Effects of type of placebo intervention in patients with other back conditions: All outcomes	Insufficient	There was insufficient evidence from trials of epidural corticosteroid injections for spinal stenosis, nonradicular back pain, or chronic postsurgical pain, to determine effects of comparators on estimates of effect, due to small numbers of trials for specific comparisons
Facet joint injections		
Effects of type of placebo therapy:	Insufficient	There was insufficient evidence from trials facet joint injections to determine effects of comparators on estimates of effect, due to small numbers of trials for specific comparisons
Key Question 3a. How do response rates vary according to the specific comparator evaluated (e.g., saline epidural, epidural with local anesthetic, nonepidural injection, no injection, surgery, nonsurgical therapies)?		
Epidural injections for radiculopathy		
Epidural corticosteroid injections vs. placebo interventions (direct comparisons): Pain, function, successful outcome	Low	Three trials found no differences between epidural local anesthetic vs. epidural saline injections (3 trials) or soft tissue injections (2 trials) in mean improvements in pain or function or the proportion experiencing pain relief or a successful outcome
Epidural corticosteroid injections vs. placebo interventions (indirect comparisons): Pain function	Low	In trials of epidural corticosteroid injections for radiculopathy, improvement in pain was smaller in patients who received epidural local anesthetic injections (3 trials, WMD –6.51, 95% CI –11.9 to –1.16, I2=45%) than epidural saline injections (4 trials, WMD –19.8, 95% CI –25.1 to –14.3, I2=56%) at immediate-term followup; there were no clear differences at other time points, but analyses were limited by small numbers of trials and statistical heterogeneity

Key Question Outcome	Strength of Evidence Grade	Conclusion
Epidural corticosteroid injections vs. other interventions: Pain, function	Insufficient	Trials were too limited to determine effects on response rates, due to variability in the interventions evaluated, small numbers of trials, and methodological limitations
Key Question 4. What are the harms of epidural corticosteroid, facet joint corticosteroid injections, medial branch blocks, and sacroiliac joint corticosteroid injection compared to epidural nonsteroid injection, nonepidural injection, no injection, surgery, or nonsurgical therapies?		
Epidural injections		
Harms	Moderate	29 trials of epidural corticosteroid injections vs. placebo for radiculopathy reported no serious adverse events and few harms, but methods for assessing harms were not well reported and harms data were sparse. Observational studies were consistent with the trials in showing a low risk of serious adverse events
Harms	Moderate	Nine trials of epidural corticosteroid injections vs. other therapies for radiculopathy reported no serious adverse events and few harms
Harms	Low	Two trials of transforaminal vs. interlaminar epidural corticosteroid injections for radiculopathy reported no serious adverse events
Harms	Insufficient	There was insufficient evidence from four trials that compared epidural injections for radiculopathy with different corticosteroids to determine effects on harms
Harms	Insufficient	There was insufficient evidence from six trials of epidural corticosteroid injections for radiculopathy that compared different doses to determine effects on harms
Harms	Low	Eight trials of epidural corticosteroid injections vs. placebo injections for spinal stenosis reported no serious harms and few adverse events, but methods for assessing harms were not well reported and harms data were sparse
Harms	Low	Two trials of epidural corticosteroid injections for nonradicular back pain reported no serious harms
Harms	Insufficient	There was insufficient evidence from four trials of epidural corticosteroid injections for chronic postsurgical back pain to determine effects on harms
Facet joint injections		
Harms	Low	Ten trials of facet joint corticosteroid injections reported no serious harms and few adverse events, but methods for assessing harms were not well reported and harms data sparse
Sacroiliac joint injections		
Harms	Insufficient	Harms were not reported in one small trial of peri-articular sacroiliac joint injections

CI = confidence interval; MILD = minimally invasive lumbar decompression; ODI = Oswestry Disability Index; RR = relative risk; SF-36 = Short Form-36; SMD = standardized mean difference; SPECT = single photon electronic computed tomography; WMD = weighted mean difference

Strengths of our review are inclusion of additional trials compared with prior reviews, evaluation of epidural corticosteroid injections for back pain conditions other than radiculopathy, evaluation of continuous as well as dichotomous outcomes, evaluation of outcomes at defined time points, evaluation of the effectiveness of epidural corticosteroids versus other active

Evidence was most robust for epidural corticosteroid injections in patients with radiculopathy. In trials of epidural corticosteroid injections versus placebo interventions, the only statistically significant effects were on mean improvement in pain at immediate-term (5 days to ≤2 week) followup (WMD –7.55 on a 0 to 100 scale, 95% CI –11.4 to –3.74), mean improvement in function at immediate-term (SMD –0.33, 95% CI –0.56 to –0.09) followup, and risk of surgery at short-term (>2 weeks to ≤3 months) followup (RR 0.62, 95% CI 0.41 to 0.92). However, the magnitude of the effect on pain was small (WMD –7.55 on 0 to 100 scale) and did not meet our predefined minimum clinically important differences of 15 points.[42] The effect on immediate-term function was of only statistically significant when an outlier trial[47] was excluded. Differences were also small in the nonoutlier trials (5.1 and 7.6 points on the 0 to 100 ODI)[48, 49] and 1.3 points on the 0 to 24 RDQ) and did not meet predefined thresholds for minimum clinically important differences (10 points for the ODI and 5 points for the RDQ).[42] Differences were not present for either outcome at longer-term followup. There were also no differences at any time point between epidural corticosteroid injections and placebo interventions in likelihood of experiencing a successful pain, function, or composite outcome; or likelihood of undergoing surgery. Direct evidence from randomized trials on effects of performing epidural corticosteroid injections for radiculopathy using different approaches, different corticosteroids, or different doses was limited, but indicated no clear effects on outcomes. There were also no clear differential effects of the epidural approach used, different corticosteroids, different doses, use of imaging correlation, restriction to patients with herniated disc, duration of symptoms, or exclusion of patients with prior surgery, primarily based on meta-regression and subgroup analyses.

Although comparator interventions such as epidural local anesthetic injection, epidural saline injection, soft tissue injections, and no injection have traditionally been considered placebo interventions, it is possible that they may have some therapeutic effects.[35] However, placebo response rates were high in trials of epidural corticosteroid injections regardless of the comparator used and there were no clear differences in estimates of effectiveness based on the specific comparator, suggesting that observed improvements represent the natural history of radiculopathy or a general placebo response.

Trials of epidural corticosteroid injections for radiculopathy versus nonplacebo interventions did not clearly demonstrate effectiveness, but were limited by small numbers of trials for specific comparisons and methodological limitations, resulting in low or insufficient strength of evidence ratings.

Evidence was limited for epidural corticosteroid injections versus placebo interventions for spinal stenosis or nonradicular back pain, but showed no differences in outcomes related to pain or function. The evidence on epidural corticosteroid injections for spinal stenosis included a recent, well-conducted multicenter trial that was also the largest trial (n=386) to date in this population.[50] Although epidural injections could be performed by either the interlaminar or transforaminal approach in this trial, there was also no evidence of an effect when results were stratified according to the approach used. Another potential issue in interpreting this trial is that the corticosteroids and doses varied, which could have attenuated effects if certain corticosteroids or lower doses are associated with decreased effectiveness. For chronic postsurgical pain, evidence was very limited. No trial compared epidural corticosteroid injections

versus placebo, and trials of epidural corticosteroid injections versus various other interventions found no clear differences.

Evidence was also limited for facet joint corticosteroid injections versus placebo interventions. Studies found no clear differences between various facet joint corticosteroid injections (intra-articular, extra-articular [peri-capsular], or medial branch) and placebo interventions. Although one trial found an intra-articular corticosteroid injection associated with better outcomes than a saline injection at 6 months, results are difficult to interpret because there were no differences at 1 month, the corticosteroid group received more cointerventions, and there was no difference in the likelihood of sustained improvement (improvement at 6 months in patients with improvement at 1 month).[51] Trials of facet joint injections versus radiofrequency denervation were difficult to interpret because they reported inconsistent outcomes, evaluation of different types of injections (intra-articular or medial branch corticosteroid injection), and differential use of diagnostic blocks to select patients, depending on which intervention they were randomized to.[52, 53]

There was insufficient evidence from one very small (n=24) trial to determine effects of peri-articular sacroiliac joint corticosteroid injections versus a placebo (local anesthetic) injection.[53]

Methods for assessing harms in randomized trials were generally not well reported and data sparsely reported, but evidence from trials and observational studies were consistent in suggesting a low risk of serious harms following epidural injections such as neurological complications or infection. However, cases of serious neurological complications have been reported following lumbar epidural injections, and there was a recent outbreak of serious fungal infections due to contaminated methylprednisolone injections.[17, 54, 55]

Findings in Relationship to What is Already Known

Our findings were consistent with a previous qualitative review[17] conducted by our team and funded by the APS that found fair evidence that epidural corticosteroid injections for radiculopathy are more effective than placebo interventions for short-term symptom relief, but not for long-term symptom relief, and limited evidence of ineffectiveness for spinal stenosis and nonradicular low back pain. Unlike the current review, which found that short-term effects on pain did not meet the threshold for minimum clinically important differences, the APS review classified the magnitude of short-term benefit for pain relief as "moderate" (equivalent to a 10- to 20-point difference on a 100-point pain scale). However, it noted inconsistency between trials, did not perform meta-analysis, and based some conclusions on prior reviews with small numbers of studies. Our findings were also consistent with more recent qualitative and quantitative systematic reviews, despite variability in the studies included and methods used for data synthesis and meta-analysis.[20, 21, 23, 37, 56, 57] Our review was also concordant with other reviews in finding limited evidence that lumbar epidural corticosteroid injections are associated with a low risk of serious harms.[17, 20, 54] Like a prior review, we also found no evidence on effectiveness of multiple versus single injections.[58] Although one systematic review found an association between volume differences (higher volume relative to control interventions) and effectiveness of epidural corticosteroid injections, results may have been confounded by differences in epidural approaches (e.g., caudal injections typically used higher volumes) and inclusion of comparators that did not involve epidural injections (e.g., soft tissue injections or noninjection therapies).[59] We were unable to determine effects of differences in injectate volume on effectiveness, as only three trials that compared epidural corticosteroid injections versus epidural local anesthetic or saline injections reported a volume difference.[47, 60, 61]

With regard to effects of control interventions on effect estimates, our findings were similar to a recent systematic review that found limited direct evidence showing no differences between epidural nonsteroid and nonepidural injections.[35] Although the prior systematic review found some evidence that epidural nonsteroid injections might be more effective than nonepidural injections, its conclusions were based on indirect comparisons that were highly discrepant with direct comparisons. We did not perform indirect comparisons, as the presence of such discrepancies may result in misleading findings.[62] Although the prior APS review found some evidence that effects of epidural corticosteroid injections were more likely to be positive in studies that used epidural nonsteroid injection controls than in studies that used nonepidural injection controls, these findings were based on a qualitative evaluation based on counts of positive and negative studies.[17]

Our findings of limited evidence on facet joint corticosteroid injections versus placebo interventions, without clear demonstration of beneficial effects, were also consistent with prior systematic reviews.[17, 63, 64]

Some systematic reviews reported more positive conclusions regarding the effectiveness of epidural corticosteroid and facet joint injections.[24-26, 65-67] Differences between the methods used in these reviews and ours that may explain the discrepant findings included reliance on qualitative synthesis, inclusion of observational studies, categorization of improvement from baseline following an epidural corticosteroid injection as demonstrating effectiveness (even when there was no difference versus a placebo intervention), and failure to consider inconsistency between trials.

Applicability

Some issues could impact the applicability of our findings. Results are most applicable to patients with chronic back pain, as few trials enrolled patients with acute or subacute symptoms. Although studies were typically performed in the United States or Europe in specialty settings, they varied in how the injections were performed, including the use of imaging guidance, the specific epidural or facet injection technique used, the methods used to select patients (e.g., use of imaging, the imaging findings required for inclusion, or the use of diagnostic blocks), the types and doses of corticosteroid used, and the number and frequency of injections. Although we found no clear evidence of an association between these factors and estimates of treatment effectiveness, direct evidence from head-to-head trials on these factors was limited. The effectiveness of injection therapies is also likely to depend in part on the skill and experience of the person performing the injection, but we were unable to determine effects of provider experience on treatment effects, as studies did not report this information or reported it in a nonstandardized manner. Because most trials excluded patients with prior lumbar surgery, results may not be applicable to this patient population. The applicability of findings to patients with important medical and psychiatric comorbidities was also uncertain, and there was insufficient evidence to determine how effectiveness might vary based on the receipt of concomitant interventions such as supervised exercise therapy or cognitive behavioral therapy. Trials also differed in methods used to select patients for inclusion. For example, trials of radiculopathy and spinal stenosis differed in the clinical symptoms required for enrolment as well as in whether concordant imaging findings were required, and trials of presumed facet joint pain varied in whether a positive response to diagnostic blocks were required as well as methods for performing blocks (e.g., single or double block).

In order to facilitate interpretation of findings, we stratified outcomes by followup duration. We also compared observed effects on continuous outcomes to previously proposed thresholds for minimum clinically important changes. Although immediate-term effects of epidural corticosteroid injections versus placebo interventions on improvement in pain scores were statistically significant, they did not meet the predefined threshold for a minimum clinically important difference.[42] We also evaluated effects of injection therapies on the likelihood of experiencing a clinically meaningful outcome, which might be more clinically interpretable than mean effects on continuous scales.[68] Although trials varied in how they defined clinically meaningful outcomes related to pain, function, or overall success, analyses were consistent in showing no effects at different time points.

Implications for Clinical and Policy Decisionmaking

Our review has implications for clinical and policy decisionmaking. Epidural corticosteroid injections are the most commonly used interventional procedure for low back pain, but evidence indicates that benefits are limited to pain relief and reduced risk of surgery shortly after the procedure in patients with radiculopathy, without long-term benefits on these outcomes and no effect on functional outcomes. Some clinical practice guidelines recommend epidural corticosteroid injections for short-term benefits in patients with persistent radicular symptoms, particularly for patients who are not candidates for or interested in undergoing surgery.[28] Factors that may influence decisions about performing epidural corticosteroid injections include how highly patients value short-term symptom improvement of small magnitude, preferences regarding alternative therapies (including surgery), the severity of symptoms, and costs and other burdens. Decisions should also consider the risk of serious harms with epidural injections, which have been reported in case series and other uncontrolled observational studies.[69]

Potential strategies to enhance the effectiveness of epidural injections would be to perform them using techniques shown to be more effective, or to selectively perform injections in patients more likely to benefit. However, our review found no clear evidence of greater benefits based on technical factors such as the specific epidural technique used, use of fluoroscopic guidance, the specific corticosteroid, the dose, or the number or frequency of injections. Evidence on patient factors was also too limited to identify subgroups of patients more likely to benefit.

Other findings of our review that have implications for clinical and policy decisionmaking included limited evidence of no effectiveness of epidural corticosteroid injections for spinal stenosis or nonradicular low back pain, or for facet joint corticosteroid injections for presumed facet joint pain. Although prior guidelines found insufficient evidence to develop recommendations on use of epidural corticosteroid injections for spinal stenosis and nonradicular low back pain,[28] the strength of evidence has improved, particularly for spinal stenosis,[50] suggesting that re-evaluation may be appropriate. Guidelines are inconsistent with regard to use of facet joint corticosteroid injections,[28, 70, 71] but recent trials have not provided additional evidence to support effectiveness.

Limitations of the Comparative Effectiveness Review Process

An important limitation of our review is that substantial statistical heterogeneity was present in several pooled analyses. To address this, we used the Dersimonian-Laird random effects model to pool studies. The Dersimonian-Laird random effects model may result in confidence intervals that are too narrow when heterogeneity is present, particularly when the number of studies is small.[45] Therefore, we repeated analyses using the profile likelihood method, which

resulted in similar findings. Regardless of the method used, meta-analyses based on small numbers of trials can underestimate statistical heterogeneity and must be interpreted with caution.[45] We also stratified trials according to the epidural technique used, and further explored heterogeneity by performing additional analyses stratified based on the comparator used, exclusion of poor-quality and outlier studies, and meta-regression (when sufficient numbers of studies were available) on use of blinding, patient selection methods, and methods used to perform the injections (e.g., the corticosteroid or local anesthetic used and the dose). Although statistical heterogeneity remained present in some analyses, with some unexplained outlier trials, results were generally robust in sensitivity and stratified analyses.

Another limitation of our review is that we used indirect comparisons to supplement limited direct evidence on the effects of technical and patient factors on estimates. Although findings based on indirect comparisons were generally consistent with available evidence from head-to-head trials (e.g., showing no clear effects of different corticosteroids, different epidural approaches, or different doses), results based on indirect comparisons should also be interpreted with caution.[72]

We excluded non-English language articles and did not search for studies published only as abstracts. We only formally assessed for publication bias using statistical and graphical methods to assess for small sample effects when there were at least 10 studies, as research indicates that such methods can be misleading with smaller numbers of studies.[46] We found no evidence of small sample effects based on analyses of short-term improvement in pain, short-term improvement in function, or long-term risk of surgery. Finally, we restricted evidence on serious harms to randomized controlled trials and large cohorts of patients undergoing injections, in order to be able to estimate rates of events. Although serious neurological events with epidural corticosteroid injections have been reported in case series and other uncontrolled studies, it is not possible to estimate the rates of events from such data.[69]

Limitations of the Evidence Base

An important limitation of the evidence base is the small number of trials available on epidural corticosteroid injections for conditions other than radiculopathy and the small number on effectiveness of facet joint or sacroiliac corticosteroid injections. The lack of evidence made it difficult to reach strong conclusions regarding the effectiveness of these interventions versus placebo interventions or to evaluate effects of methodological, technical, or patient factors on outcomes. Although more trials were available for epidural corticosteroid injections for radiculopathy, there were fewer trials when results were stratified by specific outcomes and time points, and subgroup analyses were limited by the variability in techniques used on a number of factors.

In addition to the small number of trials, the evidence base was limited by methodological limitations in the available studies. Only eight trials were rated good quality. Of the 92 included trials, only 27 trials reported blinding of the person performing the injection, 57 trials blinding of patients, and 47 trials blinding of outcome assessors. Conclusions were generally not impacted by exclusion of poor-quality trials or assessments based on blinding status, but would be stronger if more high-quality trials were available.

Other limitations include the relatively limited number of trials that directly compared different injection techniques, corticosteroids, doses, and comparators. No trials directly compared use of imaging guidance versus no guidance, use of a single injection versus multiple injections, or effects of different injectate volumes. Few trials reported how effectiveness varied

according to patient characteristics such as age, sex, race, medical or psychological comorbidities, duration of symptoms, imaging findings, cause of low back pain, use of concomitant therapies, or other factors.

Research Gaps

Research gaps limit the full understanding of the comparative effectiveness of low back injections. For radiculopathy, additional research could help determine whether patient characteristics such as severity or duration of symptoms, presence of specific imaging findings, or presence of psychiatric comorbidities are associated with responsiveness to injections. If such characteristics are identified, future trials could be designed to focus on more specific target populations that might experience greater benefits. Trials are also needed to understand whether injections may be more effective when given in the context of a more comprehensive approach that includes the delivery of concomitant treatments such as supervised exercise therapy or cognitive behavioral therapy. Additional research would also help confirm whether there are differences in outcomes associated with different epidural injection approaches, corticosteroids, doses, use of imaging guidance, and number and frequency of injections. Ideally such studies would include a placebo intervention group to aid in interpretability of findings.

For spinal stenosis and nonradicular low back pain, evidence was limited but indicated that epidural corticosteroid injections are not effective compared to placebo interventions. Because spinal stenosis is usually degenerative and the etiology of nonradicular low back pain may be difficult to determine, the rationale for performing epidural corticosteroid injections may not be as strong as for radiculopathy due to herniated disc. Additional research on the effectiveness of epidural corticosteroid injections for these conditions may only be warranted if specific subgroups of patients who have more of an inflammatory component can be identified. Limited evidence also indicates that facet joint corticosteroid injections are not effective compared with placebo interventions. The lack of effectiveness could be due to the ineffectiveness of the procedure or suboptimal accuracy methods for identifying patients with facet joint pain.[17] A randomized trial found that use of dual or single diagnostic facet joint blocks to select patients for radiofrequency denervation (an intervention not included in this report) was associated with lower rates of successful outcomes than selection of patients without a diagnostic block.[73] Therefore, additional research on accurate methods for identifying patients with facet joint pain is needed to inform the design of future intervention studies.

Conclusions

Epidural corticosteroid injections for radiculopathy are associated with immediate improvements in pain and might be associated with immediate improvements in function, but benefits are small and not sustained, and there is no effect on the long-term risk of surgery. Evidence did not suggest that effectiveness varies based on injection technique, corticosteroid, dose, or comparator. Limited evidence suggested that epidural corticosteroid injections are not effective for spinal stenosis or nonradicular back pain, and that facet joint corticosteroid injections are not effective for presumed facet joint pain. There was insufficient evidence to evaluate the effectiveness of sacroiliac joint corticosteroid injections.

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Introduction

Background

Low back pain is one of the most frequently encountered conditions in clinical practice. Up to 84 percent of adults have low back pain at some time in their lives, and a national survey of U.S. adults in 2002 found that over one-quarter reported low back pain lasting at least a whole day in the previous 3 months.[1, 2] Although low back pain affects individuals of all ages, its prevalence peaks at 55 to 64 years of age and remains common in those 65 years of age and older.[3] Low back pain can have major adverse impacts on quality of life and function and is frequently associated with depression or anxiety. Low back pain is also costly. In 1998, total U.S. health care expenditures for low back pain were estimated at $90 billion.[4] Since that time, costs of low back pain care have risen substantially, at a rate higher than observed for overall health expenditures.[5] Low back pain is one of the most common reasons for missed work or reduced productivity while at work, resulting in high indirect costs; this makes the total costs associated with low back pain substantially higher than the direct health care costs.[6]

The prognosis of acute low back pain (an episode lasting less than 4 weeks) is generally favorable. Following onset of low back pain, most patients experience a rapid improvement in (and often a complete resolution of) pain and disability and are able to return to work.[7] In those with persistent symptoms, continued improvement is often seen in the subacute phase between 4 and 12 weeks, though at a slower rate than observed in the acute phase. In a minority of patients, low back pain lasts longer than 12 weeks, at which point it is considered chronic, and levels of pain and disability often remain relatively constant.[8] Such patients appear to account for the bulk of the burdens and costs associated with low back pain.[9, 10]

In the majority (>85%) of patients with low back pain, symptoms cannot be attributed to a specific disease or spinal pathology.[11] Spinal imaging abnormalities such as degenerative disc disease, facet joint arthropathy, and bulging or herniated intervertebral discs are extremely common in patients with low back pain, particularly in older adults. However, such findings poorly predict the presence or severity of low back pain.[12] Radiculopathy from nerve root impingement and spinal stenosis (narrowing of the spinal canal) each occur in about 4 to 5 percent of patients with low back pain and can cause neurological symptoms such as lower extremity pain, paresthesias, and weakness.[13, 14]

Multiple treatment options for subacute and chronic low back pain are available. Broadly, these can be classified as pharmacological treatments,[15] nonpharmacological treatments (e.g., exercise therapy, cognitive behavioral therapy, spinal manipulation, acupuncture, and others),[16] injection therapies,[17] and surgical treatments.[18] Injection therapies, the topic of this evidence review, include injections of medications to various structures in and around the spine (such as the epidural space, facet joints, intervertebral discs, and soft tissues).[17] The most commonly used medications in back injections are corticosteroids to reduce inflammation and local anesthetics for analgesia, though others (such as anti-tumor necrosis factor agents, clonidine, methylene blue, and ozone) have also been studied. Corticosteroid injections can be administered into the epidural space or in and around the facet joints. Other interventional therapies involve the application of various types of energy to ablate pain-generating nerves, without the injection of medications.[17] Ablative therapies include radiofrequency denervation, intradiscal electrothermal therapy, percutaneous intradiscal radiofrequency thermocoagulation, and other procedures.

Between 1994 and 2001, use of epidural injections increased by 271 percent and facet joint injections by 231 percent among Medicare beneficiaries.[19] Total inflation-adjusted reimbursed

costs (based on professional fees only) increased from $24 million to over $175 million over this time period. More recent data indicate continued rapid growth in use of spinal injection therapies among Medicare beneficiaries, with an increase of 187 percent in use between 2000 and 2008.[19]

Despite these dramatic increases, use of injection therapies for low back pain remains controversial. Systematic reviews of injection therapies have come to conflicting conclusions regarding the benefits of injection therapies,[17, 20-27] and clinical practice guidelines provide discordant recommendations regarding their use.[28-34] An important challenge in interpreting the evidence on injection therapies is the inconsistency of results across trials. Some of this inconsistency could be due to variability across studies in the methods used to select patients for inclusion, the specific injection techniques used, the comparisons evaluated, and the outcomes assessed.[17] For example, trials of epidural corticosteroid injections for radiculopathy differ in how they define radiculopathy, whether imaging correlation with symptoms is required to be eligible for inclusion, the specific findings on imaging required for eligibility, the duration of pain, and other factors. All of these factors, which impact how patients are selected for study inclusion, could affect outcomes related to the injection therapy. There has also been variability in methods used to approach the epidural space (e.g., interlaminar [via the interlaminar space in the spine], transforaminal [through the neuroforamen of the exiting nerve root], or caudal [through the sacral hiatus at the sacral canal]), the use of fluoroscopic guidance, the volume of injectate administered, the specific corticosteroid and dose used, the local anesthetic used, and the number of injections and levels injected.[23] In addition, trials have compared an epidural corticosteroid injection to an epidural saline injection, epidural injection of local anesthetic without corticosteroid, a soft tissue injection with local anesthetic and/or saline, no injection, or noninjection comparators.[35] Similarly, for trials of facet joint injections, diagnostic methods for identifying patients with presumed facet joint pain vary across studies, including use of single or double facet joint blocks, the type and dose of corticosteroid injected, and the location of the injection (e.g., intra-articular [into the facet joint] or peri-articular [around the facet joint]).[28] Although medial branch blocks, which are performed at the medial branch of the primary dorsal ramus nerves that innervate the facet joints were originally developed as a diagnostic test to determine presence of facet joint, they have also been evaluated as therapeutic facet joint injections using corticosteroid and/or local anesthetic.

All of these factors could introduce heterogeneity and make it difficult to determine whether negative results in a given trial are due to suboptimal patient selection, an ineffective therapy, or some combination of both factors.[17] Another challenge is that trials of injection therapies have frequently focused on short-term outcomes related to pain, rather than longer-term functional outcomes.

Given the continued growth in use of epidural, facet joint, and sacroiliac injections for low back pain and continued uncertainty regarding their role and optimal use, the purpose of this systematic review is to summarize the current state of evidence, identify and evaluate inconsistencies in the evidence on these therapies, and identify important research gaps.

Scope of Review and Key Questions

The Key Questions used to guide this report are shown below. The analytic framework (**Figure 1**, located at the end of the report) shows the target populations, interventions, and outcomes that we examined.

Key Question 1. In patients with low back pain, what is the effectiveness of epidural corticosteroid injections, facet joint corticosteroid injections, medial branch blocks, and

sacroiliac joint corticosteroid injections versus epidural nonsteroid injection, nonepidural injection, no injection, surgery or nonsurgical therapies on outcomes related to pain, function and quality of life?

Key Question 1a. How does effectiveness vary according to the medication (corticosteroid, local anesthetic) used, the dose or frequency of injections, the number of levels treated, or degree of provider experience?

Key Question 1b. How does effectiveness vary according to use of imaging guidance or route of administration (e.g., for epidural injections interlaminar, transforaminal, caudal for epidural injections and for facet joint injections intra-articular, extra-articular [peri-capsular] or medial branch injections)?

Key Question 2. In patients with low back pain, what patient characteristics predict responsiveness to injection therapies on outcomes related to pain, function, and quality of life?

Key Question 3. In randomized trials of low back pain injection therapies, how does effectiveness vary according to the control therapy used (e.g., epidural nonsteroid injection, nonepidural injection, no injection)?

Key Question 3a. How do response rates vary according to the specific comparator evaluated (e.g., saline epidural, epidural with local anesthetic, nonepidural injection, no injection, surgery, nonsurgical therapies)?

Key Question 4. What are the harms of epidural corticosteroid, facet joint corticosteroid injections, medial branch blocks, and sacroiliac joint corticosteroid injection compared to epidural nonsteroid injection, nonepidural injection, no injection, surgery, or nonsurgical therapies?

Methods

The methods for this Technology Assessment follow the methods suggested in the Agency for Healthcare Research and Quality (AHRQ) Methods Guide for Effectiveness and Comparative Effectiveness Reviews.[36] All methods were determined *a priori*.

Input From Stakeholders

This topic was selected for review based on a nomination from the Centers for Medicare and Medicaid Services (CMS). The initial Key Questions for this Technology Assessment were developed with input from CMS staff. The Key Questions and scope were further developed with input from a group of stakeholders (Key Informants) convened for this report to provide diverse stakeholder perspectives and content and methodological expertise. The Key Informants consisted of experts in internal medicine, health services research, pain medicine, radiology, neurology, occupational medicine, and physical medicine and rehabilitation, as well as those representing the patient perspective. Key Informants disclosed financial and other conflicts of interest prior to participation. The AHRQ Task Order Officer and the investigators reviewed the disclosures and determined that the Key Informants had no conflicts of interest that precluded participation. A topic refinement document was then posted for public comment from December 17, 2013, through January 17, 2014 with the Key Question and inclusion criteria. Based on public comments, we further revised the Key Questions and scope. The protocol for this Technology Assessment was finalized prior to initiation of the review, and was posted on the AHRQ Web site.

Literature Search Strategy

A research librarian conducted searches in Ovid MEDLINE, the Cochrane Central Register of Controlled Trials, the Cochrane Database of Systematic Reviews, and the National Guideline Clearinghouse from 2008 through October, 2014 (see Appendix A for full search strategy). We restricted search start dates to January 2008, as there are multiple recent systematic evidence reviews directly addressing the Key Questions in the current review, including a good-quality review conducted by the same investigators of the current review that was commissioned by the American Pain Society (APS) and conducted searches through July 2008.[17] The APS review included all of the interventions addressed in the current review. We used the APS review and other systematic reviews[37] to identify studies published prior to 2008.

We also hand searched the reference lists of relevant studies and searched for unpublished studies in ClinicalTrials.gov. We did not solicit Scientific Information Packets (SIPs) for published and unpublished studies because the corticosteroid and local anesthetic drugs examined in this review are generic and the injections do not involve use of proprietary devices.

Literature searches will be updated while the draft report is posted for public comment and undergoing peer review to identify any new publications. Literature identified during the update search will be assessed by following the same process of dual review as all other studies considered for inclusion in the report. If any pertinent new literature is identified for inclusion in the report, it will be incorporated before the final submission of the report.

Study Selection

We developed criteria for inclusion and exclusion of articles based on the Key Questions and the populations, interventions, comparators, outcomes, timing, setting approach (Appendix B), in accordance with the AHRQ Methods Guide.[38] Articles were selected for full-text review if they were about epidural injections, facet joint injections, therapeutic medial branch injections, or sacroiliac injections with corticosteroids for radicular low back pain, spinal stenosis, or nonradicular low back pain, were relevant to a Key Question, and met the predefined inclusion criteria as described below. We excluded studies published only as conference abstracts, restricted inclusion to English-language articles, and excluded studies of nonhuman subjects. Studies had to report original data to be included.

To ensure accuracy, all excluded abstracts were dual reviewed. All citations deemed appropriate for inclusion by at least one of the reviewers were retrieved. Each full-text article was independently reviewed for eligibility for final inclusion by two team members. Discrepancies were resolved through discussion and consensus. A list of the included studies is available in Appendix C; excluded studies are shown Appendix D, with primary reasons for exclusion. Members of the review team were not involved in inclusion decisions for studies that they were authors on.

For epidural injections, we selected studies of adults undergoing epidural corticosteroid injections with radicular low back pain, spinal stenosis, nonradicular low back pain, or chronic postsurgical pain. We defined radiculopathy as presence of leg pain (typically worse than back pain), with or without sensory deficits or weakness, in a nerve root distribution. A number of studies used the term "sciatica," which we classified as radiculopathy. We included epidural injections performed via any approach, including the transforaminal, interlaminar, or caudal techniques. We also included studies of injections performed via the transforaminal approach that targeted the affected nerve root but did not necessarily enter the epidural space ("periradicular" injections).

For facet joint and sacroiliac injections, we selected studies of adults undergoing corticosteroid injections in or around the facet or sacroiliac joints for nonradicular low back pain presumed to originate from the facet joints (facet injections) or sacroiliac joints (sacroiliac injections). We included injections into the joint (intra-articular) or around the joint (extra-articular [peri-articular]), as well as therapeutic medial branch blocks (injections at the site of the medial branch of the dorsal ramus nerves innervating the facet joints).

We excluded studies of patients younger than 18 years of age, pregnant women, and patients with back pain due to fracture, high-impact trauma, cancer, infection, or spondyloarthropathy. We excluded studies of noninjection ablative therapies such as intradiscal electrothermal therapy or radiofrequency denervation, other noninjection therapies such as nucleoplasty, and studies that involved injection of noncorticosteroid medications (such as ozone, antitumor necrosis factor medications, methylene blue, or clonidine) unless they were compared to a corticosteroid injection. Studies on the diagnostic accuracy of diagnostic blocks was outside the scope of the review, but we evaluated how use of diagnostic blocks to select patients impacted estimates of effectiveness.

We included studies of patients with symptoms of any duration prior to enrollment. We included studies that compared the injections of interest versus epidural nonsteroid injections, soft tissue injections, no injection, surgery, or noninjection, nonsurgical therapies. We classified epidural injections with local anesthetics or saline, soft tissue injections with local anesthetics or saline, and no injections as "placebo" interventions to distinguish them from "active"

interventions such as epidural injections of other medications, other interventional procedures, surgery, or nonsurgical, noninterventional therapies. We also included studies that compared different injection techniques and corticosteroid doses.

Outcomes were pain, function, quality of life, opioid use, subsequent surgery, health care utilization, and harms, including bleeding, infection, neurological events, and systemic complications, such as weight gain, diabetes, osteoporosis, and other endocrinological effects. We included outcomes measured 1 week or later after the injection.

We included randomized trials for all Key Questions. For harms, we also included large (sample size >1000 patients) treatment series of patients who underwent the injections of interest. We excluded case series and case reports. We reviewed reference lists of systematic reviews for potentially relevant references.

Data Extraction

We extracted the following information from included studies into evidence tables using Excel spreadsheets: study design, year, setting, country, sample size, inclusion and exclusion criteria (including age, sex, race, back pain condition, duration of pain, baseline pain, baseline function, prior therapies, imaging and diagnostic findings, and psychosocial factors), intervention characteristics (including type and dose of corticosteroid and local anesthetic, volume of injectate, number and frequency of injections, levels injected, injection approach, use of imaging guidance, and experience of the person performing the injection), characteristics of the control intervention, and results.

For studies of interventions, we calculated relative risks and associated 95 percent confidence intervals (CI) based on the information provided (sample sizes and incidence of outcomes of interest in each intervention group). We noted discrepancies between calculated and reported results when present.

Data extraction for each study was performed by two investigators. The first investigator extracted the data, and the second investigator independently reviewed the extracted data for accuracy and completeness.

Assessing Quality

We assessed quality (risk of bias) for each study using predefined criteria. We used the term "quality" rather than the alternate term "risk of bias;" both refer to internal validity. Randomized trials were evaluated with criteria and methods developed by the Cochrane Back Review Group.[39] These criteria were applied in conjunction with the approach recommended in the chapter on Assessing the Risk of Bias of Individual Studies When Comparing Medical Interventions[38] in the AHRQ Methods Guide. Two investigators independently assessed the quality of each study. Discrepancies were resolved through discussion and consensus. Members of the review team who were authors on included studies were not involved in quality rating of those studies.

Individual studies were rated as having "poor," "fair," or "good" quality. We rated the quality of each randomized trial based on the methods used for randomization, allocation concealment, and blinding; the similarity of compared groups at baseline; whether attrition was adequately reported and acceptable; similarity in use of cointerventions; compliance to allocated treatments; the use of intent-to-treat analysis; and avoidance of selective outcomes reporting.[39, 40]

Studies rated "good quality" were considered to have low risk of bias and their results are likely to be valid. Studies rated "fair quality" have some methodological shortcomings, but no

flaw or combination of flaws judged likely to cause major bias. In some cases, the article did not report important information, making it difficult to assess its methods or potential limitations. The "fair quality" (moderate risk of bias) category is broad and studies with this rating vary in their strengths and weaknesses; the results of some studies assessed to have moderate risk of bias are likely to be valid, while others may be only possibly valid. Studies rated "poor quality" (high risk of bias) have significant flaws that may invalidate the results. They have a serious or "fatal" flaw or combination of flaws in design, analysis, or reporting; large amounts of missing information (including publication of only preliminary results in a subgroup of patients randomized); or serious discrepancies in reporting. The results of these studies are at least as likely to reflect flaws in the study design as the differences between the compared interventions. We did not exclude poor-quality studies *a priori*, but they were considered the least reliable when synthesizing the evidence, particularly when discrepancies between studies were present.

Treatment series of patients undergoing injection therapies were not formally rated because they already are known to have serious limitations due to the lack of a control group of patients who did not undergo injections.

Assessing Research Applicability

We recorded factors important for understanding the applicability of studies, such as whether the publication adequately described the study sample, the country in which the study was conducted, the characteristics of the patient sample (e.g., age, sex, race, type of back pain, imaging findings, duration or severity of pain, medical comorbidities, and psychosocial factors), the characteristics of the interventions used (e.g., specific corticosteroid, dose, technique, number or frequency of injections, and use of imaging guidance), and the magnitude of effects on clinical outcomes.[41] We also recorded the funding source and role of the sponsor. We did not assign a rating of applicability (such as high or low) because applicability may differ based on the user of the report.

For interpreting the clinical importance of mean changes in outcome scores, we defined a minimum clinically important difference as an improvement in 15 points on a 0 to 100 pain scale, 10 points on the Oswestry Low Back Pain Disability Questionnaire (ODI), and 5 points on the Roland Morris Disability Questionnaire (RDQ).[42] These thresholds were recommended in a report from a panel of 36 experts in the low back pain field following a review of the evidence.[42]

Evidence Synthesis and Rating the Body of Evidence

We constructed evidence tables summarizing study characteristics, results, and quality ratings for all included studies. We summarized evidence for each Key Question qualitatively using a hierarchy-of-evidence approach, where the best evidence was the focus of our synthesis for each Key Question.

We conducted meta-analyses to summarize data and obtain more precise estimates for outcomes and comparisons for which studies were homogeneous enough to provide a meaningful combined estimate.[43] Comparisons for which evidence was suitable for pooling were epidural corticosteroid injection versus placebo (epidural local anesthetic injection, epidural saline injection, soft tissue local anesthetic injection, soft tissue saline injection, needling with no injection, or no injection) for radiculopathy, epidural corticosteroid injection versus placebo for spinal stenosis, and transforaminal versus interlaminar epidural injections with corticosteroid for radiculopathy.

Outcomes were extracted and stratified by duration of followup as immediate (≤2 weeks), short term (2 weeks to ≤3 months), intermediate term (3 months to <1 year), and long term (>1 year). For each category, we used the longest duration data available. We analyzed two continuous outcomes: pain and function. For pain, we used pain as measured on a 0 to 10 or 0 to100 visual analogue or numerical rating scale and converted all scores to 0 (no pain) to 100 (worst possible pain). We used data for leg pain when available; if leg pain was not specifically reported we used overall pain (leg pain is typically worse than back pain in patients with radiculopathy). Other pain scores reported were also included, including the Multidimensional Pain Inventory (range 0 to 100, higher scores indicate greater disability) and the McGill Pain Questionnaire (pain rating index score ranges from 0 to 78; present pain intensity ranges from 1 to 5; higher scores indicate greater pain disability). For studies that assessed function using more than one measure, we prioritized the outcome used for pooling in the following order: ODI (range 0 to 100, higher scores indicate greater disability), RDQ (range 0 to 24, higher scores indicate greater disability), and other function scales (including the Hannover Functional Ability Questionnaire (range 0 to 24, lower scores indicate greater disability), the Low Back Outcome Score (range 0 to 75, higher scores indicate less disability or need), and North American Spine Society Lumbar Spine Questionnaire (range 0 to 100, higher scores indicate greater disability). The ODI and the RDQ are the most commonly used measures of back-specific function and are recommended core outcome measures.[44] Other included outcome measures are detailed in the evidence tables. In the primary analyses, we combined weighted mean difference (WMD) for pain and standardized mean difference (SMD) for function. The mean difference was calculated using the change between the followup and baseline scores. We also conducted sensitivity analysis based on differences in scores at followup and estimates from analysis of covariance or other results that adjusted for other covariates if available; results were similar to the primary analyses and not reported further. When the standard deviation was missing, we imputed the missing value using the mean standard deviation from other studies in that analysis. For binary outcomes, we combined relative risks (RR) for pain and function "success" (e.g., ≥50% improvement in pain scores or ODI, or as otherwise defined in the trials), composite or overall measures of success (e.g., ≥50% improvement in pain and ≥50% function, or as otherwise defined in the trials), and rates of subsequent surgery. In addition, we pooled placebo response rates for the binary pain and function and mean difference in change scores for pain and function in the placebo group (as a measure of placebo response), stratified by the comparator used.

The studies were combined using the Dersimonian-Laird random effects method. We assessed the presence of statistical heterogeneity among the studies by using the standard Cochran's chi-square test, and the magnitude of heterogeneity by using the I^2 statistic.[45] When statistical heterogeneity was present, we performed sensitivity analyses by conducting meta-analysis using the profile likelihood method.[46] For the primary analyses of epidural injections versus placebo, we pooled across approaches (transforaminal, interlaminar, or caudal), but also stratified the results by approach. We performed sensitivity analyses by excluding poor-quality studies and outlier studies. When the number of studies was relatively large (eight to 10),[43] we performed additional subgroup analyses and meta-regression based on the specific corticosteroid used, the corticosteroid dose (converted into prednisolone equivalents, for transforaminal ≥50 mg vs. <50 mg; for interlaminar and caudal, ≥100 mg vs. <100 mg), the local anesthetic used, the specific comparator (epidural injection with local anesthetic, epidural injection with saline, soft tissue injection with local anesthetic, soft tissue injection with saline, needling without injection, or no injection), the volume of injected (for transforaminal, >3 ml vs. ≤ 3 ml; for

interlaminar, ≥10 ml vs. <10 ml; for caudal, ≥20 ml vs. <20 ml), the duration of symptoms (restricted to acute [symptoms ≤4 weeks]), whether imaging correlation was required for patient enrollment, whether enrollment was restricted to patients with herniated disc on imaging, use of fluoroscopic guidance, whether the intervention was limited to a single injection, whether patients with prior surgery were excluded, overall quality rating (good, fair, poor), whether the person performing the injection was blinded, and blinding of outcomes assessors and patients. For transforaminal injections, we also stratified studies according to whether the injection clearly entered the epidural space or targeted the nerve root ("periradicular") without clearly entering the epidural space. Similar analyses were performed for the analysis of transforaminal versus interlaminar injections when data allowed. A funnel plot was created and the Egger test performed for primary analyses across approaches (transforaminal, interlaminar, or caudal) with 10 studies to assess for small study effects.[47] All analyses were conducted using Stata/IC 13.0 (StataCorp LP, College Station, TX).

We assessed the strength of evidence (SOE) for each Key Question and outcome using the approach described in the AHRQ Methods Guide,[38] based on the overall quality of each body of evidence, based on the risk of bias (graded low, moderate, or high); the consistency of results across studies (graded consistent, inconsistent, or unable to determine when only one study was available); the directness of the evidence linking the intervention and health outcomes (graded direct or indirect); and the precision of the estimate of effect, based on the number and size of studies and confidence intervals for the estimates (graded precise or imprecise).

We graded the SOE for each Key Question using the four categories recommended in the AHRQ Methods Guide.[38] A "high" grade indicates high confidence that the evidence reflects the true effect and that further research is very unlikely to change our confidence in the estimate of effect. A "moderate" grade indicates moderate confidence that the evidence reflects the true effect and further research may change our confidence in the estimate of effect and may change the estimate. A "low" grade indicates low confidence that the evidence reflects the true effect and further research is likely to change the confidence in the estimate of effect and is likely to change the estimate. An "insufficient" grade indicates evidence either is unavailable or is too limited to permit any conclusion, due to the availability of only poor-quality studies, extreme inconsistency, or extreme imprecision.

Peer Review and Public Commentary

Experts in low back pain and injection therapies, as well as individuals representing important stakeholder groups, have been invited to provide external peer review of this report. The AHRQ Task Order Officer will also provide comments and editorial review. To obtain public comment, the draft report was posted on the AHRQ Web site for 2 weeks. A disposition of comments report detailing the authors' responses to the peer and public review comments will be made available after the AHRQ posts the final report on the public Web site.

Results

Tables and figures for this chapter appear at the end of the report. The search and selection of articles are summarized in the study flow diagram (Figure 2).

We included a total of 92 randomized trials (reported in 107 publications); 78 trials (in 92 publications) evaluated epidural corticosteroid injections (Tables 1-4, Appendixes E1-E4, F1-F4),[48-91, 92 , 93-139] 13 trials (in 14 publications) evaluated facet joint injections (Table 5, Appendix E5, F5),[140-153] and one trial evaluated sacroiliac injections[154] (Table 6, Appendix E6, F6). We also discussed four large observational studies on harms.

Of the 78 trials of epidural corticosteroid injection, 60 trials evaluated epidural injections for radiculopathy,[48-50, 52-71, 73-81, 83-90, 92, 96-104, 106-109, 111-115, 117] 12 evaluated spinal stenosis,[66, 115-123, 126, 127] 3 evaluated nonradicular low back pain,[128, 129, 132] and 5 evaluated postsurgical low back pain.[135-139]

Epidural Injections

Epidural Injections For Radiculopathy

Sixty trials evaluated epidural injections for radiculopathy (**Table 1: Appendix E1**).

Of these, 29 (reported in 28 publications) compared an epidural corticosteroid injection to a placebo intervention.[50, 54-56, 58, 62, 64, 66, 68, 69, 71, 76, 78, 81, 85, 88, 90, 93, 96, 103, 104, 106-109, 113-115] Five evaluated transforaminal injections,[64, 71, 81, 105, 109] 11 interlaminar injections,[50, 62, 66, 69, 76, 90, 103, 106, 108, 113, 114] nine caudal injections,[54, 55, 58, 68, 78, 93, 96, 107, 115] and two (reported in one publication) oblique interlaminar injections.[88] In two trials, the specific epidural technique was not described, but the corticosteroid dose and total volume, lack of fluoroscopic guidance, and time period appear consistent with the interlaminar approach.[56, 85] Sample sizes ranged from 26 to 239 and duration of followup from 1 week to 3 years. Fifteen trials were conducted in the United States, 25 in Europe, one in the United States and Europe, and 14 in other countries. The most commonly used corticosteroids were methylprednisolone (17 trials),[54-56, 62, 64, 66, 68, 69, 76, 81, 85, 89, 96, 103, 106, 108, 109, 114] and triamcinolone (seven trials);[50, 58, 68, 71, 78, 88] other corticosteroids were betamethasone (four trials)[93, 105, 107, 134] and one trial each of dexamethasone,[68] hydrocortisone,[115] and prednisolone.[113] Corticosteroid doses in prednisolone equivalents were 12.5 to 125 mg for the transforaminal approach, 50 to 125 mg for the interlaminar approach, and 50 to 100 mg for the caudal approach. The total volume of injectate was 1 to 3 ml with transforaminal corticosteroid injections, 2 to 20 ml for interlaminar corticosteroid injections, and 10 to 42 ml for caudal corticosteroid injections. All trials of the transforaminal approach used fluoroscopic guidance; one trial[134] of the interlaminar approach and one trial[93] of the caudal approach used fluoroscopic guidance; and one trial[78] of the caudal approach used ultrasound guidance. Twelve trials required imaging findings consistent with symptoms for inclusion.[56, 62, 65, 66, 68, 88, 105, 107-109, 114, 115] Of these, eight trials required imaging findings of disc herniation.[56, 62, 64, 66, 68, 88, 115] Other imaging findings were foraminal stenosis, central spinal stenosis, and disc degeneration. Two trials reported results for patients with herniated disc and spinal stenosis separately.[66, 115] In the other trials that reported imaging findings, the majority of patients had herniated disc. Two trials evaluated patients with acute (<4 weeks) symptoms[96, 113] and five trials evaluated patients with subacute (4 to12 weeks) symptoms;[56, 62, 64, 81, 108] the remainder enrolled patients with chronic back pain, back pain of mixed duration, or did not report duration of symptoms.

Eleven trials of epidural corticosteroid injection for radiculopathy compared an epidural corticosteroid injection to other therapies.[52, 53, 57, 59, 64, 67, 70, 86, 89, 98, 111] Two trials compared

epidural corticosteroid injections versus surgery (discectomy or percutaneous microdiscectomy),[52, 59] two trials compared other interventional therapies (plasma disc decompression[70] or targeted epidural injection with spinal endoscopic guidance[67]), five trials compared epidural injections with other medications (autologous conditioned serum,[53] clonidine,[57, 111] hypertonic saline[86], or etanercept[64]), and two trials compared nonsurgical, noninvasive therapies (including medications, bed rest, exercise, and/or physical modalities).[89, 98] Epidural injections were performed using the transforaminal,[57, 64, 70, 86, 111] interlaminar,[52, 59, 89] caudal,[67, 98] or oblique interlaminar[53] approaches. Sample sizes ranged from 26 to 180 patients. Duration of followup ranged from 1 to 6 months in seven trials; in the other two trials[59, 70] duration of followup was 2 to 3 years.

Four trials of epidural injections for radiculopathy evaluated effects of one corticosteroid versus another.[63, 83, 84, 100] Three trials evaluated dexamethasone, a water soluble (nonparticulate) corticosteroid, versus the particulate corticosteroids methylprednisolone or triamcinolone.[83, 84, 100] The fourth trial evaluated a combination of betamethasone sodium phosphate and betamethasone diproprionate versus methylprednisolone; betamethasone diproprionate is considered less water soluble than betamethasone sodium phosphate.[63] Two trials[83, 100] used the transforaminal approach and two[63, 84] used the interlaminar approach. Sample sizes ranged from 60 to 106 patients and duration of followup ranged from 1 to 6 months. One trial enrolled slightly more patients with spinal stenosis than herniated disc, but results were not stratified by cause of symptoms.[101]

Six trials of epidural injections for radiculopathy evaluated effects of different doses of the same corticosteroid.[49, 53, 77, 80, 97, 99] Three trials evaluated methylprednisolone,[77, 97, 99] two trials triamcinolone,[53, 80] and one trial dexamethasone.[49] Methylprednisolone was administered via the interlaminar and caudal approaches and triamcinolone and dexamethasone through the transforaminal approach. Sample sizes ranged from 33 to 160. Duration of followup ranged from 2 weeks to 6 months.

Ten trials of epidural injections for radiculopathy evaluated effects of alternative epidural injection techniques.[48, 60, 61, 73-75, 87, 88, 102, 112] Of these, five trials directly compared epidural corticosteroid injections via the transforaminal versus interlaminar approaches.[48, 75, 87, 112, 155] One of these trials also compared these approaches with the caudal approach.[48] One trial evaluated epidural corticosteroid injections via the oblique interlaminar approach versus the standard interlaminar,[88] four trials evaluated the lateral parasagittal interlaminar approach versus the standard midline interlaminar (2 trials[60, 74]) or transforaminal (2 trials[61, 73]) approaches, and one trial compared ganglionic versus preganglionic transforaminal corticosteroid injection.[79] Sample sizes ranged from 30 to 239 and duration of followup from 10 days to 12 months.

One trial of patients with radiculopathy (due to herniated disc or central spinal stenosis) compared caudal epidural corticosteroid injections with fluoroscopic plus Doppler guidance versus fluoroscopic guidance alone[101] and one trial evaluated use of magnetic resonance imaging (MRI) versus history and physical examination to guide transforaminal or interlaminar epidural injection treatment and targets.[64]

Five trials were rated good quality, 41 trials fair quality, and 14 trials poor quality (**Appendix F1**). Thirty-seven trials reported adequate randomization methods, 10 trials reported adequate allocation concealment, 31 trials reported blinding of outcomes assessors, 19 trials blinding of the person performing the injection, and 41 trials blinding of the patient. Attrition was high or not clearly reported in 26 trials.

Epidural injections for Spinal Stenosis

Twelve trials evaluated epidural corticosteroid injections for central spinal stenosis (**Table 2; Appendix E2**).[66, 115-123, 126, 127] Of these, eight trials compared epidural corticosteroid injections versus placebo interventions.[66, 115, 117, 118, 120, 122, 123, 126] Two trials evaluated transforaminal injections,[117, 126] six trials interlaminar injections,[66, 116-118, 120, 122] and two trials caudal injections.[115, 123] Sample sizes ranged from 29 to 386 patients and duration of followup from 1 to 24 months. Four trials were conducted in the United States,[66, 117, 122, 123] and the remainder in Asia or Egypt.[115, 119, 120, 126] Two trials used the corticosteroid betamethasone,[122, 123] two trials used triamcinolone,[120, 126] two trials used methylprednisolone,[66, 118] one trial used hydrocortisone,[115] and one trial used various corticosteroids.[117] Corticosteroid doses in prednisolone equivalents ranged from 25 to 150 mg. The volume of injectate was 2 and 6 ml in trials that used the transforaminal approach,[117, 126] 4 to 10 ml in trials that used the interlaminar approach,[66, 117, 118, 122] and 10 and 30 ml in trials that used the caudal approach.[115, 123] Five trials used fluoroscopic guidance.[117, 120, 122, 123, 126] The trials focused on patients with chronic symptoms, though in one trial 12 to 20 percent of patients had symptoms for less than 3 months.[117] Six trials required imaging confirmation of central stenosis[66, 115, 117, 118, 120, 126] and four trials required leg symptoms consistent with central stenosis;[66, 115, 117, 118] the remainder did not clearly describe leg pain symptoms required for enrollment. One trial specifically enrolled spinal stenosis patients with degenerative scoliosis.[126]

One trial of epidural corticosteroid injections for spinal stenosis compared two different corticosteroids via the caudal approach[119] and four trials compared epidural steroid corticosteroid injections versus other interventions (minimally invasive lumbar decompression [MILD], physical therapy, epidural adhesiolysis, epidural etanercept), via various approaches.[116, 120, 121, 127] One trial compared caudal epidural corticosteroid injections with fluoroscopic plus Doppler guidance versus fluoroscopic guidance alone in patients with radiculopathy due to herniated disc or central spinal stenosis, but did not report results separately for patients with spinal stenosis.[101]

Of the 12 trials that reported results for patients with spinal stenosis, one was rated good quality,[117] seven fair quality,[66, 116, 119, 120, 122, 123, 127] and four poor quality (Appendix F2).[115, 118, 121, 126] Methodological shortcomings included failure to report adequate randomization or allocation concealment methods; inadequate blinding of outcome assessors and/or individuals performing the injection, or patients; and failure to clearly report primary outcomes.

Epidural Injections For Nonradicular Low Back Pain

Two trials evaluated epidural corticosteroid injections versus an epidural local anesthetic injection for chronic nonradicular low back pain (Table 3; Appendix E3; Appendix F3).[129, 132] One trial evaluated the caudal approach[129] and the other the interlaminar approach.[132] A third trial compared transforaminal versus interlaminar epidural injections with a corticosteroid plus local anesthetic.[128] Sample sizes ranged from 120 to 192 patients, and duration of followup ranged from 4 months to 2 years. All three trials were rated fair quality.

Epidural Injections For Chronic Postsurgery Pain

Five trials evaluated epidural injections in patients with pain following lumbar surgery (**Table 4; Appendix E4; Appendix F4**).[135-139] The trials compared an epidural injection with corticosteroid to injections with hyaluronidase,[135, 138] forceful injections,[137] morphine,[139] or epidural adhesiolysis.[136] Sample sizes ranged from 22 to 120 and duration of followup from 4 weeks to 2 years. Four of the five trials were rated poor quality;[135-138] the other[139] was rated fair

quality. Methodological shortcomings in the poor-quality trials included inadequate description of randomization and allocation concealment methods, unblinded design, and high attrition or failure to complete the trial.

Facet Joint Injections

Thirteen trials evaluated facet joint corticosteroid injections (Table 5; Appendix E5; Appendix F5).[140-148, 150-153] Four studies were placebo-controlled,[141, 145, 146, 151] four compared a corticosteroid to another nonsteroidal intervention,[142, 143, 147, 148] four compared one corticosteroid to another,[144, 146, 150, 152] and two utilized similar corticosteroids in both groups.[140, 153] Five trials evaluated intra-articular,[140, 141, 146, 151, 153] one trial extra-articular (peri-capsular) injections,[146] one trial intra-muscular injections,[153] and three trials evaluated medial branch injections.[140, 147, 149] One trial evaluated intra- versus extra-articular (peri-capsular) corticosteroid injection,[146] two trials intra-articular versus medial branch corticosteroid injection,[140, 150] one trial intra-articular steroid versus hyaluronic acid injection,[143] one trial intra-articular versus intra-muscular corticosteroid injection,[153]and two trials intra-articular[145] or medial branch[142] corticosteroid injections versus radiofrequency neurotomy.

Sample sizes ranged from 46 to 120 patients and duration of followup ranged from 1 to 24 months. Five trials were conducted in Europe,[142, 143, 145, 146, 151] three in the United States,[140, 147-149] one in Canada,[141] one in Australia,[150] and one in Brazil.[153] Corticosteroids used were methylprednisolone in six studies,[141, 142, 146, 147, 150, 151] betamethasone in two studies,[145, 148, 149] and triamcinolone in three studies.[140, 143, 153] Corticosteroid doses in prednisolone equivalent doses ranged from 0.6 to100 mg per injection; eight studies used doses ranging from 12.5 to 100 mg,[141-143, 145, 146, 150, 151, 153] and two studies used 0.6 to 1.7 mg per injection.[147-149] Fluoroscopic guidance was used in all trials. Eight trials required a minimum duration of back pain that ranged from 3 to 24 months;[141, 143, 145-150, 153] six trials reported mean or median baseline pain duration that ranged from 18 to 108 months.[141, 142, 147-150, 153] Six trials required imaging findings consistent with facet joint pain (e.g., degenerative changes) for inclusion.[140, 143-145, 152, 153] Five trials required positive findings on facet joint blocks,[141, 142, 145, 147-149] two trials used single[141, 145] and two used double blocks,[147, 148] and one[142] gave no details.

Two trials compared different imaging methods in conjunction with intra-articular facet joint injections with betamethasone and local anesthetic.[144, 152] One trial (n=46) evaluated bone scanning with single photon electronic computed tomography (SPECT) versus physical exam plus radiologic findings without SPECT to identify targets for fluoroscopically-guided facet joint injections.[152] The other trial (n=40) evaluated computerized tomography (CT) versus ultrasound imaging guidance.[144] Methodological limitations in the trials included unclear allocation concealment; lack of or unclear blinding of the outcome assessor, care provider, and patient; failure to report patient attrition; and failure to specify primary outcomes.

Two trials were rated good quality,[145, 153] eight trials fair quality,[117, 140-144, 148, 150, 152] and three trials poor quality (Appendix F5).[146, 147, 151] Frequent methodological shortcomings were unclear randomization and allocation concealment methods, failure to specify primary outcomes, and inadequately blinding of patients, proceduralists, and outcome assessors.

Sacroiliac Joint Injections

The fair-quality trial of sacroiliac joint injection was small (n=24) and compared a peri-articular injection with corticosteroid versus local anesthetic.[154] Duration of followup was 1 month (Table 6; Appendix E6; Appendix F6).

Key Question 1. In patients with low back pain, what is the effectiveness of epidural corticosteroid injections, facet joint corticosteroid injections, medial branch blocks, and sacroiliac joint corticosteroid injections versus epidural nonsteroid injection, nonepidural injection, no injection, surgery or nonsurgical therapies on outcomes related to pain, function and quality of life?

Key Points

Epidural Injections

Epidural injections for radiculopathy

- Epidural corticosteroid injections were associated with greater improvement in pain scores versus placebo interventions at immediate-term followup (six trials, WMD –7.55 on 0 to 100 scale, 95% CI –11.4 to –3.74, I2=30%) (SOE: moderate).
- There were no differences between epidural corticosteroid injections versus placebo interventions in improvement in pain scores at short-term (14 trials, WMD –3.94, 95% CI –9.11 to 1.24, I2=82%), intermediate-term (four trials, WMD –0.07, 95% CI –8.41 to 8.26, I2=82%), or long-term followup (six trials, WMD –0.86, 95% CI –3.78 to 2.06, I2=0%) (SOE: low for short- and intermediate-term, and moderate for long-term followup).
- There were no differences between epidural corticosteroid injections versus placebo interventions in likelihood of a successful pain outcome at short-term (eight trials, RR 1.21, 95% CI 0.98 to 1.49, I2=67%), intermediate-term (three trials, RR 1.12, 95% CI 0.93 to 1.36, I2=41%), or long-term followup (four trials, RR 1.10, 95% CI 0.94 to 1.28, I2=0%) (SOE: low for short- and intermediate-term and moderate for long-term followup).
- There were no differences between epidural corticosteroid injections versus placebo interventions in improvement in function at immediate-term (four trials, SMD –0.75, 95% CI –1.62 to 0.11, I2=94%), short-term (12 trials, SMD –0.15, 95% CI –0.47 to 0.16, I2=88%), intermediate-term (five trials, SMD –0.30, 95% CI –0.74 to 0.15, I2=86%), or long term (seven trials, SMD –0.23, 95% CI –0.55 to 0.10, I2=82%) followup. Excluding an outlier trial decreased statistical heterogeneity and resulted in a statistically significant effect for improvement in function at immediate-term followup (three trials, SMD –0.33, 95% CI –0.56 to –0.09, I2=0%) (SOE: low for immediate- and intermediate-term, moderate for short- and long-term followup).
- There were no differences between epidural corticosteroid injections versus placebo interventions in likelihood of experiencing a successful functional outcome at short-term (six trials, RR 1.01, 95% CI 0.74 to 1.38, I2=76%), intermediate-term (two trials, RR 1.18, 95% CI 0.89 to 1.57, I2=71%), or long-term followup (three trials, RR 1.15, 95% CI 0.97 to 1.35, I2=0%) (SOE: low).
- Epidural corticosteroid injections were associated with lower risk of undergoing surgery at short-term followup (eight trials, RR 0.62, 95% CI 0.41 to 0.92, I2=0%), but the estimate was no longer statistically significant after exclusion of poor-quality trials (five trials, RR 0.69, 95% CI 0.42 to 1.13, I2=0%) (SOE: low).

- There were no differences between epidural corticosteroid injections versus placebo interventions in risk of undergoing surgery at intermediate-term (one trial, RR 0.56, 95% CI 0.12 to 2.68) or long-term followup (14 trials, RR 0.97, 95% CI 0.75 to 1.25, I2=23%) (SOE: low for intermediate-term, moderate for long-term followup).
- There were no differences between epidural corticosteroid injections versus placebo interventions in likelihood of experiencing a successful outcome at short-term (nine trials, RR 1.13, 95% CI 0.98 to 1.32, I2=3.5%), intermediate-term (one trial, RR 0.71, 95% CI 0.34 to 1.48), or long-term followup (two trials, 1.04, 95% CI 0.81 to 1.34, I2=0%) (SOE: moderate for short-term, low for intermediate- and long-term followup).
- There was insufficient evidence from two trials to determine effects of epidural corticosteroid injections versus discectomy, due to methodological shortcomings in the trials (SOE: insufficient).
- One trial found epidural corticosteroid injections associated with lower likelihood than MILD of achieving ≥25 point improvement in leg pain (RR 0.49, 95% CI 0.24 to 1.0), ≥13 point improvement in the ODI (RR 0.34, 95% CI 0.34 to 0.95), and ≥5 point improvement in the SF-36 (RR 0.34, 95% CI 0.12 to 0.95) through 2 years. There was no difference in risk of undergoing surgery (RR 0.45, 95% CI 0.09 to 2.19) (SOE: low).
- There was insufficient evidence from one small (n=26), fair-quality trial to determine effects of epidural corticosteroid injections versus epidural clonidine injection (SOE: insufficient).
- One trial found transforaminal epidural corticosteroid injection superior to etanercept on the ODI at 1 month (difference –16 on 0 to 100 scale, 95% CI –26.0 to –6.27). There were no differences in other outcomes, including pain and analgesic use (SOE: low).
- One trial found no differences between epidural corticosteroid versus autologous conditioned serum administered via the oblique interlaminar approach in improvement in pain or ODI scores after 22 weeks (SOE: low)
- There was insufficient evidence from two trials to determine effects of epidural corticosteroid injections versus nonsurgical, noninterventional therapies due to methodological shortcomings in the trials and differences in the nonsurgical, noninterventional therapies evaluated (SOE: insufficient).
- One trial found transforaminal epidural corticosteroid injection with corticosteroid plus hypertonic saline associated with greater decrease in pain intensity through 4 months than a corticosteroid injection alone (difference from baseline –2.78 vs. –1.50 on 0 to 10 NRS, p=0.05), though the effect was smaller and no longer statistically significant at 6 months. There were no differences in global assessment or the ODI (SOE: low).
- One trial found no difference between transforaminal epidural injection with corticosteroid versus corticosteroid plus low-dose clonidine in pain scores through 12 weeks in patients with subacute low back pain (SOE: low).

Epidural injections for spinal stenosis

- There were no differences between epidural corticosteroid injections versus placebo interventions in improvement in pain at short-term (five trials, WMD 0.62, 95% CI –2.87 to 4.11, I^2=0%), intermediate-term (three trials, WMD 3.73, 95% CI –0.81 to 8.26, I2=0%), or long-term (one trial, mean difference 4.00, 95% CI –2,87 to 10.9) followup; epidural corticosteroid injection was superior to placebo at intermediate term (one trial, mean difference –22.0, 95 % –36.0 to –8.0) (SOE: low).

- There was no difference between epidural corticosteroid injections versus placebo interventions in likelihood of experiencing a successful pain outcome at short-term (three trials, RR 0.98, 95% CI 0.84 to 1.15, I2=0%), intermediate-term (two trials, RR 0.98, 95% CI 0.78 to 1.24, I2=0%), or long-term (three trials, RR 0.97, 95% CI 0.74 to 1.28, I2=0%) followup (SOE: low).
- There were no differences between epidural corticosteroid injections versus placebo interventions in improvement in function at immediate-term (two trials, SMD –0.32, 95% CI –0.85 to 0.22, I2=0%), short-term (five trials, SMD –0.03, 95% CI –0.31 to 0.26, I2=60%), intermediate-term (three trials, WMD 2.81, 95% CI –0.44 to 6.06, I2=0%), or long-term (two trials, WMD 2.78, 95% CI –1.24 to 6.79, I2=0%) followup (SOE: low for immediate, intermediate- and long-term, moderate for short-term followup).
- There was no difference between epidural corticosteroid injections versus placebo interventions in the likelihood of experiencing a successful functional outcome at short-term (three trials, RR 0.91, 95% CI 0.70 to 1.18, I2=37%), intermediate-term (two trials, RR 0.96, 95% CI 0.74 to 1.25, I2=0%), or long-term (two trials, RR 0.95, 95% CI 0.71 to 1.26, I2=0%) followup (SOE: low).
- There were no differences between epidural corticosteroid injections versus placebo interventions in likelihood of experiencing a successful outcome at short-term (two trials, RR 1.18, 95% CI 0.55 to 2.55, I2=80%), intermediate-term (one trial, RR 0.93, 95% CI 0.63 to 1.35), or long-term (two trials, RR 1.16, 95% CI 0.76 to 1.78, I2=0%) followup (SOE: low).
- There was no difference between an epidural corticosteroid injection versus placebo intervention in likelihood of undergoing surgery at long-term followup (one trial, RR 0.76, 95% CI 0.38 to 1.54) (SOE: low).
- One trial found an epidural corticosteroid injection associated with lower likelihood of experiencing >2 point improvement in pain at 2 weeks versus the MILD procedure, but the difference was no longer present at 6 weeks. There was no difference in function (SOE: low).
- One trial found no differences between and epidural corticosteroid injection versus intense physical therapy in pain intensity or functional outcomes at 2 weeks through 6 months (SOE: low).
- One trial found epidural corticosteroid injection associated with worse leg pain than epidural etanercept injection at 1 month, with no difference in functional outcomes (SOE: low).
- There was insufficient evidence from one poor-quality trial to determine effects of epidural corticosteroid injections versus epidural adhesiolysis (SOE: insufficient).

Epidural injections for nonradicular low back pain

- Two trials found no differences between epidural corticosteroid injections and epidural local anesthetic injections in pain, function, or opioid use (SOE: low).

Epidural injections for chronic postsurgical pain

- No trial compared an epidural injection with corticosteroid versus a placebo intervention (SOE: insufficient).

- Evidence from 5 trials was insufficient to determine effects of epidural corticosteroid injections versus other interventions, due to methodological limitations, differences in the comparators evaluated, and small sample sizes (SOE: insufficient).

Facet Joint Injections

- Two trials found no clear differences between an intra-articular facet joint injection with corticosteroid versus saline in pain or function at 1 to 3 months; in one fair-quality trial results at 6 months favored the corticosteroid injection but are difficult to interpret due to greater receipt of cointerventions and no difference in likelihood of sustained improvement (SOE: low).
- Evidence from one small, poor-quality trial was insufficient to determine effects of an intra-articular corticosteroid facet joint injection versus medial branch local anesthetic injection (SOE: insufficient).
- Evidence from one poor-quality trial was insufficient to determine effects of an extra-articular facet joint corticosteroid injection versus intra-articular saline injection (SOE: insufficient).
- Two trials found no differences between medial branch corticosteroid injection versus medial branch local anesthetic injection in pain, function, or opioid use through 12 to 24 months (SOE: low).
- One trial found no clear differences between an intra-articular facet joint versus an intramuscular corticosteroid injection in pain, function, or quality of life through 6 months (SOE: low).
- One trial found no differences between intra-articular facet injection with triamcinolone acetonide versus hyaluronic acid in pain or function at 1 month or in health-related quality of life at 1 week (SOE: low).
- One trial found no differences between intra-articular corticosteroid injection plus sham neurotomy versus medial branch radiofrequency facet neurotomy plus local anesthetic injection in pain, function, or analgesic use at 6 months (SOE: low).
- One fair-quality trial found medial branch corticosteroid injection inferior to radiofrequency facet denervation on pain at 1, 6, and 12 months, with no differences in quality of life (1, 6, and 12 months), but results may have been confounded by differential use of diagnostic blocks to select patients for inclusion (SOE: low).

Sacroiliac Joint Injections

- There was insufficient evidence from one small (n=24) trial to determine effects of peri-articular sacroiliac corticosteroid injection versus local anesthetic injection (SOE: insufficient).

Detailed Synthesis

Epidural Injections

Epidural Injections For Radiculopathy

Epidural Injections Versus Placebo Interventions

Twenty-nine trials (reported in 28 publications) evaluated epidural corticosteroid injections for radiculopathy versus placebo interventions (Table 1, Appendix E1, F1).[50, 54-56, 58, 62, 64, 66, 68, 69, 71, 76, 78, 81, 85, 88, 90, 93, 96, 103, 104, 106-109, 113-115] Pooled results (Table 7) indicated few differences on any outcome at different time points. Epidural corticosteroid injections were associated with greater improvement in pain scores at immediate-term followup (Figure 3, six trials, WMD –7.55 on 0 to 100 scale, 95% CI –11.4 to –3.74, I^2=30%).[56, 68, 71, 81, 85, 113] There were no differences between epidural corticosteroid injections versus placebo interventions in improvement in pain intensity at short-term (Figure 4, 14 trials, WMD –3.94, 95% CI –9.11 to 1.24, I^2=85%),[50, 56, 58, 62, 65, 68, 76, 78, 81, 85, 90, 93, 109, 113] intermediate-term (Figure 5, four trials, WMD 0.07, 95% CI –8.41 to 8.26, I^2=82%),[56, 81, 90, 93] or long-term followup (Figure 6, six trials, WMD –0.86, 95% CI –3.78 to 2.06, I^2=0%).[50, 58, 78, 81, 90, 93]

There were also no differences between epidural corticosteroid injections and placebo interventions in the likelihood of a successful outcome for pain at short-term (Figure 7, eight trials, RR 1.21, 95% CI 0.98 to 1.49, I^2=67%)[50, 65, 69, 71, 90, 93, 96, 110] intermediate-term (Figure 8, three trials, RR 1.12, 95% CI 0.93 to 1.36, I^2=41%),[65, 90, 93] or long-term followup (Figure 9, four trials, RR 1.10, 95% CI 0.94 to 1.28, I^2=0%).[50, 66, 90, 93] A successful pain outcome was defined as pain relief ≥50 percent,[50, 71, 90, 93] pain relief ≥50 percent plus positive Global Perceived Effect,[65] leg pain improved ≥20 points,[110] pain improved ≥75 percent,[66] "definite" improvement in pain,[96] or pain assessment "none."[69]

There were no differences between epidural corticosteroid injections and placebo interventions in improvement in function at immediate-term (Figure 10, four trials, SMD –0.75, 95% CI –1.62 to 0.11, I^2=94%),[56, 81, 107, 113] short-term (Figure 11, 11 trials, SMD –0.03, 95% CI –0.20 to 0.15, I^2=53%),[50, 56, 58, 62, 65, 78, 81, 90, 93, 109, 113] intermediate-term (Figure 12, five trials, SMD –0.30, 95% CI –0.74 to 0.15, I^2=86%),[56, 81, 90, 93, 107] or long-term followup (Figure 13, seven trials, SMD –0.23, 95% CI –0.55 to 0.10, I^2=82%).[50, 58, 78, 81, 90, 93, 107] Statistical heterogeneity was substantial. An outlier was a trial by Sayegh, et al.,[107] which reported an SMD of –1.90 (95% CI –2.25 to –1.55) for immediate-term pain versus SMDs of –0.24 to –0.52 in the other trials, –1.51 (95% CI –1.84 to –1.18) for short-term pain versus SMDs of –0.43 to 0.69 in the other trials, and –1.04 (95% CI –1.35 to –0.73) for long-term pain versus SMDs of –0.31 to 0.13 in the other trials. In this trial, patients with chronic radiculopathy and MRI findings of disc herniation or degeneration underwent caudal epidural injections with betamethasone. A difference between this trial and others is that it used sterile water (rather than saline) with local anesthetic as the control intervention. Excluding this trial eliminated statistical heterogeneity and resulted in a statistically significant effect on improvement in function at immediate-term followup (three trials, SMD –0.33, 95% CI –0.56 to –0.09, I^2=0%); estimates remained nonstatistically significant at other time points.

There were no differences between epidural corticosteroid injections and placebo interventions in likelihood of achieving a successful outcome for function at short-term (Figure 14, six trials, RR 1.01, 95% CI 0.74 to 1.38, I^2=76%),[50, 62, 68, 90, 93, 110] intermediate-term (Figure

15, two trials, RR 1.18, 95% CI 0.89 to 1.57, I^2=71%),[90, 93] or long-term followup (Figure 16, three trials, RR 1.15, 95% CI 0.97 to 1.35, I^2=0%).[50, 90, 93] A successful functional outcome was defined as an improvement in ODI of >10 points,[110] ≥50%,[90, 93] or >75%;[50] ODI score of ≤20;[62] or the RDQ improved >5 points.[68]

Epidural corticosteroid injections were associated with lower risk than placebo interventions of surgery at short-term followup, (**Figure 17**, eight trials, RR 0.62, 95% CI 0.41 to 0.92, I^2=0%),[68, 69, 85, 88, 107, 110, 113] but the difference was no longer statistically significant when poor-quality trials[68, 88] were excluded from the analysis (five trials, RR 0.69, 95% CI 0.42 to 1.13). There was no difference in risk of surgery at long-term followup (**Figure 18**, 14 trials, RR 0.97, 95% CI 0.75 to 1.25, I^2=23%).[50, 58, 64, 66, 71, 78, 81, 96, 105, 106, 108, 109, 114, 115] Estimates were similar using the profile likelihood method. One trial found no difference in risk of surgery at intermediate-term followup (12% [2/17] vs. 21% [4/19], RR 0.56, 95% CI 0.12 to 2.68).[56]

There were no differences between epidural corticosteroid injections and placebo interventions in likelihood of experiencing a successful composite outcome at immediate-term (Figure 19, two trials, RR 1.05, 95% CI 0.87 to 1.27, I^2=0%),[54, 93] short-term (Figure 20, nine trials, RR 1.13, 95% CI 0.98 to 1.32, I^2=3.5%)[56, 62, 64, 76, 85, 88, 106, 113] intermediate-term (one trial, RR 0.71, 95% CI 0.34 to 1.48)[64] or long-term followup (Figure 21, two trials, RR 1.04, 95% CI 0.81 to 1.34, I^2=0%).[93, 115] Definitions for a successful outcome differed across trials (Table 1).

Effects of epidural corticosteroids versus placebo interventions on analgesic use,[68, 69, 76, 90, 93, 106] work status,[50, 56, 62, 64, 69, 81, 106] and measures of healthcare utilization[50, 68, 69, 81] were reported in relatively few trials, using different methods. Although some trials reported results that favored epidural corticosteroid injections, few differences were statistically significant (Table 1).

For analyses other than short-term pain, exclusion of poor-quality trials had little effect on estimates and did not reduce statistical heterogeneity when it was present. There was also no effect of year of publication (prior to or after 2000) or blinding of patients or outcomes assessors on estimates, based on meta-regression.

Funnel plots on improvement in pain (Figure 22) or function (Figure 23) at short-term followup or likelihood of surgery (Figure 24) at long-term followup showed no evidence of small sample effects.

Epidural Corticosteroid Injections Versus Other Interventions

Eleven trials compared epidural corticosteroid injections versus other interventions (Table 1, Appendix E1, F1).[52, 53, 57, 59, 64, 67, 70, 86, 89, 98, 111] Two trials compared interlaminar epidural corticosteroid injections versus discectomy for radiculopathy.[52, 59] One poor-quality trial of patients (n=100) with radicular symptoms, lumbar disc herniation on imaging, and no improvement after at least 6 weeks of conservative management found interlaminar injection with 10 to15 mg betamethasone associated with increased likelihood of motor deficit (72% [36/50] vs. 38% [19/50], RR 1.89, 95% CI 1.28 to 2.80) versus discectomy (technique not specified) at 1 to 3 months, but no differences in leg pain or ODI scores.[59] Most patients (76%) underwent epidural injections with fluoroscopic guidance. Results consistent with 1 to 3 month findings were reported through 2 to 3 years, but are difficult to interpret due to high rates of crossover from the epidural injection group to discectomy (54% of patients allocated to epidural injection underwent discectomy). A poor-quality trial (n=50) of patients with lumbar disc herniation found epidural injection with corticosteroid associated with lower radicular pain scores than percutaneous microdiscectomy (2.0 vs. 7.1 on 0 to 10 Visual Analogue Scale [VAS]), but higher leg pain scores (6.5 vs. 1.0) through 6 weeks.[52] Methodological shortcomings

included failure to adequately describe randomization or blinding techniques, attrition, or blinding of outcomes assessors.

Two trials compared epidural corticosteroid injections versus other interventional procedures.[67, 70] One fair-quality trial (n=90) evaluated patients with chronic radicular symptoms, focal lumbar disc protrusion, and relatively preserved disc height (>50% of normal adjacent discs).[70] It found transforaminal epidural corticosteroid injection associated with lower likelihood than plasma disc decompression (with the Coblation® DLR or DLG SpineWand®) of achieving ≥25 point improvement in leg pain (21% [8/39] vs. 42% [18/43], RR 0.49 [95% CI 0.24 to 1.0]), ≥13 point improvement in ODI (10% [4/40] vs. 30% [13/44], RR 0.34 (95% CI 0.34 to 0.95), ≥5 point improvement in Medical Outcomes Study Short Form-36 (SF-36) (13% [5/39] vs. 33% [14/43], RR 0.34, 95% CI 0.12 to 0.95) through 2 years. There was no difference in risk of undergoing surgery (5% [2/40] vs. 11% [5/45], RR 0.45, 95% CI 0.09 to 2.19). The corticosteroid used and dose was left to the discretion of the treating physician; both procedures were performed under fluoroscopic guidance. The trial was funded by a manufacturer of a plasma disc decompression device. A fair-quality trial (n=60) of patients with chronic radicular symptoms and neurosensory and motor deficits (imaging findings not required) compared caudal epidural injection with 40 mg triamcinolone using fluoroscopic guidance versus targeted epidural injection with spinal endoscopic guidance via the sacral approach.[67] It found no differences between techniques through 6 months in pain, measures of anxiety or depression, or the short-form McGill Pain Questionnaire.

Three trials evaluated epidural corticosteroid injections versus epidural injections of noncorticosteroid medications: autologous conditioned serum,[53] clonidine,[57] or etanercept.[64] One fair-quality trial (n=26)[57] found transforaminal epidural corticosteroid injection superior to clonidine on the RDQ at 4 weeks (difference in change from baseline based on analysis of covariance [ANCOVA] 5.67 on 0 to 24 scale, 95% CI 1.22 to 10.1) and one good-quality trial[64] found transforaminal epidural corticosteroid injection superior to etanercept on the ODI at 1 month (difference –16 on 0 to 100 scale, 95% CI –26.0 to –6.27). There were no differences in other outcomes, including pain, analgesic use, successful outcomes, or rates of surgery. One other fair-quality trial found no differences between corticosteroid versus autologous conditioned serum administered via the oblique interlaminar approach in improvement in pain or ODI scores after 22 weeks.[53]

Two fair-quality trials evaluated epidural corticosteroid injections versus epidural corticosteroid injections plus hypertonic saline[86] or clonidine.[111] One trial (n=53) of patients with chronic low back pain found transforaminal epidural corticosteroid injection with corticosteroid plus hypertonic saline associated with greater decrease in pain intensity through 4 months versus corticosteroid alone (difference from baseline –2.78 vs. –1.50 on 0 to 10 NRS, p=0.05), though the effect was smaller and no longer statistically significant at 6 months.[86] There were no differences in global assessment or the ODI. The other trial (n=177) found no differences between transforaminal epidural injection with corticosteroid versus corticosteroid plus low-dose clonidine in pain scores through 12 weeks in patients with subacute low back pain.[111]

Two trials compared epidural corticosteroid injections versus nonsurgical, noninterventional therapies.[89, 98] One fair-quality trial of patients (n=50) with disc herniation on MRI correlating with clinical symptoms (duration not reported) found interlaminar epidural injection with 80 mg methylprednisolone associated with lower pain scores than medications (ibuprofen, tramadol, tizanidine, and bed rest with graded activity) at 1 month (2 vs. 4.5), but the difference was no longer present on followup at 3 months.[89] The epidural injections were not performed with

fluoroscopic guidance. A poor-quality trial (n=100) of patients with chronic radiculopathy not responsive to rest and analgesics and MRI showing lumbar disc disease found caudal epidural injection with 80 mg triamcinolone using fluoroscopic guidance associated with lower pain scores (2.7 vs. 6.1 on 0-10 VAS), better ODI scores (12 vs. 25 on 0 to 100 scale), and higher likelihood of complete pain relief (86% [43/50] vs. 24% [12/50]) than noninvasive therapy consisting of medications (tizanidine, diclofenac, and amitriptyline), traction, transcutaneous electrical nerve stimulation (TENS), short-wave diathermy, and back exercises.[98] Methodological shortcomings included inadequate description of allocation concealment, failure to blind outcomes assessors, and failure to report attrition.

Epidural Injections For Spinal Stenosis

Epidural Corticosteroid Versus Placebo Interventions

Eight trials compared epidural corticosteroid injections with epidural local anesthetic injection, epidural saline injection, or no injection for spinal stenosis.(Table 2, Appendix E2, F2).[66, 115, 117, 118, 120, 122, 123, 126] One trial was rated good quality, four fair quality, and three poor quality.

The good-quality trial (n=386) enrolled patients with symptoms (duration ranged from <3 months to >5 years) of neurogenic claudication and imaging findings of spinal stenosis.[117] Patients had to be at least 50 years of age, have central lumbar spinal stenosis on advanced imaging, average pain of >4 on a 0 to 10 scale, score of 7 or higher on the RDQ, and pain the lower back, buttock, leg, or a combination of these sites on standing, walking, or spinal extension in the past week, with pain worse in the buttock, leg, or both than in the back. Patients were randomized to fluoroscopically-guided epidural injection via the interlaminar or transforaminal approach with various corticosteroids versus epidural injection with local anesthetic. It found epidural corticosteroid injection associated with a greater improvement in RDQ at 3 weeks (difference –1.8, 95% CI –2.8 to –0.9 on 0 to 24 scale), though the difference was smaller (–1.0, 95% CI –2.1 to 0.1) and no longer statistically significant at 6 weeks. There was no difference in likelihood of experiencing an improvement in RDQ or pain scores of >30 percent or >50 percent at 6 weeks, and no difference in improvement in pain scores at 3 or 6 weeks.

Pooled analyses were consistent with the good-quality trial (Table 8). There was no difference between epidural corticosteroid injections and placebo interventions in improvement in pain intensity at short-term (Figure 25, five trials, WMD 0.62, 95% CI –2.87 to 4.11, I^2=0%)[117, 120, 122, 123, 126] or intermediate-term followup (Figure 26, three trials, WMD 3.73, 95% CI –0.81 to 8.26, I^2=0%).[120, 123] Only one trial evaluated improvement in pain intensity at immediate-term (mean difference –22.0, 95% CI –36.0 to –8.00)[120] or long-term (mean difference 4.00, 95% CI –2.87 to 10.9) followup.[123] There were also no differences in likelihood of experiencing a successful pain outcome at short-term (Figure 27, three trials, RR 0.98, 95% CI 0.84 to 1.15, I^2=0%),[117, 122, 123] intermediate-term (Figure 28, two trials, RR 0.98, 95% CI 0.78 to 1.24, I^2=0%),[122, 123] or long-term (Figure 29, three trials, RR 0.97, 95% CI 0.74 to 1.28, I^2=0%) followup.[66, 122, 123]A successful pain outcome was defined as pain improvement of ≥50 percent[117, 122, 123] or ≥75 percent.[66]

There was no difference between epidural corticosteroid injections and placebo interventions in improvement in function at immediate-term (Figure 30, two trials, SMD –0.32, 95% CI –0.85 to 0.22, I^2=0%),[120, 126] short-term (Figure 31, five trials, SMD –0.03, 95% CI –0.31 to 0.26, I^2=60%[117, 120, 122, 123, 126] intermediate-term (Figure 32, three trials, WMD 2.81, 95% CI –0.44 to 6.06, I^2=0%),[120, 122, 123] or long-term followup (Figure 33, two trials, WMD 2.78, 95% CI –1.24

to 6.79, I^2=0%).[122, 123] There were also no differences in likelihood of experiencing a successful functional outcome at short-term (Figure 34, three trials, RR 0.91, 95% CI 0.70 to 1.18, I^2=37%),[117, 122, 123] intermediate-term (Figure 35, two trials, RR 0.96, 95% CI 0.74 to 1.25, I^2=0%),[122, 123] or long-term followup (Figure 36, two trials, RR 0.95, 95% CI 0.71 to 1.26, I^2=0%).[122, 123] A successful functional outcome was defined as improvement in the ODI or RDQ of ≥50.[117, 122, 123] There was no difference between epidural corticosteroid injections and placebo interventions in risk of surgery at long-term followup (RR 0.76, 95% CI 0.38 to 1.54).[115]

There were no differences between epidural corticosteroid injections and placebo interventions in likelihood of experiencing a successful composite outcome at short-term (Figure 37, two trials, RR 1.18, 95% CI 0.55 to 2.55, I^2=80%),[122, 126] intermediate-term (one trial, RR 0.93, 95% CI 0.63 to 1.35), or long-term followup (Figure 38, two trials, RR 1.16, 95% 0.76 to 1.78, I^2=0%).[115, 122] A successful outcome was defined as >75 percent improvement in symptoms and no spinal surgery;[115] pain improved >40 percent, ODI improved >20 percent, and patient satisfaction good or excellent;[126] or pain improved ≥50 percent and ODI improved ≥50 percent.[122]

Findings were similar when poor-quality trials were excluded. Meta-regression and subgroup analyses were not performed due to the small numbers of trials.

One poor-quality trial was not included in pooled analyses because it focused on walking distance in meters as the primary outcome.[118] In patients with chronic symptoms of spinal stenosis, it found no differences between a caudal epidural injection with 40 mg methylprednisolone versus an epidural injection with local anesthetic or saline in mean walking distance or likelihood of being able to walk >20 meters at 1 week or 1 month. The epidural corticosteroid and epidural local anesthetic injection were superior to epidural saline for walking distance at 1 week, but differences were no longer present at 1 month followup.

Epidural Corticosteroid Injections Versus Other Interventions

Four trials compared epidural corticosteroid injections for spinal stenosis versus other interventions (MILD, intensive physical therapy, epidural etanercept, or epidural adhesiolysis) (Table 2, Appendix E2, F2).[116, 120, 121, 127]

One fair-quality trial (n=38) compared interlaminar epidural steroid injection with 80 mg triamcinolone acetate (40 mg in diabetic patients) versus the MILD procedure, each with fluoroscopic guidance, for degenerative spinal stenosis with hypertrophic ligamentum flavum on MRI.[116] The MILD procedure involves use of a device to access the interlaminar space and remove portions of the lamina and ligamentum flavum. At 2 weeks, the corticosteroid injection was associated with lower likelihood of experiencing ≥2-point improvement in pain than the MILD procedure (35% [6/17] vs. 76% [16/21]), but there was no difference at 6 weeks. There was no difference in functional outcomes based on the ODI or patient satisfaction at 2 or 6 weeks.

One fair-quality trial (n=23) compared interlaminar epidural injection with 60 mg triamcinolone acetonide using fluoroscopic guidance versus intense physical therapy for chronic (mean >5 years) spinal stenosis.[120] Physical therapy was performed 5 days/week for 2 weeks, including ultrasound for 10 minutes, hot pack for 20 minutes, and TENS for 20 minutes. There were no differences between groups in mean pain intensity, the RDQ or the Nottingham Health Profile at 2 weeks through 6 months.

One fair-quality trial (n=80) of patients with subacute low back and leg pain with central, lateral recess, or foraminal stenosis found transforaminal epidural injection with 3.3 mg dexamethasone associated with worse leg pain than epidural etanercept at 1 month (5.2 vs. 3.5 on

0-10 scale, p=0.03), but no difference in leg numbness or the ODI. Injections were performed with fluoroscopic guidance.[127]

One poor-quality trial (n=50) compared caudal epidural injection versus epidural adhesiolysis with 6 mg betamethasone.[121] Both procedures were performed with fluoroscopic guidance and an epidurogram was also performed for adhesiolysis. Patients had chronic symptoms and had previously failed fluoroscopically directed epidural injections. Although patients in the caudal injection group reported worse outcomes than the adhesiolysis group through 12 months on mean pain (6.2 vs. 3.9 on 0-10 Numeric Rating Scale [NRS]), likelihood of pain improvement ≥50 percent (4% [1/25] vs. 76% [19/25], mean ODI (25 vs. 16 on 0-50 scale), and likelihood of ODI improvement ≥40 percent (0% [0/25] vs. 80% [20/25]), methodological limitations included lack of blinding of outcomes assessors and patients, high noncompletion rate due to selective withdrawals, and reporting of only preliminary results in a subgroup of patients (50 of 82 randomized).

Epidural Injections For Nonradicular Low Back Pain

Two fair-quality trials (n=120 in each trial) evaluated epidural corticosteroid injections versus an epidural local anesthetic injection for chronic nonradicular low back pain (Table 3, Appendix E3, F3).[129, 132] In one trial, which evaluated a caudal epidural injection with 6 mg betamethasone or 40 mg methylprednisolone, patients were required to have no evidence of disc herniation on imaging and negative double blocks for facet and sacroiliac joint pain.[129] In the other trial, which evaluated an interlaminar epidural injection with 6 mg betamethasone, imaging findings were not specified.[132] In both trials, injections were performed with fluoroscopic guidance. Neither trial found a difference between epidural injection with corticosteroid versus epidural injection with local anesthetic through 2 years followup in pain, function, or opioid use.

One other trial evaluated an epidural injection (technique not described) for chronic nonradicular pain, but did not meet inclusion criteria because an intrathecal injection with 5 percent dextrose (a procedure not performed in current practice) was also performed.[156]

Epidural Injections For Chronic Postsurgical Low Back Pain

Five trials evaluated epidural injections in patients with pain following lumbar surgery (Table 4, Appendix E4, F4).[135-139] No trial compared an epidural injection with corticosteroid versus a placebo intervention. Comparators were epidural injections with hyaluronic acid, forceful injections, or morphine. Four of the five trials were rated poor quality; the other[139] was rated fair quality.

The fair-quality trial of patients with persistent pain following laminectomy (n=22) found no difference in effects on pain at 6 months between an epidural injection (approach not specified) with 75 mg triamcinolone versus morphine versus both.[139]

The poor-quality trials evaluated different comparators. One trial of patients with postdiscectomy sciatica (n=47) found a caudal epidural injection with 125 mg prednisolone associated with greater improvement in pain score in the first 30 days than forceful caudal epidural injection with 20 ml saline, with or without prednisolone.[137] Differences in pain were no longer present at 60 or 120 days and there were no differences in function based on the Dallas Activities of Daily Living score. A trial (n=60) of patients with persistent radicular symptoms following spinal surgery thought due to epidural fibrosis found no differences between transforaminal injection with 60 mg methylprednisolone versus hyaluronic acid or both in likelihood of achieving >50 percent pain relief at 1, 3, or 6 months,[135] but another trial (n=25)

found injection with 40 mg triamcinolone plus hyaluronic acid associated with lower pain score a week 4 (1.5 vs. 2.5 on 0-10 VAS, p=0.02 on repeated measures analysis), and higher patient satisfaction score (4.2 vs. 3.4, p=0.001).[138] A trial of patients (n=120) with low back pain following surgery (with or without leg pain) found a caudal epidural injection with 6 mg betamethasone associated with worse pain scores (6.2 vs. 3.6 on 0-10 NRS), ODI (23 vs. 14 on 0-50 scale), and likelihood of experiencing pain relief >50 percent and ODI improvement >50 percent (5% [3/60] vs. 82% (49/60]) than epidural adhesiolysis with 6 mg betamethasone and hypertonic saline after 2 years.[136] Opioid use was also higher in the epidural injection group (68 vs. 76 mg morphine equivalent dose [MED]/day) at 2 years. An important shortcoming of this trial is that a very high proportion of patients randomized to the epidural injection group became unblinded and did not complete the trial (87% versus 10% in the adhesiolysis group).

Facet Joint Injections

Facet Joint Corticosteroid Injections Versus Placebo Interventions

Five trials evaluated facet joint corticosteroid injections versus placebo injections (Table 5, Appendix E5, F5).[141, 146-148, 151] The trials differed in whether the corticosteroid injections were given with or without local anesthetic, whether the control injection used local anesthetic or saline, the location of the facet joint injection (intra-articular, extra-articular [peri-capsular], or medial branch), the location of the control injection (intra-articular or medial branch), and the outcomes evaluated. In addition, two trials were rated poor quality.[146, 147, 151] Therefore, we did not attempt pooling.

One fair-quality trial (n=101) compared intra-articular facet joint injection with 20 mg methylprednisolone acetate (without local anesthetic) versus saline.[141] Patients had chronic back pain (median 18-24 months) and a positive (≥50% pain relief) response to a single intra-articular facet joint block. Imaging was not required for enrollment. Patients received an average of 3.6 injections at two levels; most (80%) received bilateral injections. At 1 month, there was no difference between the corticosteroid versus saline injections in likelihood of patient-reported "very marked" or "marked" improvement (42% [20/48] vs. 33% [16/48]; RR 1.25 [95% CI, 0.74, 2.11]), mean 10-point VAS pain score (4.5 vs. 4.7 on 0-10 scale), Sickness Impact Profile scores (physical dimension: 5.2 vs. 6.3; psychosocial dimension: 8.2 vs. 9.0), or the McGill pain questionnaire (pain rating index: 19.0 vs. 22.8; present pain intensity: 2.3 vs. 2.6). At 6 months the corticosteroid injection was associated with greater likelihood of "very marked" or "marked" improvement (46% [22/48] vs. 15% [7/47]; RR 3.08, 95% CI, 1.64, 6.51), lower 10-point VAS pain scores (4.0 vs. 5.0, p<0.05), and better Sickness Impact Profile physical dimension scores (4.3 vs. 7.9, p<0.05), with no differences on other outcomes. However, 6-month results may have been confounded by differential receipt of cointerventions such as physical therapy, antidepressant medication, or other injections (22% vs. 12%). In a sensitivity analysis based on outcomes at the last evaluation prior to cointerventions carried forward, there was no difference in likelihood of improvement at 6 months (31% vs. 17%, p=0.17). There was also no difference in the likelihood of sustained improvement (improvement at 6 months in patients with improvement at 1 month) (55% vs. 31%).

One poor-quality trial (n=70) compared intra-articular facet joint injection with methylprednisolone acetate plus local anesthetic versus saline (8 mL) for chronic (>3 months) back pain.[146] Neither facet joint block nor imaging was required for inclusion. Patients received one unilateral injection at two levels. There were no differences between corticosteroid versus

saline injections in mean 100-point VAS score at 2 weeks (31 vs. 41), 6 weeks (40 vs. 42), or 3 months (44 vs. 43). There was also no difference in return to work (data not reported).

One poor-quality trial (n=67) compared intra-articular facet joint with 20 mg methylprednisolone plus local anesthetic injection versus medial branch injection with local anesthetic.[151] The duration of symptoms, number of injections, and levels treated were not reported, and positive diagnostic blocks or concordant imaging findings were not required for inclusion. At 1 month, there were no differences between the intra-articular corticosteroid versus medial branch injections in likelihood of patient-rated "moderate", "severe", or "very severe" pain (83% [25/30] vs. 85% [22/26]; RR 0.98, 95% CI, 0.78, 1.24); patient-rated "full" functional status (57% [17/30] vs. 58% [15/26]; RR 0.98, 95% CI, 0.62, 1.55), or decreased analgesic usage (30% [9/30] vs. 38% [10/26]; RR 0.78, 95% CI, 0.38, 1.62).

One of the poor-quality trials described above also compared extra-articular (peri-capsular) facet joint injection with 80 mg methylprednisolone acetate plus local anesthetic versus saline (n=81).[146] At 3 months, there were no differences in mean 100-point VAS score (42 vs. 43) or in return to work rates (data not reported). Similar results were reported at 2 and 6 weeks.

One fair-[148] and one poor-quality[147] trial compared medial branch injection with corticosteroid (0.075 mg to 0.225 mg betamethasone or 0.5mg to 1.5 mg methylprednisolone) plus local anesthetic versus local anesthetic (Table 5, Appendix E5, F5). Although one of the trials also randomized patients to Sarapin (extract from pitcher plant, thought to have analgesic properties) versus no Sarapin, results were similar and the Sarapin and non-Sarapin groups were combined for the final analysis;[148] all patients in the other trial also received Sarapin.[147] Patients had chronic back pain (mean 21 months[147] and median 108 months[148]) and a positive response (defined as ≥80% pain relief in one,[148] not defined in the other study[147]) to two facet joint blocks. Neither study required imaging for patient selection. Patients received a mean of six to seven injections over a period of approximately 2 years in both studies; one study did not report the number of levels treated[148] and the other treated four levels per patient.[147]

There were no differences between medial branch corticosteroid versus local anesthetic injection at all time points through 12[147] or 24 months[148] on all outcomes, including mean pain scores (0-10 NRS), likelihood of ≥50 percent pain relief, mean ODI score, likelihood of ≥40 percent improvement in ODI, and use of opioids. One trial also found no differences in risk of depression or generalized anxiety disorder through the 12-month followup based on the Millon Clinical Multiaxial Inventory (MCMI)-II and Beck Depression Inventory.[147] Both studies used substantially lower doses of corticosteroid (0.6 mg to 1.7 mg prednisolone equivalent) than other trials of facet joint injections.

Facet Joint Corticosteroid Injections Versus Other Interventions

Four trials compared facet joint corticosteroid injections versus other interventions (systemic corticosteroids,[153] hyaluronic acid injections[143] or radiofrequency neurotomy[142, 145] (Table 5, Appendix E5, F5). One good-quality trial (n=60) of patients with chronic low back pain and imaging findings of degenerative facet joint disease found no clear differences between an intra-articular facet joint versus an intramuscular injection of 20 mg triamcinolone hexacetonide in pain, function, or quality of life through 6 months, though results favored the intra-articular injection at 3 to 6 months.[153]One fair-quality trial (n=60) compared intra-articular facet injection with 10 mg triamcinolone acetonide versus hyaluronic acid.[143] The rationale for the hyaluronic acid was to provide viscosupplementation to the joint. Patients were required to have nonradicular low back pain for at least 3 months and CT scan evidence of facet joint arthropathy with osteophytes. Diagnostic blocks were not used for patient selection. Patients received

bilateral injections at three levels over 3 weeks, with one joint treated per week. There were no differences between groups on any outcome at 1 month or 6 months, including mean pain score, RDQ, ODI, Low Back Outcome score, or the SF-36.

Two trials compared an intra-articular[145] or medial branch[142] corticosteroid injection versus radiofrequency neurotomy. One good-quality trial (n=56) compared intra-articular injection with 3 mg betamethasone plus local anesthetic with sham neurotomy versus medial branch radiofrequency neurotomy plus local anesthetic injection (1 mL).[145] Patients had chronic (≥24 months) symptoms, MRI-confirmed facet joint osteoarthritis and hypertrophy, and a positive response (≥50% pain relief) to a single intra-articular facet joint block. The number of treatments was not reported. At 6 months, there were no differences between the corticosteroid injection and neurotomy in mean 10-point VAS scores (5.4 vs. 4.7), mean ODI scores (33 vs. 28 on a 0 to100 scale), mean RDQ score (9.0 vs. 9.1), or analgesic usage (data not reported). One fair-quality trial (n=100) compared medial branch injection with 40 mg methylprednisolone plus local anesthetic versus radiofrequency neurotomy.[142] Patients had chronic back pain (mean duration 19 months) unresponsive to at least 6 weeks of conservative therapy. Although patients in the injection group were not required to undergo diagnostic block, patients in the neurotomy group were required to have a positive response (criteria not reported) to a diagnostic block for inclusion. There were no imaging requirements for patient selection. Patients underwent a single treatment at one to four levels; the number of levels treated was similar in both treatment groups. The corticosteroid injection was associated with worse outcomes than neurotomy through 12 months based on mean pain scores (3.4 vs. 2.2 on 0-10 VAS at 1 month and 4.9 vs. 2.6 at 12 months), proportion with greater than 50 percent improvement in pain (80% vs. 100% at 1 month, 62% vs. 88% at 12 months). Patient satisfaction was higher with neurotomy at 12 months (mean 2.0 vs. 1.5 on the North American Spine Society [NASS] Patient Satisfaction Scale) though differences were not statistically significant at earlier time points. There were no differences between groups in quality of life as measured by the EuroQOL Five Dimensions Questionnaire (EQ-5D) scores. Results are difficult to interpret, as they may have been differential use of diagnostic blocks for selection of patients in the corticosteroid injection and neurotomy groups.

Sacroiliac Joint Injections

One small (n=24), fair-quality trial of patients with nonspondylarthropathic sacroiliac joint pain (based on tenderness over sacroiliac joint, positive physical exam maneuvers, and absence of sacroiliitis on imaging) found a peri-articular sacroiliac joint injection with 60 mg methylprednisolone associated with larger decrease in pain 1 month after injection than peri-articular local anesthetic injection (change –40 vs. –13 on 0 to 100 VAS) (Table 6; Appendix E6, F6).[154] Functional outcomes were not reported.

Key Question 1a. How does effectiveness vary according to the medication used (corticosteroid, local anesthetic, or both), the dose or frequency of injections, the number of levels treated, or degree of provider experience?

Key Points

Epidural Injections

- Four trials that directly compared epidural corticosteroid injections for radiculopathy with different corticosteroids found few differences in outcomes including pain and function, but conclusions were limited by differences in the corticosteroids compared, doses, and some inconsistency (SOE: low).
- No trial directly compared effects of epidural corticosteroid injections with one local anesthetic versus another (SOE: insufficient).
- Six trials that directly compared epidural injections for radiculopathy using different corticosteroid doses found no clear differences in outcomes including pain and function (SOE: low).
- No trial directly compared the effectiveness of epidural corticosteroid injections based on the number of injections, number of levels injected, or provider experience. Two trials found no association between receipt of more injections and better outcomes (SOE: low for number of injections, insufficient for number of levels or provider experience).
- One trial found no clear differences between caudal epidural injection for spinal stenosis with methylprednisolone versus triamcinolone in pain or claudication distance through 6 months, though results favored methylprednisolone (SOE: low).

Facet Joint Injections

- No trial of facet joint injections directly compared effects of different corticosteroids, different local anesthetics, different doses, different frequency or number of injections, or degree of provider experience. Indirect evidence was too limited to reach reliable conclusions (SOE: insufficient)

Detailed Synthesis

Epidural Injections For Radiculopathy

Effect of Corticosteroid Used

Four fair-quality trials compared epidural injections with one corticosteroid versus another (Table 1, Appendix E1, F1). Three trials evaluated dexamethasone, a water soluble (nonparticulate) corticosteroid, versus the particulate corticosteroids methylprednisolone or triamcinolone.[83, 84, 100] The fourth trial evaluated a combination of betamethasone sodium phosphate and betamethasone diproprionate versus methylprednisolone; betamethasone diproprionate is considered less water soluble.[63] Sample sizes ranged from 60 to 106 patients and duration of followup ranged from 1 to 6 months. All of the trials required imaging correlation with radicular symptoms.

Two trials of transforaminal epidural injection with dexamethasone versus triamcinolone reported somewhat inconsistent results.[83, 100] One trial (n=78) of patients with subacute (mean duration 8.6-10 weeks) lumbar radicular pain found no differences between dexamethasone versus triamcinolone in pain or function at 1 to2 weeks, 3 months, or 6 months, and no difference in rates of surgery (15% [6/41] vs. 19% [7/37]) at 6 months.[83] The other trial (n=106) found dexamethasone associated with worse pain scores than triamcinolone at 1 month (4.1 vs. 2.4 on 0 to 10 VAS), though there was no statistically significant difference on the ODI (45 vs. 59).[100] Differences were more pronounced when taking into account differences in baseline pain scores (7.4 vs. 8.3). The duration of pain at baseline was not reported. Differences in dosing might explain the inconsistency between trials, as the therapeutically equivalent dose of dexamethasone (100 mg) was higher than triamcinolone (60 mg) in the trial that found no differences (prednisolone equivalents 100 vs. 75 mg), and equivalent in the trial that found dexamethasone associated with worse outcomes (7.5 mg dexamethasone versus 40 mg triamcinolone, corresponding to 50 prednisolone equivalents for both).

One trial of patients (n=60) with chronic (>6 months) radicular pain found no differences between interlaminar epidural injection with dexamethasone versus methylprednisolone in pain, pain medication use, emergency room visits for pain, or new treatments for pain at 1 to 2 months.[84] Corticosteroid doses were therapeutically equivalent (15 mg dexamethasone versus 80 mg methylprednisolone, each corresponding to 100 mg prednisolone equivalents).

One trial of patients (n=70) with acute radicular pain found interlaminar betamethasone associated with decreased pain at 2 weeks versus triamcinolone (mean 5.7 vs. 1.1 on 0 to 10 VAS).[63] By week 6, pain was close to 0 in both groups and no differences were observed from 6 weeks to 6 months. There was no difference in function based on the ODI through 6 months. Corticosteroid doses were slightly lower for betamethasone than triamcinolone after conversion to prednisolone equivalents (10 mg betamethasone versus 80 mg triamcinolone, or 83 versus 100 mg prednisolone equivalents).

Trials of epidural corticosteroid injections versus placebo interventions were of limited usefulness for evaluating effects of local anesthetics on estimates of effects due to small numbers of trials for most analyses, but meta-regression indicated no statistically significant effect of the specific corticosteroid on improvement in pain or function at short-term, likelihood of a successful pain outcome at short-term, or risk of surgery at long-term followup.

Effect of Local Anesthetic

No trial directly compared effects of epidural corticosteroid injection with one local anesthetic versus another. Trials of epidural corticosteroid injections versus placebo interventions were of limited usefulness for evaluating effects of local anesthetics on estimates of effects due to small numbers of trials for most analyses, but meta-regression indicated no statistically significant effect of the specific local anesthetic on improvement in pain or function at short-term, likelihood of a successful pain outcome at short-term, or risk of surgery at long-term followup**.**

Effect of Dose

Six trials compared epidural injections with different doses of corticosteroid (Table 1, Appendix E1, F1).[49, 53, 77, 80, 97, 99] Four trials were rated fair quality and two trials[77, 99] poor quality. Three trials evaluated methylprednisolone,[77, 97, 99] two trials triamcinolone,[53, 80] and one trial dexamethasone.[49] Methylprednisolone was administered via the interlaminar, caudal, or undescribed approach and triamcinolone and dexamethasone through the transforaminal

approach. Sample sizes ranged from 42 to 160 in four parallel group trials; one crossover trial[97] enrolled 33 patients. Duration of followup ranged from 2 weeks to 6 months.

The trials found no clear differences between different doses of corticosteroids (Table 1, Appendix F1). Two trials of patients with symptoms of varying duration found no differences between interlaminar or caudal methylprednisolone 40 versus 80 mg (equivalent to 50 versus 100 mg prednisolone) in pain, function, or use of analgesics.[77, 97, 99] One trial of patients with acute or subacute symptoms found triamcinolone 5 mg (6.25 prednisolone equivalents) administered via the transforaminal approach associated with less likelihood of achieving pain relief than 10, 20, or 40 mg (12.5 to 50 prednisolone equivalents) at 1 week (45% vs. 65% to 75% achieved ≥67% improvement in VAS pain score), but differences were no longer statistically significant at 2 weeks (pain relief achieved in 68% of 5 mg group vs. 75% to 85% in other groups).[80] In another other trial of transforaminal triamcinolone, which enrolled patients with symptoms present for 6 weeks or longer, there were no differences between 5 versus 10 mg of triamcinolone in pain or function at 4 weeks through 6 months.[53] One trial of patients with chronic low back pain found no difference between transforaminal dexamethasone 4, 8, or 12 mg (26.7, 53.3, and 80 mg prednisolone equivalents) in pain or function through 12 weeks.[49]

Meta-regression analyses of trials of epidural corticosteroid injections versus placebo interventions were of limited usefulness for evaluating effects of dose on estimates of effects due to small numbers of trials, but found no statistically significant effect of use of higher doses of corticosteroids on improvement in pain or function at short term or on risk of surgery at short term or long-term followup.

Effect of Number or Frequency of Injections, Number of Levels Injected, or Provider Experience

No trial directly compared the effectiveness of epidural corticosteroid injections for radiculopathy according to the number of injections or number of levels injected. One trial found that if a first epidural corticosteroid injection was not successful, additional injections within the first 6 weeks were no more effective.[50] One trial of fluoroscopy plus Doppler versus fluoroscopy alone to guide caudal epidural corticosteroid injections found no association between the number of injections and responsiveness to treatment after adjustment for age, sex, symptom duration, cause (spinal stenosis or herniated disc), and type of imaging guidance.[100] Three trials evaluated injections that were performed at multiple levels,[64, 75, 105] but the number of levels in the trials varied depending on the approach used and provider preferences, and none reported results stratified by the number of levels injected. Information regarding the level of provider experience was very sparse and not reported in a standardized fashion, and no study reported results stratified according to the degree of provider experience.

Epidural Injections For Spinal Stenosis

One fair-quality trial directly compared a caudal epidural injection with 80 mg methylprednisolone versus 80 mg triamcinolone for chronic (mean 17 to 18 months) spinal stenosis.[119] Imaging findings were not required for enrollment and fluoroscopic guidance was not used. It found no differences between the corticosteroids through 3 months in mean pain score, pain improvement >2 points, or claudication distance, though results favored methylprednisolone for likelihood of improvement in pain scores at 6 months (80% [28/35] vs. 60% [21/35], RR 1.33, 95% CI 0.97 to 1.83). Mean pain scores (3.6 vs. 4 .8) and claudication distance (637 m vs.

350 m) also favored methylprednisolone at 6 months, but statistical significance was not reported.

No trial of epidural corticosteroid injections for spinal stenosis directly compared effects of different local anesthetics, different doses, differences in frequency or numbers of injections, or degree of provider experience on outcomes. There were too few trials of epidural corticosteroid injections versus placebo interventions (epidural local anesthetic, epidural saline, soft tissue local anesthetic, soft tissue saline, soft tissue needling, or no injection) to perform informative subgroup analyses on these factors.

Facet Joint Injections

No trial of facet joint injections directly compared effects of different corticosteroids, different local anesthetics, different doses, frequency or number of injections, or degree of provider experience on outcomes. There were too few trials of facet joint corticosteroid versus local anesthetic or saline injections to perform informative subgroup analyses on these factors.

Key Question 1b. How does effectiveness vary according to use of imaging guidance or route of administration (interlaminar, transforaminal, caudal for epidural injections or intra-articular, extra-articular [peri-capsular], or medial branch for facet injections)?

Key Points

Epidural Injections

- No trial directly compared the effectiveness of epidural injections for radiculopathy performed with or without imaging guidance. Indirect evidence was not useful for evaluating effects of imaging guidance on estimates of effects because use of imaging guidance was highly associated with the epidural technique used (SOE: insufficient).
- One trial of caudal epidural corticosteroid injections for radiculopathy found no difference between fluoroscopic plus Doppler guidance versus fluoroscopic guidance alone in pain or ODI scores through 12 weeks (SOE: low).
- One trial found no difference between use of MRI versus history and physical examination without MRI to guide epidural corticosteroid injection treatment and targets on pain, function, or medication use (SOE: low).
- There were no differences between transforaminal versus interlaminar epidural corticosteroid injections for radiculopathy in improvement in pain intensity at immediate-term (five trials, WMD –10.1, 95% CI –24.8 to 4.54, I^2=83%), short-term (three trials, WMD –1.29, 95% CI –12.6 to 10.1, I^2=54%), or intermediate-term (two trials, WMD –11.3, 95% CI –44.8 to 22.4, I^2=87%) followup (SOE: low).
- There were no differences between transforaminal versus interlaminar epidural corticosteroid injections for radiculopathy in improvement in function at immediate-term (four trials, SMD 0.03, 95% CI –0.48 to 0.53, I^2=68%), short-term (three trials, SMD 0.39, 95% CI –0.36 to 1.13, I^2=74%), or long-term (one trial, WMD –2.00, 95% CI –8.77 to 4.77) (SOE: low) followup.

- There were no differences between transforaminal versus interlaminar epidural corticosteroid injections for radiculopathy in risk of undergoing surgery at intermediate-term followup in two trials (RR 0.76, 95% CI 0.18 to 3.19, and RR 1.33, 95% CI 0.44 to 4.05) (SOE: low).
- One trial found the transforaminal epidural corticosteroid injections for radiculopathy associated with better pain outcomes than the caudal approach, with no differences in measures of function or depression, but no differences between the interlaminar versus caudal approaches in measures of pain or depression (SOE: low).
- Indirect evidence from trials of epidural corticosteroid injections versus placebo interventions for radiculopathy was consistent with direct evidence in showing no clear differences in estimates between the transforaminal, interlaminar, and caudal approaches.
- One trial found no differences between epidural corticosteroid injections for radiculopathy using the oblique interlaminar versus standard interlaminar approaches in likelihood of achieving a successful outcome or undergoing surgery (SOE: low).
- One trial of epidural corticosteroid injections for radiculopathy found the lateral parasagittal interlaminar approach associated with greater likelihood of achieving >50 percent pain relief (RR 4.1, 95% CI 1.4 to 12) and greater improvement in pain and function than the standard interlaminar approach through 6 months; a second trial also reported results that favored the lateral parasagittal approach, but differences were smaller and not statistically significant (SOE: low).
- Two trials found no differences between epidural corticosteroid injections for radiculopathy using the lateral parasagittal versus transforaminal approaches in pain or function through 6 or 12 months (SOE: low).
- One trial found transforaminal epidural corticosteroid injections for radiculopathy at the ganglionic versus preganglionic approaches associated with a lower likelihood of a successful outcome at 1 month (RR 0.80, 95% CI 0.70 to 0.91), though differences were no longer present after 5 months (SOE: low).
- No trial randomized patients with spinal stenosis to different approaches for performing epidural corticosteroid injections. One trial in which epidural corticosteroid injections could be performed by the interlaminar or transforaminal approaches found that interlaminar corticosteroid injections were associated with greater improvement in leg pain and function versus local anesthetic injections at 3 weeks, but there were no differences between transforaminal corticosteroid versus local anesthetic injections (SOE: low).

Facet Joint Injections

- One trial found intra-articular facet joint corticosteroid injection in patients with subacute low back pain selected on the basis of positive facet joint SPECT findings associated with lower pain intensity (3.2 vs. 5.4 on 0 to 10 NRS, $p<0.05$), greater likelihood of ≥50% pain relief (61% vs. 26%, RR 2.33, 95% CI 1.09 to 5.00), and better ODI score (12 vs. 23, $p<0.05$) versus medial branch injection at 12 weeks (SOE: low).
- One trial found intra-articular facet joint corticosteroid injection for chronic low back pain (imaging findings not required) associated with higher likelihood of pain relief versus medial branch injection at 1 month (RR 1.68, 95% CI 1.03 to 2.73), but results were no longer statistically significant at 3 months, and there was no difference in likelihood of experiencing good or excellent pain relief (SOE: low).

- There was insufficient evidence from one poor-quality trial to determine effectiveness of intra- versus extra-articular (peri-capsular) facet joint corticosteroid injections (SOE: insufficient).
- No trial directly compared the effectiveness of epidural injections for radiculopathy performed with or without imaging guidance (SOE: insufficient).
- One trial found no difference between CT- versus ultrasound-guided intra-articular facet joint corticosteroid injections with betamethasone and local anesthetic in pain at 6 weeks (SOE: low).

Detailed Synthesis

Epidural Injections for Radiculopathy

Imaging Guidance

No study directly compared the effectiveness of epidural injections performed with or without imaging guidance. One fair-quality trial (n=110) of patients with chronic radicular pain found no differences between a caudal epidural injection with 10 mg dexamethasone with fluoroscopic plus Doppler guidance versus fluoroscopic guidance alone in pain or ODI scores through 12 weeks.[100]

Trials of epidural corticosteroid injections versus placebo interventions were not useful for evaluating effects of imaging guidance on estimates of effects because all trials that used the transforaminal approach used fluoroscopic guidance and no trials of the interlaminar approach used fluoroscopic guidance. One trial of the caudal approach used imaging (ultrasound) guidance,[78] but estimates from this trial and three other trials of caudal epidural corticosteroid injections that did not use imaging guidance[58, 96, 115] reported imprecise estimates for risk of surgery at long-term followup.

One good-quality trial (n=132) evaluated use of MRI versus history and physical examination without MRI to guide transforaminal or interlaminar epidural injection treatment and targets.[65] Injections were performed with 60 mg methylprednisolone and fluoroscopic guidance. There were no differences in any outcome (leg pain, back pain, ODI, global perceived effect, medication reduction, overall success) through 3 months of followup.

Route of Administration

Five trials directly compared epidural corticosteroid injections via the transforaminal versus interlaminar approaches for radicular symptoms (Table 1, Appendix E1, F1).[48, 75, 87, 112, 155] Sample sizes ranged from 30 to 64 and duration of followup from 10 to 16 days through 6 months. Two trials restricted inclusion to patients with subacute symptoms;[48, 112] the rest included patients with chronic symptoms or did not specify duration. All of the trials required imaging correlation for inclusion and three[48, 75, 87] required herniated disc on imaging. Fluoroscopic guidance was used in all of the trials. In four trials, the injection was described as epidural; in the fifth trial[87] the injection was described as a "nerve root injection" and it was unclear if the injection entered the epidural space. In two trials,[48, 75] the corticosteroid was triamcinolone; one trial each evaluated methylprednisolone,[102] dexamethasone,[112] and cortivazol.[87] Corticosteroid doses ranged from 12.5 to 33.2 mg prednisolone equivalents and were equivalent for the transforaminal and interlaminar approaches in three trials. In two trials, the corticosteroid dose was lower with the transforaminal than the interlaminar approach (40 vs.

80 mg methylprednisolone or triamcinolone, or 50 vs. 100 prednisolone equivalents).[75, 102] The volume of injectate ranged from 2 to 5 ml for the transforaminal approach and from 2 to 8 ml for the interlaminar approach. In two trials, a single injection was performed,[112] and in the remainder a series of injections were performed or additional injections were permitted based on patient response. All of the trials were rated fair quality. Methodological limitations included failure to describe adequate randomization or allocation concealment methods, failure to report attrition, and lack of or unclear blinding of individuals performing injections, patients, and outcomes assessors.

There was no difference between transforaminal versus interlaminar epidural corticosteroid injections in improvement in pain intensity at immediate-term (Figure 39, five trials, WMD –10.1, 95% CI –24.8 to 4.63, I^2=83%) (Table 9),[48, 75, 87, 102, 112] short-term (Figure 40, three trials, WMD –1.29, 95% CI –12.6 to 10.1, I^2=54%),[87, 102, 112] or intermediate-term followup (Figure 41, two trials, WMD –11.3, 95% CI –44.8 to 22.2, I^2=87%).[102, 112] No trial evaluated long-term outcomes. There was also no difference between transforaminal versus interlaminar epidural corticosteroid injections in improvement in function at immediate-term (Figure 42, four trials, SMD 0.03, 95% CI –0.48 to 0.53, I^2=68%)[48, 75, 102, 112] or short-term followup (Figure 43, three trials, SMD 0.39, 95% CI –0.36 to 1.13, I^2=74%).[87, 102, 112] One trial each evaluated improvement in function at intermediate-term (mean difference –4.60, 95% CI –8.85 to –0.35)[112] or long-term (mean difference –2.00, 95% CI –8.77 to 4.77)[102] followup. One trial found no effect in likelihood of experiencing a successful pain outcome (defined as >50% improvement in VAS from baseline) at intermediate-term followup (RR 1.18, 95% CI 0.77 to 1.79).[102] Two trials (Figure 44) that evaluated intermediate-term rates of surgery found no differences (RR 0.76, 95% CI 0.18 to 3.19[87] and RR 1.33, 95% CI 0.44 to 4.05[112]). Findings were similar when trials were stratified according to whether they used differential doses of corticosteroids depending on the approach or when a trial[87] that evaluated corticosteroid "nerve root injections" that did not clearly enter the epidural space was excluded. For example, for immediate-term pain, there were no statistically significant differences between transforaminal versus interlaminar epidural corticosteroid injections in trials in which lower doses of corticosteroids were administered with interlaminar than transforaminal injections (WMD –4.35, 95% CI –26.2 to 17.6, I^2=84%)[75, 102] and in three trials that used equivalent doses with the two approaches (WMD –14.1, 95% CI –36 to 7.6, I^2=85%).[48, 87, 112] Excluding the nerve root injection trial[87] had little effect on the pooled estimate (four trials, WMD –13.5, 95% CI –31 to 4.1).

Among trials of epidural corticosteroid injections versus placebo interventions, there were no clear differences between estimates for pain, function, surgery, or successful composite outcomes at various time points when trials were stratified according to the approach used, though findings were limited by small number of trials and imprecise estimates (Table 10). For improvement in pain intensity at intermediate-term followup, one trial[81] that evaluated the transforaminal approach (mean difference 13.3, 95% CI 5.60 to 21.0) reported worse outcomes than trials that evaluated the interlaminar (Figure 5, two trials, WMD –4.38, 95% CI –8.56 to –0.21, I^2=0%)[56, 134] or caudal (one trial, mean difference –3.00, 95% CI –8.74 to 2.74)[93] approaches, but was also the only trial to use an epidural saline control.

One trial (n=87) evaluated epidural corticosteroid injections via the oblique interlaminar approach versus the standard interlaminar approach for radiculopathy and disc herniation seen on MRI or CT.[88] Like the transforaminal approach, the goal of the oblique interlaminar approach is to more directly target the affected nerve root. Patients had "intractable" duration but this was not defined; the mean duration was not reported. For the oblique interlaminar approach, 10 mg of

triamcinolone was used; the dose and corticosteroid for the standard interlaminar approach was not reported. A series of three injections without fluoroscopic guidance was performed at 1-week intervals. There was no difference in the likelihood of achieving a "good" result based on the modified McNab criteria (leg pain <10%, back pain <20%, return to work, sports as before) at 3 months (68% [32/47] vs. 53% [21/40]; RR 1.30, 95% CI 0.91 to 1.85) or in likelihood of undergoing surgery (8.5% [4/47] vs. 18% [7/40]; RR 0.49, 95% CI 0.15 to 1.54).

Four trials evaluated the lateral parasagittal interlaminar approach versus the standard midline interlaminar approach (2 trials[60, 74]) or the transforaminal approach (2 trials[61, 73]) in patients with radiculopathy. The lateral parasagittal interlaminar approach is performed at the lateral-most part of the interlaminar space (the standard interlaminar approach is performed at the midline), potentially providing closer proximity to the affected nerve root with better delivery of the corticosteroid than the standard (midline) approach, while potentially avoiding neurological complications associated with the transforaminal approach. In all trials, imaging correlation with radicular symptoms was required and the injections were performed with fluoroscopic guidance. Three trials evaluated injections of methylprednisolone 80 mg and one trial[60] evaluated methylprednisolone 120 mg. One trial was rated good quality[73] and the other three trials were rated fair quality. Methodological shortcomings in the fair-quality trials included unblinded design, inadequate description of allocation concealment methods, and failure to report attrition.

Versus the standard interlaminar approach, one fair-quality trial (n=37) found an epidural injection via the lateral parasagittal approach associated with greater likelihood of achieving >50 percent pain relief through 6 months (68% [13/19] vs. 17% [3/18], RR 4.1, 95% CI 1.4 to 12), as well as lower mean pain scores (31 vs. 51 on 0 to 100 VAS, estimated from graph) and better function (30 vs. 43 on the ODI, estimated from graph) in patients with radiculopathy for at least 3 months.[74] A second fair-quality trial (n=106) also found that effects favored the lateral parasagittal approach, but differences were not statistically significant through 12 months (differences on pain intensity at rest <0.5 point on a 0 to 10 scale at 4 weeks and ~1.2 points at 6 months and 365 days; on the ODI the difference was ~5 points at 4 weeks and 10-15 points at 6 months and 365 days).[60]

A good-quality trial (n=62) found no differences between an epidural injection via the lateral parasagittal approach versus the transforaminal approach in likelihood of experiencing ≥50% pain relief through 12 months (78% vs. 77% at 3 months, 69% vs. 77% at 12 months), pain intensity (differences ~0 points on a 0 to 100 pain scale), or the ODI (differences <2.5 points).[73] A fair-quality trial (n=57) via the lateral parasagittal interlaminar versus the transforaminal approach in patients with radiculopathy of varying duration found no differences between approaches in mean pain intensity through 6 months (41 vs. 47 on 0 to 100 VAS).[61]

One trial compared standard transforaminal injection with corticosteroid at the level of the affected nerve root ganglion versus a transforaminal preganglionic injection.[79] Because the spinal nerves travel downwards before exiting the neural foramen, the preganglionic injection is performed at the supra-adjacent level (i.e., 1 level higher). One fair-quality trial (n=239) compared an epidural injection with 40 mg triamcinolone via the transforaminal ganglionic versus the preganglionic approach in patients with radiculopathy of varying duration found the ganglionic approach associated with a lower likelihood of overall "good" or "excellent" results at 1 month followup (71% [90/127] vs. 88% [99/112], RR 0.80, 95% CI 0.70 to 0.91), though the difference was no longer present at longer (>6 month) followup (67% [78/116] vs. 60% [64/106],

RR 1.11, 95% CI 1.11, 95% CI 0.91 to 1.36).[79] About 80 percent of patients had herniated disc and 20 percent spinal stenosis on imaging.

One of the trials of transforaminal versus interlaminar injections also compared fluoroscopic-guided transforaminal versus caudal epidural injection with 40 mg triamcinolone (n=60).[48] Patients had S1 dermatomal radicular symptoms with L5-S1 disc herniation on MRI; mean duration of symptoms was a little over 1 month. The volume of injectate was 5 ml for the transforaminal approach and 20 ml for the caudal approach and three injections were performed at 2-week intervals. The transforaminal approach was associated with higher likelihood of achieving complete pain relief (30% [9/30] vs. 3% [1/30], RR 9.0, 95% CI 1.21 to 67) and lower pain scores (2.4 vs. 6.1 on 0 to 10 NRS) 2 weeks after the last injection. There was no difference in the ODI (14 vs. 14 on 0 to 70 scale) or the Beck Depression Inventory (12 vs. 13 on 0 to 63 scale).

The same trial also compared fluoroscopic-guided interlaminar versus caudal epidural injection with the same dose and type of corticosteroid and number and frequency of injections (n=60).[48] There was no difference in the likelihood of achieving complete pain relief (10% [3/30] vs. 3% [1/30], RR 3.0, 95% CI 0.33 to 27), mean pain scores (5.7 vs. 6.1 on 0 to 10 NRS), ODI (13 vs. 14 on 0 to 70 scale), or the Beck Depression Inventory (11 vs. 13 on 0 to 63 scale) 2 weeks after the last injection.

Epidural Injections For Spinal Stenosis

No trial of epidural corticosteroid injections for spinal stenosis randomized patients to different approaches. In one trial of epidural corticosteroid versus local anesthetic injection, the injection could be performed by either the transforaminal or interlaminar approach.[117] In a stratified analysis, interlaminar corticosteroid injections were associated with greater improvement from baseline than local anesthetic injections at 3 weeks on the RDQ (ANCOVA –2.5, 95% CI –3.7 to –1.3) and on leg pain (ANCOVA –0.9 on 0 to 10 NRS, 95% CI –1.5 to –0.3) but there was no difference between transforaminal corticosteroid versus local anesthetic injections (RDQ –0.1, 95% CI –1.7 to 1.6 and leg pain 0.0, 95% CI –0.9 to 0.9). There were no differences with either approach on the RDQ or leg pain at 6 weeks based on the prespecified p-value of 0.025 for subgroup analyses, though results favored the RDQ in the interlaminar subgroup (–1.4, 95% CI –2.8 to –0.1, p=0.04).

No trial randomized patients with spinal stenosis to epidural corticosteroid injections with imaging guidance versus without imaging guidance. In stratified analyses, there were no clear difference in findings between trials that used fluoroscopic guidance versus those that did not use fluoroscopic guidance, but analyses were limited by the small numbers of trials and potential confounding by other factors (e.g., different approaches, corticosteroids, doses, and duration).

Epidural Injections For Nonradicular Low Back Pain

One trial compared transforaminal versus interlaminar epidural corticosteroid injection in patients with nonradicular low back pain, but only reported results in subgroups stratified by presence of imaging findings of herniated disc or spinal stenosis (see KQ 2).[128]

Facet Joint Injections

Imaging Guidance

No trial directly compared facet joint corticosteroid injection with versus without imaging guidance. We could not perform analyses of trials of facet joint corticosteroid versus local anesthetic or saline injections stratified according to use of imaging guidance, because all trials used fluoroscopic guidance.[141, 146-148, 151]

One fair-quality trial (n=40) of intra-articular facet joint corticosteroid injections compared the effectiveness of CT- versus ultrasound-guided injections in patients with chronic (>6 months) low back pain (imaging performed to exclude contraindications).[144] Diagnostic blocks were not used for patient selection and a single injection with 4 mg betamethasone was performed at one level. At 6 weeks, there was no difference in mean 100-point VAS pain levels between the CT-guided versus ultrasound-guided injection groups (46 vs. 38).

Route of Administration

Two fair-quality trials compared intra-articular facet joint injection versus medial branch injections.[140, 150] One trial (n=46) evaluated injection with 8 mg triamcinolone in patients with low back pain for <6 months (mean 7.6 weeks) and positive facet joint findings on SPECT imaging.[140] At 12 weeks, the intra-articular injection was associated with lower pain intensity (3.2 vs. 5.4 on 0 to 10 NRS, $p<0.05$), greater likelihood of ≥50% pain relief (61% vs. 26%, RR 2.33, 95% CI 1.09 to 5.00), and better ODI score (12 vs. 23, $p<0.05$). One trial (n=86) evaluated injection with 20 mg methylprednisolone acetate in patients with chronic (>6 months) low back pain (median duration 8.5 years).[150] Imaging or diagnostic blocks were not required for patient selection, and the number of injections or levels treated was not reported. At 1 month, the intra-articular injection was associated with higher likelihood of at least slight pain relief compared with the medial branch injection group (57% [24/42] vs. 34% [15/44]; RR 1.68, 95% CI, 1.03, 2.73), but by 3 months the result was no longer statistically significant (39% [16/41] vs. 29% [12/42]; RR 1.37, 95% CI, 0.74, 2.52). There was no difference in the likelihood of experiencing good or excellent pain relief at any time point (22% [9/41] vs. 14% [6/42] at 3 months; RR 1.54, 95% CI, 0.60, 3.93).

One poor-quality trial (n=67) compared intra- versus extra-articular (peri-capsular) facet joint injections with 80 mg methylprednisolone acetate plus local anesthetic in patients with chronic (>3 months) low back pain.[146] Back pain was localized to one side with tenderness and local muscle spasm over the facet joints; no imaging or diagnostic testing was performed for patient selection. At 3 months, there were no differences in mean pain scores, (44 vs. 42 on 0-100 VAS), disability scores (data after treatment not reported), or return to work rates (data not reported). Similar results were reported at 2 and 6 weeks.

There were too few trials of facet joint corticosteroid versus local anesthetic or saline injections to perform informative analyses stratified according the specific type of injection (intra-articular, extra-articular [peri-capsular], or medial branch).

Key Question 2. In patients with low back pain, what characteristics predict responsiveness to injection therapies on outcomes related to pain, function, and quality of life?

Key Points

Epidural Injections

- Five of six trials of patients with radiculopathy found no association between duration of symptoms and responsiveness to epidural corticosteroid injections (SOE: low).
- Trials or patients with radiculopathy found no association between age, sex, anxiety/depression, opioid use, baseline function, presence of neurological abnormalities, previous episodes, or work status and responsiveness to epidural corticosteroid injections (SOE: low).
- There was insufficient evidence from four trials to determine how the cause of radicular symptoms affected responsiveness to epidural corticosteroid injections for radiculopathy, due to inconsistent results (SOE: insufficient).
- No study evaluated the association between smoking status, body mass index, or receipt of opioid or other concomitant therapies on responsiveness to epidural corticosteroid injection therapies for radiculopathy (SOE: insufficient).
- There was no clear association between prior lumbar surgery, requirement for imaging correlation with symptoms, or requirement for presence of herniated disc on imaging and estimates of treatment effect, based on meta-regression analyses of trials of epidural corticosteroid injections versus placebo interventions for radiculopathy, (SOE: low).
- One trial of patients with spinal stenosis found no interaction between race and responsiveness to epidural corticosteroid injections (SOE: low).
- One trial of patients with nonradicular low back pain found no differences between transforaminal versus interlaminar epidural corticosteroid injection in pain or a patient satisfaction index in the subgroup of patient with imaging findings of a herniated disc, but in patients with spinal stenosis effects on pain favored the transforaminal approach (1.79 vs. 2.19 on the 0 to 5 Roland pain score, $p<0.05$; likelihood of improving ≥2 points 51% vs. 31%, RR 1.64, 95% CI 0.98 to 2.76) (SOE: low).

Facet joint Injections

- One trial found no difference between use of SPECT bone scans versus no SPECT to identify targets for intra- and extra-articular facet joint corticosteroid injections in pain outcomes through 6 months (SOE: low).

Detailed Synthesis

Epidural Injections

Epidural Injections For Radiculopathy

Few trials of epidural injections for radiculopathy evaluated predictors of responsiveness to epidural injections. Five trials that evaluated duration of symptoms at trial enrollment found no association with treatment responsiveness after adjusting for other potentially contributing

factors[50, 64, 72, 79, 101] One trial of transforaminal corticosteroid versus local anesthetic injection found longer duration associated with less favorable outcomes.[109]

Trials found no statistically significant effects of age,[64, 79, 101, 109] sex,[64, 79, 101, 109] anxiety/depression,[50, 109] opioid use,[64] baseline function,[50, 64] presence of neurological abnormalities,[50, 72] level of herniation, herniation morphology, size of herniation, presence of degenerative changes,[72] previous back episodes,[50] or work status[50] on responsiveness to epidural corticosteroid injections. One trial found that transforaminal epidural corticosteroid injection was associated with greater likelihood of achieving ≥50 percent pain relief in patients with low-grade versus high-grade nerve root compression.[72]

Results of studies that enrolled populations with different causes of radicular symptoms were somewhat inconsistent regarding the effects of the cause of radicular symptoms on effectiveness of therapy. Two studies found no clear differences in response to treatment between patients with herniated disc versus spinal stenosis in response to treatment.[66, 101] One trial found that rates of improvement were higher in patients with herniated disc (71% to 74%) than spinal stenosis (50% to 56%) regardless of whether they received epidural corticosteroid or saline.[115] One trial of transforaminal injections found disc prolapse associated with greater improvement in ODI than foraminal stenosis (14 points with or without corticosteroid with disc prolapse versus 1.5 with corticosteroid and 6.5 without corticosteroid for foraminal stenosis), though effects on mean pain score and likelihood of a good or excellent response were similar.[109] Another trial found no effect of transforaminal injections versus saline injection on pain or the ODI in the subgroup of patients with bulges; effects on leg pain were stronger in the subgroup of patients with contained herniations than extrusions at 2 to 4 weeks, though results in both groups favored saline injection at 6 months.[82] There were no effects on the ODI in any group through 3 months.

No study evaluated factors such as smoking status, body mass index, or use of opioid or other concomitant therapies on responsiveness to treatment.

One study that evaluated effects of radiographic parameters on responsiveness to injections found no association with presence of lateral recess stenosis at the level of disc herniation, though multiple levels of lumbar disc degeneration and presence of Modic-type-1 inflammatory changes associated with less improvement in back and lower extremity pain.[59]

Trials of epidural corticosteroid injections versus placebo interventions were of limited usefulness for evaluating the effects of patient characteristics on estimates of effects due to small numbers of trials for most analyses. However, for outcomes where more trials were available for analysis (improvement in pain or function and likelihood of a successful pain outcome, successful composite outcome, or of undergoing surgery at short-term, and likelihood of surgery at long-term followup), meta-regression found no statistically significant effects on estimates of exclusion of patients with prior surgery, imaging correlation requirement for enrollment, herniated disc on imaging requirement for enrollment, or duration of symptoms.

Epidural Injections For Spinal Stenosis

One good-quality trial of epidural corticosteroid versus local anesthetic injections found no significant interaction between race and treatment in analyses of RDQ scores (p=0.73 for interaction) or leg pain (p=0.99).[117]

Epidural Injections For Nonradicular Low Back Pain

One trial (n=192) of patients with nonradicular low back pain but imaging findings of herniated disc or spinal stenosis found no difference between a transforaminal versus

interlaminar epidural injection on pain or a patient satisfaction index in the herniated disc subgroup, but effects on pain favored the transforaminal approach in the spinal stenosis subgroup (1.79 vs. 2.19 on the 0 to 5 Roland pain score, $p<0.05$; likelihood of improving ≥2 points 51% vs. 31%, RR 1.64, 95% CI 0.98 to 2.76).[128]

Facet Joint Injections

One fair-quality trial (n=46) evaluated bone scan with SPECT versus physical exam plus radiologic findings without SPECT to determine targets for fluoroscopically-guided injections with 3 mg betamethasone in patients with chronic (>6 months) back pain without leg pain and radiological evidence of facet joint abnormalities.[152] A positive response to diagnostic block was not required for patient selection. Patients in the SPECT group received facet injections at the levels identified on SPECT imaging. For SPECT patients with no abnormalities on SPECT imaging and for patients in the control group, injection levels were based on physical exam and imaging. Overall, patients were treated at a mean of four joints; the number of injections was not reported. There was no difference between the SPECT imaging and no SPECT groups in pain scores (16 vs. 11 at 6 months on 0 to 100 American Academy of Orthopedic Surgeons [AAOS] scale) or the likelihood of experiencing greater than 17 point improvement (48% [15/31] vs. 45% [5/16] at 1 month, RR 1.55, 95% CI, 0.69, 3.49; 39% [12/31] vs. 36% [5/14] at 6 months, RR 1.08, 95% CI, 0.47, 2.49). However, within the SPECT group, pain outcomes were better through 3 months for those with abnormalities on SPECT imaging (n=15) versus those without SPECT abnormalities (n=16), based on the AAOS pain score (38 vs. 7 at 3 months, $p<0.001$) and likelihood of >17 point improvement (80% [12/15] vs. 13% [2/16] at 3 months, RR 6.40, 95% CI, 1.71, 23.98). However, differences were less pronounced and no longer statistically significant at 6 months (21 vs. 10 on the AAOS pain scale and 53% [8/15] vs. 25% [4/16] with >17 point improvement, RR 2.13, 95% CI, 0.81, 5.64). Another trial of intra-articular facet joint versus medial branch corticosteroid injection selected patients on the basis of positive facet joint SPECT findings, but did not evaluate a comparison group of patients who did not undergo SPECT (see KQ 1b).[140]

Key Question 3. In randomized trials of low back pain injection therapies, how does effectiveness vary according to the comparator used (e.g., epidural nonsteroid injection, nonepidural injection, no injection, surgery, or nonsurgical therapies)?

Key Points

Epidural Injections

- In trials of epidural corticosteroid injections versus placebo injections for radiculopathy, there were no clear differences in estimates for improvement in pain or function, likelihood of a successful pain or functional outcome, or likelihood of undergoing surgery when trials were stratified according to the type of placebo therapy (SOE: low).
- Trials of epidural corticosteroid injections versus other interventions were too limited to determine effects on outcome estimates, due to variability in the interventions evaluated, small numbers of trials, and methodological limitations (SOE: insufficient).

- There was insufficient evidence from trials of epidural corticosteroid injections for spinal stenosis, nonradicular back pain, or chronic postsurgical pain, to determine effects of comparators on estimates of effect, due to small numbers of trials for specific comparisons (SOE: insufficient).

Facet Joint Injections

- There was insufficient evidence from trials facet joint injections to determine effects of comparators on estimates of effect, due to small numbers of trials for specific comparisons (SOE: insufficient).

Detailed Synthesis

Three trials compared epidural corticosteroid injections for radiculopathy with more than one type of placebo comparator, enabling direct comparisons of effect estimates.[71, 78, 85] All trials compared epidural local anesthetic and epidural saline injections; one trial each evaluated the transforaminal,[71] interlaminar,[85] or caudal[78] routes. One trial also evaluated soft tissue local anesthetic and soft tissue saline injections[71] and one trial evaluated soft tissue needling without injection.[85] Based on direct comparisons from these trials, there were no clear differences between control interventions in mean improvements in pain or function associated with epidural corticosteroid epidural injections, or the likelihood of experiencing pain relief or a successful outcome.

In trials of epidural corticosteroid injections versus placebo injections for radiculopathy, there were no clear differences in estimates related to pain, function, surgery, or successful composite outcomes at different time points when trials were stratified according to whether the control intervention was an epidural local anesthetic injection, epidural saline injection, or soft tissue injection, though analyses were limited by small numbers of trials for each comparator and imprecise estimates (Table 11). For improvement in pain at intermediate-term followup, one trial[81] of an epidural corticosteroid versus saline injection (mean difference 13.3, 95% CI 5.60 to 21.0) reported worse outcomes than trials that evaluated an epidural local anesthetic injection (two trials, WMD –3.64, 95% CI –7.09 to –0.18, I^2=0%)[93, 134] or no injection (one trial, mean difference –9.70, 95% CI –25.8 to 6.43),[56] but also differed from the other trials in that it was the only trial to use the transforaminal approach.

Three trials of epidural corticosteroid injections versus epidural injections with other medications (autologous conditioned serum,[53] clonidine,[57] or etanercept[64]) were generally consistent with trials of epidural injections versus placebo interventions in showing no clear benefits associated with the epidural corticosteroid injection. One trial of caudal epidural corticosteroid injection with fluoroscopic guidance versus spinal endoscopic guidance also found no differences in outcomes.[67]

Three trials evaluated epidural corticosteroid injections versus surgical interventions.[52, 59, 70] Two trials found interlaminar epidural corticosteroid injections associated with worse outcomes than discectomy (technique not specified)[59] or percutaneous microdiscectomy,[52] but both trials had important methodological shortcomings (see Key Question 1). One trial found transforaminal epidural corticosteroid injection associated with lower likelihood of achieving a successful pain or functional outcome than plasma disc decompression.[70]

Two trials compared found epidural corticosteroid injections to be more effective than noninjection, nonsurgical interventions,[89, 98] However, the comparator interventions differed (medications and bed rest with graded activity in one trial[89] and medications, traction, TENS,

short-wave diathermy, and back exercises in the other[98]), one of the trials was rated poor quality,[98] and in the other differences at 1 month were no longer present at 3 months,[89] making it difficult to determine whether the use of noninjection, nonsurgical interventions was associated with differential effects versus other comparators.

Two trials of epidural corticosteroid injections for spinal stenosis evaluated multiple comparators, allowing direct comparisons. One fair-quality trial found epidural corticosteroid injections associated with better outcomes than no injection on pain, function, and the Nottingham Health Profile, but no difference versus physical therapy.[120] One poor-quality trial found epidural corticosteroid injections associated with greater improvements in walking distance than saline injection at 1 week, but no difference versus an epidural local anesthetic injection.[118] There were no differences versus either comparator at 1 or 3 months.

There were too few trials of epidural corticosteroid injections of spinal stenosis for meaningful indirect comparisons of subgroup effects based on use of different comparators (**Appendix E2**). There were no direct comparisons of different comparators of epidural corticosteroid injections for nonradicular back pain or chronic postsurgical pain and facet joint corticosteroid injections and too few trials to evaluate effects of different comparators on estimates based on indirect comparisons (Appendix E3-E5).

Key Question 3a. How do response rates vary according to the specific comparator evaluated (e.g., saline epidural, epidural with local anesthetic, nonepidural injection, no injection, surgery, nonsurgical therapies)?

Key Points

- Three trials that compared epidural corticosteroid injections for radiculopathy versus more than one type of placebo comparator found no differences between epidural local anesthetic versus epidural saline injections (three trials) or soft tissue injections (two trials) in mean improvements in pain or function or the proportion experiencing pain relief or a successful outcome (SOE: low).
- In trials of epidural corticosteroid injections for radiculopathy, improvement in pain was smaller in patients who received epidural local anesthetic injections (three trials, WMD –6.51, 95% CI –11.9 to –1.16, I2=45%) than epidural saline injections (four trials, WMD –19.8, 95% CI –25.1 to –14.3, I2=56%) at immediate-term followup; there were no clear differences at other time points, but analyses were limited by small numbers of trials and statistical heterogeneity (SOE: low).
- Trials of epidural corticosteroid injections versus other interventions for radiculopathy were too limited to determine effects on response rates due to variability in the interventions evaluated, small numbers of trials, and methodological limitations (SOE: insufficient).

Detailed Synthesis

Three previously-described trials compared epidural corticosteroid injections for radiculopathy versus more than one type of placebo comparator.[71, 78, 85] All trials compared epidural local anesthetic and epidural saline injections; one trial each evaluated the

transforaminal,[71] interlaminar[85] or caudal[78] routes. One trial also evaluated soft tissue local anesthetic and soft tissue saline injections[71] and one trial evaluated soft tissue needling without injection.[85] Based on direct comparisons from these three trials, there were no clear differences between epidural local anesthetic injections and epidural saline or soft tissue injections in mean improvements in pain or function or the proportion of patients that experienced pain relief or a successful outcome.

Responses to control injections were similar for pain, function, surgery, and successful composite outcomes at most time points when trials of epidural injections versus placebo were stratified according to whether the comparator was an epidural local anesthetic, epidural saline, or soft tissue injection (Table 12). Immediate-term improvement in pain scores in the control group were smaller in trials that used epidural local anesthetic injections (three trials, WMD –6.51, 95% CI –11.9 to –1.16, I^2=45%)[68, 71, 85] than epidural saline injections (four trials, WMD –19.8, 95% CI –25.2 to –14.3, I^2=56%, p=0.012 for difference in estimates).[71, 81, 85, 113] There were no statistically significant differences in intermediate-term changes in pain scores with soft tissue injections versus epidural local anesthetic or saline injections. There were also no differences in short-, intermediate-, or long-term improvement in pain scores between epidural local anesthetic, epidural saline, and soft tissue injections, though analyses were limited by small numbers of trials. Although immediate-term change in pain scores was larger with no injection (–43.9, 95% CI –54.9 to –32.9) than other placebo interventions, only one trial evaluated this comparator.[56]

Evidence on response rates following surgical therapies was limited. Two trials evaluated epidural corticosteroid injections versus discectomy.[52, 59] In one poor-quality trial, improvement in leg pain following discectomy (technique not specified) averaged 5.6 points on a 0 to 10 VAS at 1 to 3 months and 5.5 points at 2 to 3 years, and improvement in the ODI was 26 points (0 to 100 scale) at 1 to 3 months and 32 points at 2 to 3 years.[59] One poor-quality trial reported mean improvements in leg pain following percutaneous microdiscectomy of 1.1 points on a 0 to10 VAS at 1 week and 2.0 points at 6 weeks; for back pain improvements were 4.5 and 6.5 points, respectively.[52] One fair-quality trial reported improvements in leg pain of 42 to 47 points on a 0 to 100 VAS at 6 weeks to 3 months, and improvements on the ODI of 11 to 14 points.[70] Forty-two percent of patients experienced ≥25 point improvement in leg pain at 6 months and 39 percent had ≥12 point improvement in ODI.

Evidence on response rates following noninjection, nonsurgical interventions was also limited. One poor-quality trial reported an improvement in pain of 2.0 points on a 0-10 VAS at 6 months and improvement in ODI of 11 points.[98] The proportion of patients reporting complete pain relief was 32 percent at 3 months and 24 percent at 6 months. One fair-quality trial also evaluated noninjection, nonsurgical interventions, but did not report baseline pain or function.[89] The proportion of patients reported satisfaction with improvement in pain was 52 percent at 2 weeks and 64 percent at 6 months.

There were too few trials to determine how response rates vary according to the comparator used in trials of epidural injections for spinal stenosis, nonradicular low back pain, chronic postsurgical back pain, or for facet joint injections.

Key Question 4. What are the harms of epidural corticosteroid, facet joint corticosteroid injections, medial branch blocks, and sacroiliac joint corticosteroid injection compared to epidural nonsteroid injection, nonepidural injection, no injection, surgery, or nonsurgical therapies?

Key Points

Epidural Injections

- Twenty-nine trials of epidural corticosteroid injections versus placebo for radiculopathy reported no serious adverse events and few harms, but methods for assessing harms were not well-reported and harms data were sparse. Observational studies were consistent with the trials in showing a low risk of serious adverse events (SOE: moderate).
- Nine trials of epidural corticosteroid injections versus other therapies for radiculopathy reported no serious adverse events and few harms (SOE: moderate).
- Two trials of transforaminal versus interlaminar epidural corticosteroid injections for radiculopathy reported no serious adverse events (SOE: low).
- There was insufficient evidence from four trials that compared epidural injections for radiculopathy with different corticosteroids to determine effects on harms (SOE: insufficient).
- There was insufficient evidence from six trials of epidural corticosteroid injections for radiculopathy that compared different doses to determine effects on harms (SOE: insufficient).
- Eight trials of epidural corticosteroid injections versus placebo injections for spinal stenosis reported no serious harms and few adverse events, but methods for assessing harms were not well-reported and harms data were sparse (SOE: low).
- Two trials of epidural corticosteroid injections for nonradicular back pain reported no serious harms (SOE: low).
- There was insufficient evidence from four trials of epidural corticosteroid injections for chronic postsurgical low back pain to determine effects on harms (SOE: insufficient).

Facet Joint Injections

- Ten trials of facet joint corticosteroid injections reported no serious harms and few adverse events, but methods for assessing harms were not well reported and harms data were sparse (SOE: low).

Sacroiliac Joint Injections

- Harms were not reported in one small trial of peri-articular sacroiliac joint injections (SOE: insufficient).

Detailed Synthesis

Epidural Injections For Radiculopathy

In 29 trials (total n=2,792) of epidural corticosteroid injections for radiculopathy versus placebo (epidural local anesthetic, epidural saline, soft tissue local anesthetic, or soft tissue saline, or no injection), only one serious adverse event (a case of retroperitoneal hematoma in a patient on anticoagulation)[81] was reported (Appendix E1). However, methods for assessing harms were not well reported and harms data were sparse**.** Thirteen trials either did not report harms at all, or reported no harms.[55, 66, 69, 71, 76, 90, 93, 96, 103, 105, 106, 114, 115] Three trials reported no difference in risk of headache.[62, 68, 113] One trial[64] reported no cases of new neurological symptoms in patients (n=28) undergoing epidural corticosteroid injections and one[107] reported no difference in risk of transient lower extremity paresthesia. Other harms were reported inconsistently across trials, with small numbers of events and no clear differences in risk.

Eleven trials of epidural corticosteroid injections (using various approaches) versus other therapies (epidural autologous conditioned serum, hypertonic saline, clonidine, or etanercept; discectomy or automatic percutaneous discectomy; spinal endoscopy; noninvasive therapies) reported no serious adverse events.[52, 53, 57, 59, 64, 67, 70, 86, 89, 98, 111] Trials that reported specific adverse events by intervention group reported no differences in risk of headache,[53] discomfort at injection site, worsening of symptoms, or new neurological symptoms.[52, 53, 57, 64, 67, 70] One trial (n=50) of interlaminar epidural corticosteroid injection reported four cases (12%) of hyperglycemia (blood glucose >180 mg/dl) in patients without a history of diabetes.[89]

Of five trials that directly compared the transforaminal versus interlaminar approaches,[48, 75, 87, 102, 112] three did not report adverse events.[75, 102, 112] In one trial, one case of transient hypertension was reported with the transforaminal approach,[87] and one trial that compared the transforaminal, interlaminar, and caudal approaches reported no adverse events.[48] No harms were reported in three trials of the lateral parasagittal interlaminar approach, except for one case of paresthesia resulting in discontinuation of the procedure.[61, 73, 74] One trial reported no differences between the lateral parasagittal interlaminar approach versus the midline interlaminar approach in risk of injection site pain, headache, or nausea.[60]

A trial of ganglionic versus preganglionic transforaminal corticosteroid injection reported no harms.[79]

Harms were not reported in the two trials of transforaminal epidural injection with dexamethasone versus triamcinolone.[83, 100] Two head-to-head trials of interlaminar dexamethasone versus triamcinolone[84] or betamethasone versus methylprednisolone[63] reported no harms in either group.

Harms were poorly reported in five trials (n=452) of corticosteroid dose comparisons.[49, 53, 80, 97, 99] One trial reported no differences in risk of hyperglycemia with interlaminar methylprednisolone 80 vs. 40 mg (4.6% vs. 0%)[99] and one (poor-quality) trial reported greater likelihood of early secondary adrenal insufficiency based on adrenocorticotropin hormone stimulation testing following methylprednisolone 80 vs. 40 mg (86% vs. 53% at week 1 and 22% vs. 15% at week 2), though associated clinical effects were not evaluated.[77] No serious adverse events were reported in any of the trials.

One trial reported no cases of intravascular injection with caudal epidural injections with fluoroscopic plus Doppler guidance versus two cases (0% [0/55] vs. 3.6% [2/55], RR 0.21, 95% CI 0.01 to 4.22) with fluoroscopic guidance alone, with no differences in risk of headache, vasovagal reaction, or pain exacerbation.[100]

Epidural Injections For Spinal Stenosis

Eight trials (total n=821) of epidural corticosteroid injections versus local anesthetic or saline injections for spinal stenosis reported few harms (including no serious harms), but in most trials, methods for assessing harms were not well-reported and data on harms were sparse (Appendix E2).[66, 115, 117, 118, 120, 122, 123, 126] One good-quality trial found transforaminal or interlaminar epidural corticosteroid injections associated with increased risk of experiencing at least one adverse event versus a local anesthetic injection (22% [43/200] vs. 16% [31/200], RR 1.39, 95% CI 0.91 to 2.11), but no increased risk of serious adverse events (2.5% [5/200] vs. 2.5% [5/200]), headache (4.0% [8/200] vs. 1.5% [3/200]), or fever and/or infection (5.0% [10/200] vs. 1.0% [2/200]).[117] There was no clear difference in risk of adverse events between the interlaminar and transforaminal approaches, though estimates were imprecise. Among the other studies, two trials reported no harms[118] or no major harms,[122] two did not report harms by treatment group,[120, 122] and three trials did not report any harms information.[66, 115, 126]

Harms were also not well-reported in one trial[119] that compared epidural injections with different corticosteroids or four trials[116, 120, 121, 127] of epidural corticosteroid injections versus other interventions MILD procedure, intensive physical therapy, epidural adhesiolysis, epidural etanercept). No serious adverse events were recorded in any of the trials.

Epidural Injections For Nonradicular Back Pain

Two trials (total n=240) of epidural corticosteroid injections for nonradicular low back pain versus epidural injection with corticosteroid reported few adverse events and no serious harms (**Appendix E3**).[129, 132]

Epidural Injections For Chronic Postsurgical Back Pain

One small (n=24) trial found epidural morphine injection associated with higher rates of nausea and vomiting, pruritus, urinary retention and need for naloxone than epidural corticosteroid injection, but sample sizes were small (Appendix E4).[139] Three trials of epidural corticosteroid injections versus other interventions (forceful caudal epidural injections, epidural adhesiolysis, or epidural hyaluronic acid) reported no difference in rates of postintervention pain,[137] no adverse events,[136] or did not report adverse events.[135]

Facet Joint Injections

Ten trials (total N=823) of facet joint injections (intra-articular, extra-articular, or medial branch) versus local anesthetic or saline injections reported no serious harms (Appendix E5).[141-148, 150, 151] However, methods for assessing harms were not well-reported and data on harms were sparse. Four trials reported no adverse events[141, 147, 148, 151] and one trial did not report harms by treatment group.[146] Two trials[142, 145] of facet joint corticosteroid injections versus radiofrequency denervation and one trial[143] of facet joint corticosteroid versus hyaluronic acid also reported no serious adverse events; one trial (n=100) that reported specific harms by treatment group reported no cases of infection, new motor deficit, or new sensory deficit; and two patients in the neurotomy group experienced a burning sensation in the treated region and increase in back pain following the procedure (0% [0/50] vs. 4% [2/50]).[142]

Sacroiliac Joint Injections

Harms were not reported in one small trial (n=24) of peri-articular sacroiliac joint injection with corticosteroid (Appendix E6).[154]

Observational Studies on Harms

Large, observational studies of epidural and other spinal injections were consistent with randomized trials in reporting rare serious adverse events, though minor adverse events such as local hematoma, bleeding, return of blood, and dural puncture were more common.[157-160] For example, in a recent study that also evaluated the largest sample, there were no cases of nerve damage, infection, abscess, or epidural hematoma following 2,760 lumbar epidural injections under fluoroscopic guidance.[158] Rates of profuse bleeding ranged from 0.2 to 0.8 percent depending on the approach used. There were no cases of transient nerve root irritation in 3,985 caudal injections, 4 cases (0.28%) in 1,450 interlaminar injections, and 60 cases (4.6%) in 1,310 transforaminal injections. Similarly, the largest analysis of facet joint injections reported no cases of infection, spinal cord irritation, or nerve damage in 3,162 encounters for lumbar facet joint nerve blocks (multiple nerve blocks were often performed at each encounter).[159] There were three episodes (0.1%) of nerve root irritation. Minor adverse events such as local bleeding (73%) were common.

Discussion

Key Findings and Strength of Evidence Summary

The key findings of this review are summarized in the summary of evidence table (Table 13) and the factors used to determine the overall strength of evidence grades are summarized in Appendix G. Strengths of our review are inclusion of additional trials compared with prior reviews, evaluation of epidural corticosteroid injections for back pain conditions other than radiculopathy, evaluation of continuous as well as dichotomous outcomes, evaluation of outcomes at defined time points, evaluation of the effectiveness of epidural corticosteroids versus other active interventions, conduction of additional analyses to evaluate effects of methodological limitations, patient characteristics, and injection techniques on findings.

Evidence was most robust for epidural corticosteroid injections in patients with radiculopathy. In trials of epidural corticosteroid injections versus placebo interventions, the only statistically significant effects were on mean improvement in pain at immediate-term (5 days to ≤2 weeks) followup (weighted mean difference [WMD] –7.55 on a 0 to 100 scale, 95% confidence interval [CI] –11.4 to –3.74), mean improvement in function at immediate-term followup (standardized mean difference [SMD] –0.33, 95% CI –0.56 to –0.09), and risk of surgery at short-term (>2 weeks to ≤3 months) followup (RR 0.62, 95% CI 0.41 to 0.92). However, the magnitude of the effect on pain was small (WMD –7.55 on 0 to 100 scale) and did not meet our predefined minimum clinically important differences of 15 points.[42] The effect on immediate-term function was only statistically significant when an outlier trial[107] was excluded. Differences were also small in the nonoutlier trials (5.1 and 7.6 points on the 0 to 100 Oswestry Disability Index [ODI][56, 81] and 1.3 points on the 0 to 24 Roland Morris Disability Questionnaire [RDQ]) and did not meet predefined thresholds for minimum clinically important differences (10 points for the ODI and 5 points for the RDQ).[42] Differences were not present for either outcome at longer-term followup. There were also no differences at any time point between epidural corticosteroid injections and placebo interventions in likelihood of experiencing a successful pain, function, or composite outcome; or likelihood of undergoing surgery. Direct evidence from randomized trials on effects of performing epidural corticosteroid injections for radiculopathy using different approaches, different corticosteroids, or different doses was limited, but indicated no clear effects on outcomes. There were also no clear differential effects of the epidural approach used, different corticosteroids, different doses, year of publication, use of imaging correlation, restriction to patients with herniated disc, duration of symptoms, or exclusion of patients with prior surgery, primarily based on meta-regression and subgroup analyses.

Although comparator interventions such as epidural local anesthetic injection, epidural saline injection, soft tissue injections, and no injection have traditionally been considered placebo interventions, it is possible that they may have some therapeutic effects.[35] However, placebo response rates were high in trials of epidural corticosteroid injections regardless of the comparator used and there were no clear differences in estimates of effectiveness based on the specific comparator, suggesting that observed improvements represent the natural history of radiculopathy or a general placebo response.

Trials of epidural corticosteroid injections for radiculopathy versus nonplacebo interventions did not clearly demonstrate effectiveness, but were limited by small numbers of trials for specific comparisons and methodological limitations, resulting in low or insufficient strength of evidence ratings.

Evidence was limited for epidural corticosteroid injections versus placebo interventions for spinal stenosis or nonradicular back pain, but showed no differences in outcomes related to pain or function. The evidence on epidural corticosteroid injections for spinal stenosis included a recent, well-conducted multicenter trial that was also the largest trial (n=386) to date in this population.[117] Although epidural injections could be performed by either the interlaminar or transforaminal approach in this trial, there was also no evidence of an effect when results were stratified according to the approach used. Another potential issue in interpreting this trial is that the corticosteroids and doses varied, which could have attenuated effects if certain corticosteroids or lower doses are associated with decreased effectiveness. For chronic postsurgical pain, evidence was very limited. No trial compared epidural corticosteroid injections versus placebo, and trials of epidural corticosteroid injections versus various other interventions found no clear differences.

Evidence was also limited for facet joint corticosteroid injections versus placebo interventions. Studies found no clear differences between various facet joint corticosteroid injections (intra-articular, extra-articular [peri-capsular], or medial branch) and placebo interventions. Although one trial found an intra-articular corticosteroid injection associated with better outcomes than a saline injection at 6 months, results are difficult to interpret because there were no differences at 1 month, the corticosteroid group received more cointerventions, and there was no difference in the likelihood of sustained improvement (improvement at 6 months in patients with improvement at 1 month).[141] Trials of facet joint injections versus radiofrequency denervation were difficult to interpret because they reported inconsistent outcomes, evaluation of different types of injections (intra-articular or medial branch corticosteroid injection), and differential use of diagnostic blocks to select patients, depending on which intervention they were randomized to.[142, 145]

There was insufficient evidence from one very small (n=24) trial to determine effects of peri-articular sacroiliac joint corticosteroid injections versus a placebo (local anesthetic) injection.[145]

Methods for assessing harms in randomized trials were generally not well-reported and data sparsely reported, but evidence from trials and observational studies were consistent in suggesting a low risk of serious harms following epidural injections such as neurological complications or infection. However, cases of serious neurological complications have been reported following lumbar epidural injections, and there was a recent outbreak of serious fungal infections due to contaminated methylprednisolone injections.[17, 161, 162]

Findings in Relationship to What is Already Known

Our findings were consistent with a previous qualitative review[17] conducted by our team and funded by the American Pain Society (APS) that found fair evidence that epidural corticosteroid injections for radiculopathy are more effective than placebo interventions for short-term symptom relief, but not for long-term symptom relief, and limited evidence of ineffectiveness for spinal stenosis and nonradicular low back pain. Unlike the current review, which found that short-term effects on pain did not meet the threshold for minimum clinically important differences, the APS review classified the magnitude of short-term benefit for pain relief as "moderate" (equivalent to a 10 to 20 point difference on a 100 point pain scale). However, it noted inconsistency between trials, did not perform meta-analysis, and based some conclusions on prior reviews with small numbers of studies. Our findings were also consistent with more recent qualitative and quantitative systematic reviews, despite variability in the studies included and methods used for data synthesis and meta-analysis.[20, 21, 23, 37, 163, 164] Our review was also

concordant with other reviews in finding limited evidence that lumbar epidural corticosteroid injections are associated with a low risk of serious harms.[17, 20, 161] Like a prior review, we also found no evidence on effectiveness of multiple versus single injections.[165] Although one systematic review found an association between volume differences (higher volume relative to control interventions) and effectiveness of epidural corticosteroid injections, results may have been confounded by differences in epidural approaches (e.g., caudal injections typically used higher volumes) and inclusion of comparators that did not involve epidural injections (e.g., soft tissue injections or noninjection therapies).[166] We were unable to determine effects of differences in injectate volume on effectiveness, as only three trials that compared epidural corticosteroid injections versus epidural local anesthetic or saline injections reported a volume difference.[62, 107, 109]

With regard to effects of control interventions on effect estimates, our findings were similar to a recent systematic review that found limited direct evidence showing no differences between epidural nonsteroid and nonepidural injections.[35] Although the prior systematic review found some evidence that epidural nonsteroid injections might be more effective than nonepidural injections, its conclusions were based on indirect comparisons that were highly discrepant with direct comparisons. We did not perform indirect comparisons, as the presence of such discrepancies may result in misleading findings.[167] Although the prior APS review found some evidence that effects of epidural corticosteroid injections were more likely to be positive in studies that used epidural nonsteroid injection controls than in studies that used nonepidural injection controls, these findings were based on a qualitative evaluation based on counts of positive and negative studies.[17]

Our findings of limited evidence on facet joint corticosteroid injections versus placebo interventions, without clear demonstration of beneficial effects, were also consistent with prior systematic reviews.[17, 168, 169]

Some systematic reviews reported more positive conclusions regarding the effectiveness of epidural corticosteroid and facet joint injections.[24-26, 170-172] Differences between the methods used in these reviews and ours that may explain the discrepant findings include reliance on qualitative synthesis, inclusion of observational studies, categorization of improvement from baseline following an epidural corticosteroid injection as demonstrating effectiveness (even when there was no difference versus a placebo intervention), and failure to consider inconsistency between trials.

Applicability

Some issues could impact the applicability of our findings. Results are most applicable to patients with chronic back pain, as few trials enrolled patients with acute or subacute symptoms. Although studies were typically performed in the United States or Europe in specialty settings, they varied in how the injections were performed, including the use of imaging guidance, the specific epidural or facet injection technique used, the methods used to select patients (e.g., use of imaging, the imaging findings required for inclusion, or the use of diagnostic blocks), the types and doses of corticosteroid used, and the number and frequency of injections. Although we found no clear evidence of an association between these factors and estimates of treatment effectiveness, direct evidence from head-to-head trials on these factors was limited. The effectiveness of injection therapies is also likely to depend in part on the skill and experience of the person performing the injection, but we were unable to determine effects of provider experience on treatment effects, as studies did not report this information or reported it in a

nonstandardized manner. Because most trials excluded patients with prior lumbar surgery, results may not be applicable to this patient population. The applicability of findings to patients with important medical and psychiatric comorbidities was also uncertain, and there was insufficient evidence to determine how effectiveness might vary based on the receipt of concomitant interventions such as supervised exercise therapy or cognitive behavioral therapy. Trials also differed in methods used to select patients for inclusion. For example, trials of radiculopathy and spinal stenosis differed in the clinical symptoms required for enrolment as well as in whether concordant imaging findings were required, and trials of presumed facet joint pain varied in whether a positive response to diagnostic blocks were required as well as methods for performing blocks (e.g., single or double block).

In order to facilitate interpretation of findings, we stratified outcomes by followup duration. We also compared observed effects on continuous outcomes to previously proposed thresholds for minimum clinically important changes. Although immediate-term effects of epidural corticosteroid injections versus placebo interventions on improvement in pain scores were statistically significant, they did not meet the predefined threshold for a minimum clinically important difference.[42] We also evaluated effects of injection therapies on the likelihood of experiencing a clinically meaningful outcome, which might be more clinically interpretable than mean effects on continuous scales.[173] Although trials varied in how they defined clinically meaningful outcomes related to pain, function, or overall success, analyses were consistent in showing no effects at different time points.

Implications for Clinical and Policy Decisionmaking

Our review has implications for clinical and policy decisionmaking. Epidural corticosteroid injections are the most commonly used interventional procedure for low back pain, but evidence indicates that benefits are limited to pain relief and reduced risk of surgery shortly after the procedure in patients with radiculopathy, without long-term benefits on these outcomes, and no effect on functional outcomes. Some clinical practice guidelines recommend epidural corticosteroid injections for short-term benefits in patients with persistent radicular symptoms, particularly for patients who are not candidates for, or interested in, undergoing surgery.[28] Factors that may influence decisions about performing epidural corticosteroid injections include how highly patients value short-term symptom improvement of small magnitude, preferences regarding alternative therapies (including surgery), the severity of symptoms, and costs and other burdens. Decisions should also consider the risk of serious harms with epidural injections, which have been reported in case series and other uncontrolled observational studies.[174]

Potential strategies to enhance the effectiveness of epidural injections would be to perform them using techniques shown to be more effective, or to selectively perform injections in patients more likely to benefit. However, our review found no clear evidence of greater benefits based on technical factors such as the specific epidural technique used, use of fluoroscopic guidance, the specific corticosteroid, the dose, or the number or frequency of injections. Evidence on patient factors was also too limited to identify subgroups of patients more likely to benefit.

Other findings of our review that have implications for clinical and policy decisionmaking included limited evidence of no effectiveness of epidural corticosteroid injections for spinal stenosis or nonradicular low back pain, or for facet joint corticosteroid injections for presumed facet joint pain. Although prior guidelines found insufficient evidence to develop recommendations on use of epidural corticosteroid injections for spinal stenosis and nonradicular low back pain,[28] the strength of evidence has improved, particularly for spinal stenosis,[117]

suggesting that re-evaluation may be appropriate. Guidelines are inconsistent with regard to use of facet joint corticosteroid injections,[28, 175, 176] but recent trials have not provided additional evidence to support effectiveness.

Limitations of the Comparative Effectiveness Review Process

An important limitation of our review is that substantial statistical heterogeneity was present in several pooled analyses. To address this, we used the Dersimonian-Laird random effects model to pool studies. The Dersimonian-Laird random effects model may result in confidence intervals that are too narrow when heterogeneity is present, particularly when the number of studies is small.[46] Therefore, we repeated analyses using the profile likelihood method, which resulted in similar findings. Regardless of the method used, meta-analyses based on small numbers of trials can underestimate statistical heterogeneity and must be interpreted with caution.[46] We also stratified trials according to the epidural technique used, and further explored heterogeneity by performing additional analyses stratified based on the comparator used, exclusion of poor-quality and outlier studies, and meta-regression (when sufficient numbers of studies were available) on use of blinding, patient selection methods, and methods used to perform the injections (e.g., the corticosteroid or local anesthetic used and the dose). Although statistical heterogeneity remained present in some analyses, with some unexplained outlier trials, results were generally robust in sensitivity and stratified analyses.

Another limitation of our review is that we used indirect comparisons to supplement limited direct evidence on the effects of technical and patient factors on estimates. Although findings based on indirect comparisons were generally consistent with available evidence from head-to-head trials (e.g., showing no clear effects of different corticosteroids, different epidural approaches, or different doses), results based on indirect comparisons should also be interpreted with caution.[177]

We excluded non-English language articles and did not search for studies published only as abstracts. However, a systematic review found little empirical evidence that exclusion of non–English-language articles leads to biased estimates for noncomplementary or alternative medicine interventions,[178] and we did not identify non-English language articles that would otherwise meet inclusion criteria in literature searches or reviews of reference lists. We formally assessed for publication bias using statistical and graphical methods to assess for small sample effects when there were at least 10 studies, as research indicates that such methods can be misleading with smaller numbers of studies.[47] We found no evidence of small sample effects based on analyses of short-term improvement in pain, short-term improvement in function, or long-term risk of surgery. Finally, we restricted evidence on serious harms to randomized controlled trials and large cohorts of patients undergoing injections, in order to be able to estimate rates of events. Although serious neurological events with epidural corticosteroid injections have been reported in case series and other uncontrolled studies, it is not possible to estimate the rates of events from such data.[174]

Limitations of the Evidence Base

An important limitation of the evidence base is the small number of trials available on epidural corticosteroid injections for conditions other than radiculopathy and the small number on effectiveness of facet joint or sacroiliac corticosteroid injections. The lack of evidence made it

difficult to reach strong conclusions regarding the effectiveness of these interventions versus placebo interventions or to evaluate effects of methodological, technical, or patient factors on outcomes. Although more trials were available for epidural corticosteroid injections for radiculopathy, there were fewer trials when results were stratified by specific outcomes and time points, and subgroup analyses were limited by the variability in techniques used on a number of factors.

In addition to the small number of trials, the evidence base was limited by methodological limitations in the available studies. Only eight trials were rated good quality. Of the 92 included trials, only 27 trials reported blinding of the person performing the injection, 57 trials blinding of patients, and 47 trials blinding of outcome assessors. Conclusions were generally not impacted by exclusion of poor-quality trials or assessments based on blinding status, but would be stronger if more high-quality trials were available.

Other limitations include the relatively limited number of trials that directly compared different injection techniques, corticosteroids, doses, and comparators. No trials directly compared use of imaging guidance versus no guidance, use of a single injection versus multiple injections, or effects of different injectate volumes. Few trials reported how effectiveness varied according to patient characteristics such as age, sex, race, medical or psychological comorbidities, duration of symptoms, imaging findings, cause of low back pain, use of concomitant therapies, or other factors.

Research Gaps

Research gaps limit the full understanding of the comparative effectiveness of low back injections. For radiculopathy, additional research could help determine whether patient characteristics such as severity or duration of symptoms, presence of specific imaging findings, or presence of psychiatric comorbidities are associated with responsiveness to injections. If such characteristics are identified, future trials could be designed to focus on more specific target populations that might experience greater benefits. Trials are also needed to understand whether injections may be more effective when given in the context of a more comprehensive approach that includes the delivery of concomitant treatments such as supervised exercise therapy or cognitive behavioral therapy. Additional research would also help confirm whether there are differences in outcomes associated with different epidural injection approaches (including newer approaches such as the lateral parasagittal interlaminar approach), corticosteroids, doses, use of imaging guidance, and number and frequency of injections. Ideally such studies would include a placebo intervention group to aid in interpretability of findings.

For spinal stenosis and nonradicular low back pain, evidence was limited but indicated that epidural corticosteroid injections are not effective compared to placebo interventions. Because spinal stenosis is usually degenerative and the etiology of nonradicular low back pain may be difficult to determine, the rationale for performing epidural corticosteroid injections may not be as strong as for radiculopathy due to herniated disc. Additional research on the effectiveness of epidural corticosteroid injections for these conditions may only be warranted if specific subgroups of patients who have more of an inflammatory component can be identified.

Limited evidence also indicates that facet joint corticosteroid injections are not effective compared with placebo interventions. The lack of effectiveness could be due to the ineffectiveness of the procedure or suboptimal accuracy methods for identifying patients with facet joint pain.[17] A randomized trial found that use of dual or single diagnostic facet joint blocks to select patients for radiofrequency denervation (an intervention not included in this report) was

associated with lower rates of successful outcomes than selection of patients without a diagnostic block.[179] Therefore, additional research on accurate methods for identifying patients with facet joint pain is needed to inform the design of future intervention studies.

Conclusions

Epidural corticosteroid injections for radiculopathy are associated with immediate improvements in pain and might be associated with immediate improvements in function, but benefits are small and not sustained, and there is no effect on the long-term risk of surgery. Evidence did not suggest that effectiveness varies based on injection technique, corticosteroid, dose, or comparator. Limited evidence suggested that epidural corticosteroid injections are not effective for spinal stenosis or nonradicular back pain, and that facet joint corticosteroid injections are not effective for presumed facet joint pain. There was insufficient evidence to evaluate the effectiveness of sacroiliac joint corticosteroid injections.

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Ackerman, 2007[48] 24 weeks Fair	Approach	MRI; Electro-myographic evidence of S1 nerve root involvement	Randomized: 90 Analyzed: 90	A: Transforaminal epidural injection with 40 mg triamcinolone (1 ml) and saline (4 ml), with fluoroscopic guidance (n=30) B: Interlaminar epidural injection with 40 mg triamcinolone (1 ml) and saline (4 ml), with fluoroscopic guidance (n=30) C: Caudal epidural injection with 40 mg triamcinolone (1 ml) and saline (19 ml), with fluoroscopic guidance (n=30)	A vs. B vs. C: Age (mean): 34 vs. 39 vs. 36 years Male: 67% vs. 70% vs. 63% Baseline pain (0 to 10): 8.6 vs. 8.8 vs. 8.9 Baseline ODI (0-70): 30 vs. 33 vs. 37 Duration of symptoms (days): 35 vs. 33 vs. 38	A vs. B vs. C: <u>Pain</u> Complete pain relief (complete, partial, or no pain relief): 30% (9/30) vs. 10% (3/30) vs. 3% (1/30) at 24 weeks: A vs. B, RR 3.0 (95% CI 0.90 to 10.07); A vs. C, RR 9.0 (95% CI 1.21 to 66.71); B vs. C, RR 3.0 (95% CI 0.33 to 27.23) Complete or partial pain relief: 83% (25/30) vs. 60% (18/30) vs. 57% (17/30) at 24 weeks: A vs. B, RR 1.39 (95% CI 1.0 to 1.9); A vs. C, RR 1.47 (95% CI 1.03 to 2.10; B vs. C, RR 1.06 (95% CI 0.69 to 1.62) Pain (mean, 0-10): 2.4 vs. 5.7 vs. 6.1 at 2 weeks after last injection ($p<0.05$ for A vs. B or C) <u>Function</u> ODI (mean, 0-70): 14 vs. 13 vs. 14 at 2 weeks after last injection ($p>0.05$) <u>Other outcomes</u> Beck Depression Inventory (mean, 0-63): 12 vs. 11 vs. 13 at 2 weeks after last injection ($p>0.05$)

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Ahadian, 2011[49] 12 weeks Fair	Dose	Not specified	Randomized: 98 Analyzed: 98	A: Transforaminal epidural injection with 12 mg dexamethasone (3 ml), with fluoroscopic guidance (n=32) B: Transforaminal epidural injection with 8 mg dexamethasone (2 ml), with fluoroscopic guidance (n=33) C: Transforaminal epidural injection with 4 mg dexamethasone (1 ml), with fluoroscopic guidance (n=33)	A vs. B vs. C: Age (median): 58 vs. 57 vs. 60 years Male: 53% vs. 70% vs. 88% Baseline pain (0 to 100): 73 vs. 71 vs. 68 Baseline ODI (0 to 50): 23 vs. 24 vs. 24 Duration of symptoms >2 years: 91% vs. 88% vs. 91%	A vs. B vs. C: <u>Pain</u> Pain (mean, 0-100 VAS, estimated from graph): 73 vs. 71 vs. 68 at baseline; 42 vs. 38 vs. 41 at 4 weeks; 51 vs. 37 vs. 50 at 8 weeks; 52 vs. 45 vs. 54 at 12 weeks (p>0.05 for between group differences at all time points) <u>Function</u> ODI (mean, 0-100 VAS, estimated from graph): 23 vs. 24 vs. 24 at baseline; 18 vs. 17 vs. 18 at 4 weeks; 20 vs. 17 vs. 19 at 8 weeks; 21 vs. 19 vs. 20 at 12 weeks, (p>0.05 for between group differences at all time points) <u>Global Assessment</u> Global impression of change ≤ 3 (7 point scale): No difference between groups, data not reported Global satisfaction scale ≥2 (5 point scale): No difference between groups, data not reported

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Arden, 2005[50] Price, 2005[51] 12 months Fair	Epidural corticosteroid vs. placebo	Lumbar spine X-ray	Randomized: 228 Analyzed: 228	A: Interlaminar epidural injection with 80 mg triamcinolone acetonide plus 0.125% bupivacaine (10 ml) (n=120) B: Soft tissue injection into interspinous ligament of normal saline (2 ml) (n=108)	A vs. BAge (mean): 43 vs. 44 years Male: 52% vs. 54% Baseline leg pain (0-100 VAS): 52 vs. 56 Baseline back pain (0-100 VAS): 40 vs. 44 Baseline ODI (0-100): 44 vs. 45 Duration of symptoms: Mean not reported (4 weeks to 18 months by inclusion criteria); 38% vs. 35% acute (4 weeks to 4 months)	A vs. B: <u>Pain</u> Leg pain (mean improvement from baseline, 0-100 VAS): 12 vs. 10 at 3 weeks; 15 vs. 15 at 6 weeks; 13 vs. 18 at 12 weeks; 17 vs. 20 at 52 weeks (p>0.05 at all time points) Leg pain improved >50%: 35% (42/120) vs. 26% (28/108) at 3 weeks, RR 1.35 (95% CI 0.90 to 2.02); 47% (56/120) vs. 41% (44/108) at 6 weeks, RR 1.15 (95% CI 0.85 to 1.54); 43% (52/120) vs. 46% (50/108) at 12 weeks, RR 0.94 (95% CI 0.70 to 1.25); 48% (58/120) vs. 44% (48/108) at 52 weeks, RR 1.09 (95% CI 0.82 vs. 1.44) Back pain (mean improvement from baseline, 0-100 VAS): 6 vs. 2 at 3 weeks; 6 vs. 8 at 6 weeks; 4 vs. 7 at 12 weeks, 8 vs. 9 at 52 weeks <u>Function</u> ODI (mean improvement from baseline, 0-100): 10 vs. 7 at 3 weeks; 13 vs. 10 at 6 weeks; 12 vs. 12 at 12 weeks;16 vs. 14 at 52 weeks (p>0.05 at all time points) (p>0.05 at all time points)ODI (0-100, estimated from figure): 44 vs. 45 at baseline; 32 vs. 39 at 3 weeks (p=0.05); 31 vs. 35 at 6 weeks (p=0.15); 33 vs. 34 at 12 weeks (p=0.92), 29 vs. 33 at 52 weeks (p=0.55) ODI improved >75%: 12% (15/120) vs. 3.7% (4/108) at 3 weeks, RR 3.38 (95% CI 1.16 to 9.86); 15% (18/120) vs. 13% (14/108) at 6 weeks, RR 1.16 (95% CI 0.61 to 2.21); 16% (19/120) vs. 22% (24/108) at 12 weeks, RR 0.71 ((5% CI 0.41 to 1.23); 32% (38/120) vs. 30% (32/108) at 52 weeks, RR 1.07 (95% CI 0.72 to 1.58) SF-36: No statistically significant differences (data not reported)

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Arden, 2005[50] Price, 2005[51] 12 months Fair (Continued)						Other outcomes Surgery: 13% (15/120) vs. 13% (14/108) through 52 weeks, RR, 0.96 (95% CI 0.49 to 1.9) Physiotherapy: 26% vs. 23% over 52 weeks Other injections: 13% vs. 11% over 52 weeks HAD anxiety (mean improvement from baseline): 2 vs. 2 at 3 weeks; 2 vs. 2 at 6 weeks; 2 vs. 3 at 12 weeks; 3 vs. 3 at 52 weeks HAD depression (mean improvement from baseline): 1 vs. 1 at 3 weeks; 2 vs. 2 at 6 weeks; 2 vs. 2 at 12 weeks; 2 vs. 2 at 52 weeks Analgesic use (mean change in number consumed in a week, baseline 37 vs. 48): –6 vs. –11 at 3 weeks; –8 vs. –13 at 6 weeks; –9 vs. –16 at 12 weeks; –14 vs. –16 at 52 weeks Days off work with sciatica (median change, baseline 98 vs. 93): –21 vs. –21 at 3 weeks; –21 vs. –21 at 6 weeks; –37 vs. –23 at 12 weeks; –65 vs. –33 at 52 weeks
Aronsohn, 2010[52] 6 weeks Poor	Epidural corticosteroid vs. other	MRI or CT scans of disc herniation at L3-4, L4-5, or L5S-1	Randomized: 50 Analyzed: Unclear	A: Epidural injection (approach not reported) with 40 mg methylprednisolone plus 0.25% bupivacaine (3 ml), with fluoroscopic guidance (n=24) B: Lumbar discectomy using Stryker disc Dekompressor (n=26)	A vs. B: Age (mean): 51 vs. 41 years Male: 56% vs. 64% Baseline back pain (0-10): 7.1 vs. 7.5 Baseline radicular pain (0-10): 9.3 vs. 9.1 Baseline function: Not reported Duration of symptoms: Not reported	A vs. B: Pain Back pain (0-10 VAS): 7.1 vs. 7.5 at baseline; 6.7 vs. 3.0 at 1 week ($p<0.05$); 6.5 vs. 1.0 at 6 weeks ($p<0.05$) Radicular pain (0-10 VAS): 9.3 vs. 9.1 at baseline; 4.8 vs. 8.0 at 1 week ($p<0.05$); 2.0 vs. 7.1 at 6 weeks ($p<0.05$)

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Becker, 2007[53] 22 weeks Fair	Epidural corticosteroid vs. other dose	MRI or CT showing herniation of nucleus pulposus or scarring after previous surgery	Randomized: 84Analyzed: 83	A: Perineural epidural injection using oblique interlaminar approach with 10 mg triamcinolone plus unspecified local anesthetic (1 ml), with fluoroscopic guidance (n=24) B: Perineural epidural injection using oblique interlaminar approach with 5 mg triamcinolone plus unspecified local anesthetic (1 ml), with fluoroscopic guidance (n=24) C: Perineural epidural injection using oblique interlaminar approach with autologous conditioned serum (1 ml), with fluoroscopic guidance (n=24)	A vs. B vs. C:Age (mean): 54 years (reports no difference between groups) Male: Reports no difference between groups, data not provided Baseline pain: Not reported Baseline function: Not reported Duration of symptoms: Reports no difference between groups, data not provided	A vs. B vs. C: <u>Pain</u> Pain (mean, 0-100 VAS, estimated from graph): 84 vs. 82 vs. 78 at baseline; 30 vs. 29 vs. 35 at 4 weeks; 30 vs. 27 vs. 17 at 6 weeks; 22 vs. 33 vs. 22 at 22 weeks; mean difference A vs. B: –4.2 (95% CI –19 to 11); A vs. C: 9.3 (95% CI –4.9 to 24); for B vs. C: 14 (95% CI –0.4 to 27) <u>Function</u> ODI (mean, 0-50): 19 vs. 21 vs. 22 at baseline; 11 vs. 12 vs. 14 at 6 weeks; 11 vs. 12 vs. 11 at 10 weeks; 11 vs. 11 vs. 12 at 22 weeks (p>0.05 at all time points)
Beliveau, 1971[54] 1 week Poor	Epidural corticosteroid vs. placebo	Not specified	Randomized: 48 Analyzed: Unclear	A: Caudal epidural injection with 80 mg methylprednisolone (2 ml) + 0.5% procaine (40 ml) (n=24) B: Caudal epidural injection with 0.5% procaine (42 ml) (n=24)	A vs. B: Age (mean): 41 years (overall) Male: 75% Baseline pain: Not reported Baseline function: Not reported Duration of symptoms: Not reported	A vs. B: <u>Pain</u> Improved or completely relieved (clinician rated): 75% (18/24) vs. 67% (16/24), RR 1.13 (95% CI 0.78 to 1.62)

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Breivik, 1976[55] Unclear Poor	Epidural corticosteroid vs. placebo	Not specified	Randomized: 35 Analyzed: 35	A: Caudal epidural injection with 80 mg methylprednisolone and 0.25% cc bupivacaine (20 ml) (n=16) B: Caudal epidural injection with 0.25% bupivacaine (20 ml) followed by 100 cc saline (n=19)	A vs. B Age (mean): Not reported, range 30-63 years Male: 50% vs. 47% Baseline pain: Not reported Baseline function: Not reported Duration of symptoms: Not reported	A vs. B: Pain Pain relief "considerable" (defined as diminution of pain and/or paresis to enable return to work or rehabilitation for other work): 65% (9/16) vs. 26% (5/19) RR, 2.14 (95% CI 0.90 to 5.09)
Buchner, 2000[56] 6 months Fair	Epidural corticosteroid vs. placebo	Herniated disk ≥5 mm confirmed by MRI	Randomized: 36 Analyzed: 36	A: Interlaminar epidural injection with 100 mg methylprednisolone in 0.25% bupivacaine (10 ml) (n=17)B: No epidural injection (n=19)	A vs. B Age (mean): 37 vs. 32 years Male: 47% vs. 79% Baseline pain (0-100): 84 vs. 81 Hannover Functional Ability Questionnaire: 39% vs. 40% Duration of symptoms (weeks): median 8 vs. 8	A vs. B: Pain Pain (0-100 VAS): 84 vs. 81 at baseline; 31 vs. 37 at 2 weeks; 33 vs. 38 at 6 weeks; 33 vs. 39 at 6 months (p>0.05 at all time points) Function Hannover Functional Ability Questionnaire: 39% vs. 40% at baseline; 64% vs. 57% at 2 weeks; 62% vs. 58% at 6 weeks; 62% vs. 57% at 6 months (p>0.05 at all time points) Other outcomes Return to work: 88% (15/17) vs. 74% (14/19) at 6 months, RR: 1.20 (95% CI 0.87 to 1.65) Overall results "very good" or "good": 88% (15/17) vs. 74% (14/19), RR 1.20 (95% CI 0.87 to 1.65) at 6 months Surgery: 12% (2/17) vs. 21% (4/19) at 6 months, RR 0.56 (95% CI 0.12 to 2.68)

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Burgher, 2011[57] 4 weeks; 6 months for surgery outcome Fair	Epidural corticosteroid vs. other	Encroachment of disc material on a spinal nerve root as confirmed by CT or MRI	Randomized: 26 Analyzed: 23	A: Transforaminal epidural injection with 40 or 80 mg triamcinolone (2 ml) plus 2% lidocaine (1 ml), with fluoroscopic guidance (n=15) B: Transforaminal epidural injection with 200 or 400 mcg clonidine (2 ml) plus 2% lidocaine (1 ml), with fluoroscopic guidance (n = 11)	A vs. B: Age (mean): 50 vs. 44 years Male: 67% vs. 82% Baseline pain (0-10 NRS): 7.0 vs. 7.0 Baseline ODI (0-50): 29 vs. 31 Duration of symptoms (weeks): 5.3 vs. 5.0	A vs. B: <u>Pain</u> Pain, difference between groups compared with baseline (0-10 NRS): at 2 weeks, 0.11 (95% CI –1.79 to 2.01); at 4 weeks, 1.54 (95% CI –0.52 to 3.60) <u>Function</u> Roland Morris Disability Questionnaire, difference between groups compared with baseline: at 2 weeks, 2.96 (95% CI –1.04 to 6.96); at 4 weeks, 5.67 (95% CI 1.22 to 10.1) ODI, difference between groups compared with baseline: at 2 weeks, 5.86 (95% CI –0.57 to 12.3); at 4 weeks, 7.04 (95% CI 0.83 to 13.2) Multidimensional Pain Inventory, difference between groups compared with baseline: at 2 weeks, –4.83 (95% CI –0.57 to 12.3); at 4 weeks, –0.35 (95% CI –6.96 to 6.26) <u>Global Assessment</u> Patient Global Impression of Change ≤2 (much improved) at 4 weeks: 50% vs. 67% (p=0.669) <u>Other outcomes</u> Surgery: 6.7% (1/15) vs. 27% (3/11) at 6 months, 0.24 (95% CI) 0.30 to 2.05

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Bush, 1991[58] 1 year Fair	Epidural corticosteroid vs. placebo	Imaging findings not required	Randomized: 28Analyzed: 23	A: Caudal epidural injection with 80 mg triamcinolone acetonide in normal saline with 0.5% procaine hydrochloride (total 25 ml) (n=12) B: Caudal epidural injection with saline (25 ml) (n=11)	A vs. B: Age (mean): 38 vs. 37 years Male: 83% vs. 45% Baseline pain: Not reported Baseline function: Not reported Duration of symptoms: Not reported	A vs. B: <u>Pain</u> Pain (0-100 VAS): at 4 weeks 16 vs. 45 (p not reported); at 1 year 14 vs. 30 (p>0.05) <u>Function</u> Function/lifestyle (6-18 scale): at 4 weeks 16 vs. 14 (p not reported); at 1 year 17 vs. 16 (p>0.05) <u>Other outcomes</u> Surgery: 8.3% (1/12) vs.18% (2/11), RR 0.39 (95% CI 0.04 to 3.80)

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Buttermann, 2004[59] 2-3 years Poor	Epidural corticosteroid vs. other	Herniation >25% of cross-sectional area of the spinal canal on MRI or CT	Randomized: 100 Analyzed: 71	A: Interlaminar epidural injection with 10 to 15 mg betamethasone, with fluoroscopic guidance in 76% of patients (n=50) B: Discectomy (technique not specified) (n=50)	A vs. B: Age (mean): 41 vs. 40 years Male: Not reported Baseline back pain (0-10): 5.4 vs. 5.2 Baseline leg pain (0-10): 7.4 vs. 7.0 Baseline ODI (0-100): 47 vs. 48 Duration of symptoms (months): 3.3 vs. 3.8	A vs. B: <u>Pain</u> Back pain (mean, 0-10 VAS, estimated from graph): 5.4 vs. 5.2 at baseline, 3.0 vs. 2.0 at 1-3 months; 2.6 vs. 1.7 at 4-6 months; 2.3 vs. 1.8 at 7-12 months; 2.4 vs. 1.9 at 1-2 years; 1.8 vs. 2.4 at 2-3 years (p>0.05 at all time points) Leg pain (mean, 0-10 VAS, estimated from graph): 7.4 vs. 7.0 at baseline; 4.1 vs. 1.4 at 1-3 months; 2.7 vs. 1.2 at 4-6 months; 1.8 vs. 1.1 at 7-12 months; 1.7 vs. 1.2 at 1-2 years; 0.8 vs. 1.5 at 2- 3 years (p>0.05 at all time points) <u>Function</u> ODI (0-100): 47 vs. 48 at baseline; 34 vs. 22 at 1-3 months; 15 vs. 16 at 4-6 months; 14 vs. 14 at 7-12 months; 11 vs. 14 at 1-2 years; 8 vs. 16 at 2-3 years (p>0.05 at all time points except 1-3 months) Motor deficit (estimated from graph): 82% (41/50) vs. 88% (44/50) at baseline, RR, 0.93 (95% CI 0.79 to 1.10); 72% (36/50) vs. 38% (19/50) at 1-3 months, RR 1.89 (95% CI 1.28 to 2.81); 30% (8/27) vs. 20% (10/50) at 4-6 months, RR 1.48 (95% CI 0.66 to 3.31); 20% (5/25) vs. 12% (6/50) at 7-12 months, RR 1.67 (95%CI 0.56 to 4.93); 12% (3/24) vs. 8.0% (4/50) at 1-2 years, RR 1.56 (95% CI 0.38 to 6.43); 8.7% (2/23) vs. 4.0% (2/50) at 2-3 years, RR 2.17 (95% CI 0.33 to 14.5) <u>Other outcomes</u> Medication use "much less" (5 category scale, much less to much more): 16% (8/50) vs. 24% (12/50) at 1-3 months, RR 0.43 (95 % CI 0.23 to 0.78); 57% (13/23) vs. 32% (15/47) at 2-3 years, RR 1.77 (95 % CI 1.02 to 3.07)

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Candido, 2013[60] 12 months Fair	Approach	MRI	Randomized:106 Analyzed: 100	A. Lumbar epidural steroid injection of 120 mg methylprednisolone acetate (2 mL)+ 1 mL 1% lidocaine + 1 mL normal saline using a lateral parasagittal interlaminal approach, with fluoroscopic guidance B. Lumbar epidural steroid injection of 120 mg methylprednisolone acetate (2 mL)+ 1 mL 1% lidocaine + 1 mL normal saline using a midline interlamiar approach, with fluoroscopic guidance	A vs. B: Age (mean): 49 v. 49 years Male: 48% vs. 40% (p=0.5) Duration of symptoms: 14 vs. 14 months Baseline pain at rest (mean, 0-10 NRS): 4.9 vs. 5.1 Baseline pain during movement (mean, 0-10 NRS): 7.6 vs. 7.2 Baseline function (mean ODI, 0 to 100): 44.9% vs. 40.6% (p=NS)	A vs. B Pain Pain, Numeric Rating Scale at rest (NRS, 11-point scale, estimated from graph): at baseline, 4.9 vs. 5.1; at 14 days, 2.8 vs. 3; at 28 days, 2.7 vs. 3; at 60 days, 2.6 vs. 3.2; at 120 days, 2.6 vs. 3; at 180 days, 2 vs. 3.2; at 365 days, 2 vs. 3.2 (p>0.05) Pain, Numeric Rating Scale during movement (NRS, 11-point scale, estimated from graph): at baseline, 7.6 vs. 7.2; at 14 days, 3.3 vs. 4.5; at 28 days, 3.3 vs. 4.5; at 60 days, 3.7 vs. 5; at 120 days, 3.7 vs. 4.7; at 180 days, 3.7 vs. 5; at 365 days, 4 vs. 5 (p>0.05) Function ODI (scores 0-50 multiplied by 2 and presented as a percentage from 0-100%, estimated from graph): at baseline: 44.9% vs. 40.6% (p=NS); at 14 days, 25% vs. 28%; at 28 days, 23% vs. 27%; at 60 days, 22% vs. 25%; at 120 days, 24% vs. 27%; at 180 days, 21% vs. 31%; at 365 days, 20% vs. 33% (p>0.05) Other Outcomes Patient Satisfaction (5-point scale, where 1 = complete dissatisfaction and 5 = complete satisfaction, estimated from graph): at 1 day, 3.9 vs. 3.6; at 14 days, 4.1 vs. 2.9; at 28 days, 3.7 vs. 3.4; at 60 days, 3.7 vs. 3. 4; at 120 days, 3.5 vs. 3.3; at 180 days, 4 vs. 3.2; at 365 days, 4.1 vs. 3.2 (p-values not reported, but states "better satisfaction" in group A on days 7, 14, 180, and 365.)

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Candido, 2008[61] 6 months Fair	Approach	Not specified	Randomized: 60 Analyzed: 57	A: Posterolateral interlaminar epidural injection with 80 mg methylprednisolone plus lidocaine 1% (1 ml), with fluoroscopic guidance (n=30) B: Transforaminal epidural injection with 80 mg methylprednisolone plus lidocaine 1% (1 ml), with fluoroscopic guidance (n=30)	A vs. B: Age (mean): 52 vs. 52 years Male: 57% vs. 40% Baseline pain (0-10 VAS): 6.8 vs. 6.3 Baseline function: Not reported Duration of symptoms <3 months: 24% vs. 7.1%	A vs. B: Pain Pain intensity (mean, 0-100 VAS): 63 vs. 63 at baseline; 41 vs. 49 at 2 weeks (p=0.31); 52 vs. 53 at 1 month (p=0.94); 47 vs. 43 at 3 months (p=0.68); 41 vs. 47 at 6 months (p=0.46)

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Carette, 1997[62] 3 months Fair	Epidural corticosteroid vs. placebo	CT evidence of herniated disk	Randomized: 158 Analyzed: 156	A: Interlaminar epidural injection with 80 mg methylprednisolone (2 ml) plus isotonic saline (8 ml) (n=78) B: Interlaminar epidural injection with isotonic saline (1 ml) (n=80)	A vs. B: Age (mean): 39 vs. 41 years Male: 72% vs. 59% Baseline pain (0 to 100): 66 vs. 62 Baseline ODI (0 to 100): 50 vs. 50 Duration of symptoms (weeks): 12.9 vs. 13.0	A vs. B: *(differences are difference in change from baseline; ANCOVA results adjusted for male sex and living partner performed but reported as similar to unadjusted and not presented)* <u>Pain</u> Pain (0-100 VAS): 66 vs. 62 at baseline;45 vs. 49 at 3 weeks, difference –8.6 (95% CI –18 to 0.3); 39 vs. 40 at 3 months, difference –4.0 (95% CI –15 to 7.2) McGill Present Pain Intensity (0-5): 2.6 vs. 2.8 at baseline; 2.2 vs. 2.4 at 3 weeks, difference 0.0 (95% CI –0.4 to 0.4); 1.9 vs. 1.9 at 3 months, difference 0.2 (95% CI –0.3 to 0.7) McGill Pain-rating Index (0-77): 28 vs. 26 at baseline; 20 vs. 22 at 3 weeks; difference –3.4 (95% CI –8.1 to 1.3), 18 vs. 18 at 3 months, difference –1.2 (95% CI –7.2 to 4.9) <u>Function</u> ODI (0-100): 50 vs. 50 at baseline, 42 vs. 44 at 3 weeks, difference –2.5 (95% CI –7.1 to 2.2); 32 vs. 35 at 3 months, difference –1.9 (95% CI –9.3 to 5.4)ODI ≤20: 20% (15/77) vs. 16% (13/80) at 3 weeks, RR 1.20 (95% CI 0.61 to 2.35); 38% (29/77) vs. 42% (33/79) at 3 months, RR 0.90 (95% CI 0.61 to 1.33) Marked or very marked improvement: 33% (25/76) vs. 30% (23/78) at 3 weeks, RR 1.12 (95% CI 0.70 to 1.78); 55% (41/74) vs. 56% (43/77) at 3 months, RR 0.99 (95% CI 0.75 to 1.32) Sickness Impact Profile, Overall (0 to 100): 22 vs. 21 at baseline; 16 vs. 18 at 3 weeks; difference –2.5 (95% CI –5.1 to 0.1); 12 vs. 13 at 3 months, difference –1.2 (95% CI –5.2 to 2.8) (no differences on physical or psychosocial dimensions subscales)

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Carette, 1997[62] 3 months Fair (Continued)						Restricted activity in previous 2 weeks (number of days): 9.9 vs. 9.7 at baseline; 8.9 vs. 7.9 at 3 weeks; difference 0.8 (95% CI –0.6 to 2.2); 5.9 vs. 5.4 at 3 months; difference 0.3 (95% CI –1.8 to 2.5) Other outcomes Underwent surgery: 26% (n=77) vs. 25% (n=79) at 12 months (p=0.90, log-rank test) Returned to work within 3 months: 33% (14/43) vs. 44% (18/41), RR 0.74 (95% CI 0.43 to 1.29) Lack of efficacy withdrawal: 15% (12/78) vs. 25% (20/80) at 3 months, RR 0.62 (95% CI 0.32 to 1.17)
Cocelli, 2009[63] 6 months Fair	Epidural corticosteroid vs. epidural corticosteroid	Not specified	Randomized: 70 Analyzed: 70	A: Interlaminar epidural injection with 10 mg betamethasone diproprionate and 4 mg betamethasone sodium phosphate plus 0.125% bupivacaine (total 20 ml) (n=40) B: Interlaminar epidural injection with 80 mg triamcinolone acetonide plus 0.125% bupivacaine (total 20 ml) (n=40)	Age (mean): 49 vs. 50 years Male: 25% vs. 40% Baseline pain (0-10 VAS): 9.5 vs. 9.3 Baseline ODI (0-100): 51 vs. 62 Duration of symptoms (weeks): 3 vs. 3x	A vs. B: PainPain (0-10 VAS): 9.5 vs. 9.3 at baseline, 5.7 vs. 1.1 at 2 weeks; 0.8 vs. 0.0 at 6 weeks; 0.0 vs. 0.0 at 3 months; 0.0 vs. 0.0 at 6 months FunctionODI (0-100): 51 vs. 62 at baseline, 36 vs. 32 at 2 weeks; 25 vs. 23 at 6 weeks; 22 vs. 22 at 3 months; 19 vs. 20 at 6 months

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Cohen, 2012a[64] 1 month for primary outcomes Good	Epidural corticosteroid vs. placebo Epidural corticosteroid vs. other	MRI evidence of pathologic disc condition	Randomized: 84 Analyzed: 84	A. Transforaminal epidural injection with 60 mg methylprednisolone acetate in 2 ml sterile water and 0.5% bupivacaine (0.5 ml), with fluoroscopic guidance (n=28) B. Transforaminal epidural injection with 4 mg etanercept in 2 ml sterile water and 0.5% bupivacaine (0.5 ml), with fluoroscopic guidance (n=26) C. Transforaminal epidural injection with 2 ml sterile water and 0.5% bupivacaine (0.5 ml) , with fluoroscopic guidance (n=30)	A vs. B vs. C: Age (mean): 43 vs. 41 vs. 41 years Male: 79% vs. 69% vs. 63% Baseline leg pain (0-10): 5.71 vs. 6.62 vs. 6.31 Baseline back pain (0-10): 5.30 vs. 6.08 vs. 4.75 Baseline ODI (0-100): 42.93 vs. 41.12 vs. 40.87 Duration of symptoms (months): 2.61 vs. 2.67 vs. 2.82	A vs. B vs. C: <u>Pain</u> Leg Pain (0-10 NRS): 5.71 vs. 6.62 vs. 6.31 at baseline; 2.54 vs. 3.56 vs. 3.78 at 1 month, difference –1.26 (95% CI –2.79 to 0.27) for A vs. C, –1.01 (95% CI –2.60 to 0.58) for A vs. B Back pain (0-10 NRS): 5.30 vs. 6.08 vs. 4.75 at baseline, 3.49 vs. 4.41 vs. 4.01 at 1 month, difference –0.52 (95% CI –1.85 to 0.81) for A vs. C, –0.92 (95% CI –2.28 to 0.44) for A vs. B <u>Function</u> ODI (0-100): 42.9 vs. 41.1 vs. 40.9 at baseline, 24.1 vs. 40.3 vs. 30.0 at 1 month, difference –5.87 (95% CI –15.6 to 3.85) for A vs. C, –16.2 (95% CI –26.0 to –6.27) for A vs. B <u>Global Assessment</u> Global Perceived Effect positive (pain improved and patient satisfied): at 1 month: 82% (23/28) vs. 58% (15/26) vs. 57% (17/30) (p=0.14); A vs. B adjusted OR 3.16 (95% CI 0.88 to 11.3), A vs. C adjusted OR 3.12 (95% CI 0.91 to 10.8), B vs. C adjusted OR 0.99 (95% CI 0.33 to 2.94); 65% vs. 50% vs. 48% at 3 months, 63% vs. 45% vs. 48% at 6 months Success (≥50% decrease in leg pain and positive Global Perceived Effect): at 1 month 75% (21/28) vs. 42% (11/26) vs. 50% (15/30), A vs. C adjusted OR 3.63 (95% CI 1.10 to 12.0), A vs. B adjusted OR 2.62 (95% CI 0.82 to 8.37), B vs. C adjusted OR 0.72 (95% CI 0.24 to 2.16); at 3 months 50% (14/28) vs. 42% (11/26) vs. 43% (13/30); at 6 months 29% (8/28) vs. 38% (10/26) vs. 40% (12/30), A vs. B RR 0.74 (95% CI 0.35 to 1.59), A vs. C RR 0.71 (95% CI 0.34 to 1.48), B vs. C RR 0.96 (95 % CI 0.50 to 1.85)

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Cohen, 2012a[64] 1 month for primary outcomes Good (Continued)						Other Outcomes Surgery: at 12 months 21% (6/28) vs. 23% (6/26) vs. 17% (5/30); A vs. B RR 0.93 (95% CI 0.34 to 2.52), A vs. C RR 1.29 (95% CI 0.44 to 3.74), B vs. C RR 1.38 (95% CI 0.48 to 4.01) Remained on active duty: at 12 months 100% (15/15) vs. 93% (13/14) vs. 90% (17/19); A vs. B: RR 1.04 (95% CI 0.61 to 1.77); A vs. C: RR 1.06 (95% CI 0.64 to 1.74); B vs. C: RR 1.06 (95% CI 0.64 to 1.74) Analgesic use decreased ≥20%: 63% (17/28) vs. 36% (9/30) vs. 50% (14/30) at 1 month (p=0.24), A vs. B adjusted OR 3.0 (95% CI 0.83 to 10.8), A vs. C adjusted OR 1.67 (95% CI 0.48 to 5.77), B vs. C adjusted OR 0.56 (95% CI 0.16 to 1.89); 92% (11/12) vs. 65% (7/11) vs. 75% (9/12) at 6 months, A vs. B RR 1.44 (95% CI 0.89 to 2.32), A vs. C RR 1.22 (95% CI 0.85 to 1.76), B vs. C RR 0.84 (95% CI 0.49 to 1.47)

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Cohen, 2012b[65] 3 months Fair	Fluoroscopy vs. no fluoroscopy	MRI findings of lumbosacral radiculopathy	Randomized: 132 Analyzed: 132	A: Transforaminal epidural injection with 60 mg methylprednisolone, 0.25% bupivacaine (1 ml), and saline (0.5 ml) (total 3 ml) or interlaminar epidural injection with 60 mg methylprednisolone, 0.25% bupivacaine (1 ml), and saline (1.5 ml) (total 4 ml), with fluoroscopic guidance; treatment and level based on MRI findings (n=67) B: Injection as above, based on history and physical examination findings (n=65)	A vs. B: Age (mean): 51 vs. 53 Male: 42% vs. 45% Baseline leg pain (0-10 NRS): 6.6 vs. 6.7 Baseline back pain (0-10 NRS): 6.1 vs. 6.1 Baseline ODI (0-100): 44 vs. 45 Duration of symptoms (years): 1.5 vs. 1.6	A vs. B: <u>Pain</u> Leg pain (0-10 NRS): 6.6 vs. 6.7 at baseline, 3.6 vs. 4.4 at 1 month (p=0.12), 2.7 vs. 3.0 at 3 months (p=0.77) Back pain (0-10 NRS): 6.1 vs. 6.1 at baseline, 4.0 vs. 4.6 at 1 m (p=0.21), 3.2 vs. 3.5 at 3 m (p=0.81) <u>Function</u> ODI (0-100): 44 vs. 45 at baseline, 35 vs. 35 at 1 month (p=0.98), 30 vs. 31 at 3 months (p=0.79) Medication reduction: 48% (26/67) vs. 27% (14/65) at 1 month (p=0.02); 57% (17/67) vs. 56% (14/65) at 3 months (p=0.96) <u>Global assessment</u> Global Perceived Effect positive: 69% (42/67) vs. 55% (36/65) at 1 month (p=0.12), 53% (26/67) vs. 40% (24/65) at 3 months (p=0.17) Overall success (≥2 point decrease in leg pain plus positive Global Perceived Effect): 41% (24/67) vs. 35% (23/65) at 3 months (p=0.54) No statistically significant effect of age, sex, type of injection, duration of pain, opioid use, baseline ODI, or baseline pain on likelihood of success

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Cuckler, 1985[66] 13-30 months Fair	Epidural corticosteroid vs. placebo	Not required	Randomized: 73 Analyzed: 73	A: Interlaminar epidural injection with 80 mg methylprednisolone (2 ml) and 1% procaine (5 ml) (n=42) B: Interlaminar epidural injection with saline (2 ml) and 1% procaine (5 ml) (n=31)	A vs. B: Age (years): 49 vs. 50 Male: 48% vs. 55% Baseline pain: Not reported Baseline function: Not reported Duration of symptoms (months): 17.3 vs. 13.8	A vs. B: <u>Pain</u> Pain improved ≥75%: 26% (11/42) vs. 13% (4/31) at mean 20 months, RR 2.40 (95% CI 0.93 to 6.58) Pain improved ≥75%, herniated disc patients: 26% (6/23) vs. 15% (2/13) at mean 20 months, RR 1.94 (95% CI 0.56 to 7.66) <u>Other outcomes</u> Surgery: 38% (16/42) vs. 29% (9/31) at mean 20 months, RR 1.50 (95% CI 0.86 to 2.81) Surgery (herniated disk): 43% (10/23) vs. 23% (3/13) at mean 20 months, RR 2.56 (95% CI 1.12 to 7.35)
Dashfield, 2005[67] 6 months Fair	Epidural corticosteroid vs. placebo	Not required	Randomized: 60 Analyzed: 52	A: Caudal epidural injection with triamcinolone 40 mg plus 1% lidocaine (10 ml), with fluoroscopic guidance (n=33) B: Epidural injection with 40 mg triamcinolone plus 1% lidocaine (10 ml) and saline (50 to 150 ml), via sacral approach with spinal endoscopic guidance (n=27)	A vs. B:Age (mean): 48 vs. 45 years Male: 51% vs. 37% Baseline pain (0 - 10): 6.6 vs. 7.2 Baseline function: Not reported Duration of symptoms (months): 9.4 vs. 10.1	A vs. B: <u>Pain</u> Pain (mean, 0-10): 6.6 vs. 7.2 at baseline; 5.7 vs. 6.7 at 6 weeks; 5.4 vs. 6.4 at 3 months; 5.2 vs. 6.0 at 6 monthsShort-form McGill Pain Questionnaire, sensory subscale (scale not reported): 14.8 vs. 15.5 at baseline; 13.9 vs. 16.0 at 6 weeks; 13.1 vs. 16.4 at 3 months; 12.5 vs. 16.0 at 6 months Short-form McGill Pain Questionnaire affective subscale (scale not reported): 4.2 vs. 5.9 at baseline; 4.7 vs. 4.9 at 6 weeks; 4.6 vs. 6.6 at 3 months; 4.2 vs. 5.9 at 6 months Present Pain Intensity (0-10): 2.8 vs. 3.5 at baseline; 2.3 vs. 2.6 at 6 weeks; 2.1 vs. 3.1 at 3 months; 2.0 vs. 2.5 at 6 months <u>Other outcomes</u> HAD-anxiety (0-21): 10.9 vs. 103 at baseline; 9.3 vs.10.0 at 6 weeks; 8.4 vs. 9.6 at 3 months; 7.8 vs. 8.7 at 6 months HAD-depression (0-21): 8.4 vs. 9.0 at baseline; 8.2 vs. 8.0 at 6 weeks; 7.7 vs. 8.0 at 3 months; 7.0 vs. 7.9 at 6 months

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Datta, 2011[68] 3 months Poor	Epidural corticosteroid vs. placebo Epidural corticosteroid vs. epidural corticosteroid	CT evidence of herniated disc	Randomized: 207 Analyzed: 163	A: Caudal epidural injection with 80 mg methylprednisolone plus 0.125% bupivacaine (10-15 ml) (n=50) B: Caudal epidural injection with 80 mg triamcinolone plus 0.125% bupivacaine (10-15 ml) (n=52) C: Caudal epidural injection with 15 mg dexamethasone plus 0.125% bupivacaine (10-15 ml) (n=50) D: Caudal epidural injection with 0.125% bupivacaine (10-15 ml) (n=55)	A vs. B vs. C vs. D: Age (mean): 40 vs. 39 vs. 42 vs. 43 years Male: 92% vs. 94% vs. 90% vs. 91% Baseline pain (0-10 VAS): 7.5 vs. 7.4 vs. 7.3 vs. 7.2 Baseline RDQ (0-24): 21 vs. 22 vs. 21 vs. 22 Duration of leg pain (weeks): 16 vs. 17 vs. 16 vs. 16	A vs. B vs. C vs. D: <u>Pain</u> Pain (0-10 VAS): 7.4 vs. 7.4 vs. 7.3 vs. 7.2 at baseline; 6.3 vs. 6.3 vs. 6.4 vs. 6.8 at 3 weeks; 4.9 vs. 4.8 vs. 5.2 vs. 6.2 at 12 weeks Complete pain relief (complete, incomplete but satisfactory, unsatisfactory): at 12 weeks: A vs. B: 43% (17/39) vs. (18/42), RR 1.45 (95% CI 0.86 to 2.60) A vs. C: 43% (17/39) vs. 38% (15/40), RR 1.16 (95% CI 0.68 to 1.99) A vs. D: 43% (17/39) vs. 26% (11/42), RR 1.66 (95% CI 0.89 to 3.10) <u>Function</u> RDQ improved >5 points (percent improvement, 0-24): at 3 weeks, 41% (16/39) vs. 40% (17/42) vs. 35% (14/40) vs. 38% (16/42): A vs. B: (16/39) vs. 40% (17/42), RR 1.66 (95% CI 0.60 to 1.71) A vs. C: 41% (16/39) vs. 35% (14/40), RR 1.17 (95% CI 0.67 to 2.06) A vs. D: (16/39) vs. 38% (16/42), RR 1.17 (95% CI 0.63 to 1.84) at 12 weeks: 69% (27/39) vs. 71% (30/42) vs. 62% (25/40) vs. 24% (10/42): A vs. B: 69% (27/39) vs. 71% (30/42), RR 0.97 (95% CI 0.73 to 1.29) A vs. C: 69% (27/39) vs. 62% (25/40), RR 1.11 (95% CI 0.81 to 1.52) A vs. D: 69% (27/39) vs. 24% (10/42): RR, 2.91(95% CI 1.63 to 5.19)

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Datta, 2011[68] 3 months Poor (Continued)						<u>Other outcomes</u> Use of diclofenac (tablets/day): 3.8 vs. 3.3 vs. 4.0 vs. 4.8 at 3 weeks; 18 vs. 17 vs. 18 vs. 26 at 12 weeks Use of physiotherapy: 25% (9/39) vs. 17% (7/42) vs. 30% (12/40) vs. 45% (19/42) at 6 weeks; 15% (6/39) vs. 12% (5/42) vs. 25% (10/40) vs. 38% (16/42) from 6 weeks to 3 months Sensory deficits: 13% (5/39) vs. 21% (9/42) vs. 28% (11/40) vs. 48% (20/42) at 3 months Underwent surgery: 6.0% (3/50) vs. 7.7% (4/52) vs. 6.0% (3/50) vs. 16% (9/55) at 3 months

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Dilke, 1973[69] 3 months Fair	Epidural corticosteroid vs. placebo	Not required	Randomized: 100Analyzed: 82	A: Interlaminar epidural injection with 80 mg methylprednisolone in saline (10 ml) B: Interspinous ligament injection with saline (1 ml)	A vs. B: Age (mean): 39 vs. 42 yearsMale: 53% vs. 58% Baseline pain: Not reported Baseline function: Not reported Duration of symptoms >4 weeks: 90% vs. 90%	A vs. B: <u>Pain</u> Pain clearly relieved during admission (clearly relieved, clearly not relieved, or intermediate): 31% (16/51) vs. 8% (4/43), RR 3.37 (95% CI 1.21 to 9.33) Pain assessment "none" (none, not severe, severe): 36% (16/44) vs. 21% (8/38) at 3 months, RR 1.72 (95% CI 0.83 to 3.58) Pain assessment "none" or "not severe": 91% (40/44) vs. 74% (28/38) at 3 months, RR 1.23 (95 % CI 0.10 to 1.52) <u>Other outcomes</u> Full bed rest (days): 8.25 vs. 8.61 (p>0.05)Time to institution of spinal mobility exercises (days): 18.4 vs. 20.4 (NS)Time in hospital (days): 25.2 vs. 28.0 (p>0.05) Not resumed work at 3 months: 8.3% (3/36) vs. 40% (14/35), RR 0.21 (95 % CI 0.07 to 0.66) Analgesic consumption "none" (none, less than daily, daily) at 3 months: 50% (19/38) vs. 38% (11/29), RR 1.32 ((95 % CI 0.75 to 2.32) Underwent surgery at 3 months: 14% (7/51) vs. 21% (10/48), RR 0.66 (95% CI 0.27 to 1.59) Underwent second injection at 3 months: 31% (16/51) vs. 48% (23/48), RR 0.65 (95% CI 0.40 to 1.08) Underwent other conservative treatment at 3 months: 18% (9/51) vs. 29% (14/48), RR 0.61 (95% CI 0.29 to 1.27)

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Gerstzen, 2010[70] 2 years Fair	Epidural corticosteroid vs. other	Imaging evidence of focal lumbar disc protrusion	Randomized: 90 Analyzed: 85	A: Transforaminal epidural injection with corticosteroid, medication type (methylprednisolone acetate, betamethasone, methylprednisolone, triamcinolone acetonide) and dose left to discretion of clinician, with fluoroscopic guidance (n=44) B: Plasma disc decompression procedure with Coblation DLR or DLG Spine Wand surgical device, with fluoroscopic guidance (n=46)	A vs. B: Age (mean): 42 vs. 46 years Male: 52% vs. 47% Baseline leg pain (0-100 VAS): 75 vs. 72 Baseline back pain (0-100 VAS): 53 vs. 44 Baseline ODI (0-100): 43 vs. 42 Duration of symptoms (months): median 24 vs. 12	A vs. B: <u>Pain</u> Leg pain (mean change, 0-100 VAS): at 6 weeks –21 vs. –42 (p=0.002), at 3 months –23 vs. –46 (p=0.0001), at 6 months –21 vs. –47 (p=0.0008) Leg pain improved ≥25 points: at 6 months 21% (8/39) vs. 49% (21/43), RR 0.42 (95% CI 0.21 to 0.83); at 1 year 18% (7/39) vs. 44% (19/43), RR 0.42 (95% CI 0.21 to 0.84); at 2 years 21% (8/39) vs. 42% (18/43), RR 0.49 (95% CI 0.24 to 1.0) Back pain (mean change, 0-100 VAS): at 6 weeks 1 vs. –18 (p=0.0005), at 3 months 7 vs. –17 (p=0.0001); at 6 months –0.4 vs. –21 at 6 months (p=0.002) Back pain improved ≥12 points: at 6 months 22% (8/36) vs. 49% (19/39), RR 0.46 (95% CI 0.23 to 0.91); at 1 year 11% (4/36) vs. 39% (15/39), RR 0.26 (95 % CI 0.11 to 0.79); at 2 years 17% (6/36) vs. 39% (15/39), RR 0.43 (95% CI 0.19 to 1.0) <u>Function</u> ODI (mean change, 0-100): at 6 weeks –5 vs. –13 at 6 weeks (p=0.002); at 3 months –2 vs. –11 (p=0.002); at 6 months –4 vs. –14 (p=0.002) ODI improved ≥13 points: at 6 months15% (6/40) vs. 32% (14/44), RR 0.47 (95% CI 0.20 to 1.10); at 1 year 10% (4/40) vs. 25% (11/44), RR 0.40 (95 % CI 0.14 to 1.16); at 2 years 10% (4/40) vs. 30% (13/44), RR 0.34 (95 % CI 0.12 to 0.95)

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Gerstzen, 2010[70] 2 years Fair (Continued)						SF-36 improved ≥5 points: at 6 months 21% (8/39) vs. 37% (16/43), RR 0.55 (95% CI 0.27 to 1.14); at 1 year 13% (5/39) vs. 33% (14/43), RR 0.39 (95% CI 0.16 to 0.99); at 2 years 13% (5/39) vs. 33% (14/43), RR 0.39 (95% CI 0.16 to 0.99) <u>Other outcomes</u> Patient satisfaction "extremely satisfied": 15% vs. 38% Did not undergo secondary procedure: 17% vs. 52%, adjusted HR 2.0 (p=0.025) Surgery (not including plasma disc decompression): through 2 years: 5% (2/40) vs.11% (5/45), RR 0.45 (95% CI 0.09 to 2.19)

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Ghahreman, 2010[71] Ghahreman, 2011[72] 12 months Good	Epidural corticosteroid vs. placebo	Required	Randomized: 150 Analyzed: 150	A: Transforaminal injection with 40 mg/ml triamcinolone (1.75 ml) plus 0.5% bupivacaine (0.75 ml), with fluoroscopic guidance (n=28) B: Transforaminal injection of 0.5% bupivacaine (2 ml), with fluoroscopic guidance (n=27) C: Transforaminal injection of normal saline (2 ml), with fluoroscopic guidance (n=37) D: Intramuscular injection of40 mg/ml triamcinolone (1.75 ml), with fluoroscopic guidance (n=28) E. Intramuscular injection of normal saline (2 ml), with fluoroscopic guidance (n=30)	A vs. B vs. C vs. D vs. E: Age (median): 49 vs. 44 vs. 43 vs. 49 vs. 46 years Male: 61% vs. 51% vs. 63% vs. 54% vs. 70% Baseline leg pain (median, 0-10): 7 vs. 7 vs. 7 vs. 7 vs. 8 Baseline Roland Morris score (median, 0-24): 17 vs. 17 vs. 19 vs. 17 vs. 15 Duration of symptoms: Mean not reported, range 2 to 560 weeks	A vs. B vs. C vs. D vs. E: Pain Pain (mean, 0-10): at baseline 7.0 vs. 7.4 vs. 6.6 vs. 7.6 vs. 7.0; at 1 month 4.1 vs. 6.7 vs. 5.5 vs. 5.9 vs. 6.0, difference –2.9 vs. –0.7 vs. –1.1 vs. –1.7 vs. –1.0, A vs. C (p=0.07); A vs. B, D, or E (p<0.05); for other comparisons: (p>0.05) Achieved >=50% pain relief: at 1 month 54% (15/28) vs. 7.4% (2/27) vs.19% (7/37) vs. 21% (6/28) vs. 13% (4/30): A vs. B: RR, 7.23 (95% CI 1.82 to 28.67; A vs. C: RR, 2.83 (95% CI 1.33 to 6.00; A vs. D: RR, 2.50 (95% CI 1.14 to 5.50; A vs. E, RR 4.02 (95% CI 1.52 to 10.66): (p>0.05); B vs. C, RR 0.39 95% CI 0.89 to 1.73; B vs. D, RR 0.35 (95% CI 0.08 to 1.57); B vs. E, RR 0.56 (95% CI 0.11 to 2.80): C vs. D, RR 0.88 (95% CI 0.33 to 2.34); C vs. E, RR 1.42 (95% CI 0.46 to 4.39); D vs. E, RR 1.61 (95% CI 0.51 to 5.10); no interaction between duration of symptoms, presence of sensory changes or neurologic signs, location [central or paracentral versus foraminal] or level affected, type of herniation (broad-based bulge, focal protrusion, extrusion, sequestration), dimensions of herniation (thickness, cross-section area of herniation or vertebral canal, ratio area of herniation and spinal canal), or presence of degenerative changes; low grade nerve root compression 75% (30/40) and high grade 26% (8/31), p for difference in estimates <0.0005 Function Patient-specified Functional Outcome Scale (median, 0-12): at 1 month 8 vs. 6 vs. 6 vs. 10 vs. 10 (p>0.05)

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Ghahreman, 2010[71] Ghahreman, 2011[72] 12 months Good (Continued)						Other outcomes Underwent surgery at 12 months: 36% (10/28) vs. 26% (7/27) vs. 26% (7/27) vs. 21% (6/28) vs. 30% (9/30): A vs. B, RR 1.38 (95% CI 0.61 to 3.09); A vs. C, RR 1.38 (95% CI 0.61 to 3.09); A vs. D, RR 1.67 95% CI 0.70 to 3.10; A vs. E, RR 1.19 (95% CI 0.57 to 2.49); B vs. C, RR 1.00 (95% CI 0.39 to 2.54); B vs. D, RR 0.96 (95% CI 0.36 to 2.53); B vs. E, RR 0.69 (95% CI 0.29 to 1.62); C vs. D, RR 0.96 (95% CI 0.36 to 2.53); C vs. E, RR 0.69 (95% CI 0.29 to 1.62); D vs. E, RR 0.71 (95% CI 0.29 to 1.75) Underwent rescue transforaminal injection with steroid at 12 months: 14% (4/28) vs.67% (18/27) vs. 61% (23/38) vs. 64% (18/28) vs.73% (22/30): A vs. B, RR 0.21 (95% CI 0.83 to 0.55); A vs. C, RR 0.24 (95% CI 0.09 to 3.09); A vs. D, RR 0.22 95% CI 0.09 to 0.57; A vs. E, RR 0.19 (95% CI 0.07 to 0.50); B vs. C, RR 1.10 (95% CI 0.76 to 1.60); B vs. D, RR 1.04 (95% CI 0.71 to 1.52); B vs. E, RR 0.91 (95% CI 0.65 to 1.28); C vs. D, RR 0.94 (95% CI 0.65 to1.37); C vs. E, RR 0.83 (95% CI 0.59 to 1.62); D vs. E, RR 0.83 (95% CI 0.59 to 1.12) No differences in health care utilization No effect of chronicity on response to treatment

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Ghai, 2014[73] 12 months Good	Approach	MRI	Randomized: 62 Analyzed: 62	A. Parasagittal epidural injection with 80 mg methylprednisolone (2 ml) plus normal saline) 2 ml B. Transforaminal epidural injection with 80 methylprednisolone (2 ml) plus normal saline (2 ml), with fluoroscopic guidance	A vs. B: Age (mean): 43 vs. 46 years Male: 53% vs. 63% Duration of symptoms (months); 25 vs. 30 Baseline pain (0-100 VAS): 73 vs. 74 Modified ODI (0 to 100): 31 vs. 29	A vs. B: Pain Pain score (mean, VAS 0-100, estimated from graph): at baseline, 73 vs. 73 (p=0.56); at 15 days, 38 vs. 45 (p=0.63); at 1 month, 36 vs. 39 (p=0.61); at 2 months, 36 vs. 36 (p=0.59); at 3 months, 35 vs. 35 (p=0.64); at 6 months, 34 vs. 34 (p=0.56); at 9 months, 33 vs. 33 (p=0.23); at 12 months, 33 vs. 31 (p=0.79) >50% pain relief from baseline using VAS: at 15 days, 65.6% vs. 50% (p=0.3); at 1 month, 72% vs. 63% (p=0.59); at 2 months, 69% vs. 73% (p=0.78); at 3 months, 78% vs. 77% (p=1.0); at 6 months, 75% vs. 77% (p=1.0); at 9 months, 78% vs. 73% (p=0.77); at 12 months, 69% vs. 77% (p=0.57) Function Modified ODI (estimated from graph): at baseline, 32 vs. 29 (p=0.18); at 15 days, 21 vs. 20 (p=0.29); at 1 month, 19 vs. 18 (p=0.38); at 2 months, 19 vs. 17 (0.38); at 3 months, 20 vs. 18 (p=0.60); at 6 months, 19 vs. 17 (p=0.36); at 9 months, 18 vs. 17 (p=0.52); at 12 months, 18 vs. 17 (p=0.45) Other outcomes: Patient satisfaction: Patient Global Impression of Change Scale (7-point scale where 1-3 = improved, 4 = no change, 5-7 = worse since study start): % improved at 3 months, 78% (25/32) vs/ 77% (23/30); at 6 months, 75% (24/32) vs. 80% (24/30); at 9 months, 78% (25/32) vs. 77% (23/30); at 12 months, 78% (25/32) vs. 80% (24/30) (p>0.05 for all)

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Ghai, 2013[74] 6 months Fair	Approach	MRI performed in all patients	Randomized: 37 Analyzed: 37	A: Parasagittal interlaminar injection with 80 mg methylprednisolone (2 ml) plus normal saline (2 ml), with fluoroscopic guidance (n=19) B: Midline interlaminar injection with 80 mg methylprednisolone (2 ml) plus normal saline (2 ml), with fluoroscopic guidance (n=18)	A vs. B: Age (mean): 41 vs. 42 years Male: 68% vs. 50% Baseline pain (0-100 VAS): 69 vs. 71 Modified ODI (0 to 100): 42 vs. 49 Duration of symptoms (months); 13 vs. 14	A vs. B: <u>Pain</u> Pain score (mean, VAS 0-100, estimated from graph): at baseline, 69 vs. 71; at 15 days, 29 vs. 49; at 1 month, 28 vs. 50; at 3 months, 30 vs. 48; at 6 months, 31 vs. 51, ($p<0.05$ at all time points) 50% pain relief: at 15 days 79%(15/19) vs. 39% (7/18) RR, 2.03 (95 % CI 1.09 to 3.78); at 1 month 79% (15/19) vs. 39% (7/18) RR 2.03 (95 % CI 1.09 to 3.78); at 3 months 79% (15/19) vs. 39% (7/18) RR, 2.03 (95 % CI 1.09 to 3.78); at 6 months 68% (13/19) vs.17% (3/18), RR 4.1 (95% CI 1.4 to 12) <u>Function</u> ODI (mean, 0-100, estimated from graph): at baseline, 42 vs. 49; at 15 days, 27 vs. 40; at 1 month, 27 vs. 41; at 3 months, 30 vs. 42; at 6 months, 30 vs. 43, ($p<0.05$ at all time points)
Gharibo, 2011[75] 10-16 days Fair	Approach	Imaging correlation on CT or MRI	Randomized: 42 Analyzed: 38	A: Transforaminal epidural injection with 40 mg triamcinolone diacetate (1 ml) plus 0.25% bupivacaine (1 ml) at two levels, with fluoroscopic guidance (n=21)B: Interlaminar epidural injection with 80 mg triamcinolone diacetate (2 ml) plus 0.25% bupivacaine (2 ml), with fluoroscopic guidance (n=21)	A vs. B:Age (mean): 48 vs. 51 yearsMale: 55% vs. 72%Baseline pain (0-10): 6.4 vs. 7.0Baseline ODI (0-50): 38 vs. 38Duration of symptoms: Not reported	A vs. B:<u>Pain</u>Pain (mean, 0-10 NRS): 6.4 vs. 7.0 at baseline, 1.7 vs. 3.9 at 10-16 days ($p<0.05$)<u>Function</u>ODI (mean, 0-50): 38 vs. 38 at baseline, 22 vs. 13 at 10-16 days ($p<0.05$)<u>Other outcomes</u>Depression (scale not reported): 4.1 vs. 4.4 at baseline, 1.7 vs. 2.2 at 10-16 days ($p<0.05$)Walking distance (blocks): 8.9 vs. 8.1 at baseline, 11.8 vs. 10.6 at 10-16 days ($p<0.05$ base on 1-sided test)

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Habib 2013[77] 4 weeks Poor	Epidural injection with different doses of corticosteroid	Imaging findings not required	Randomized: 42 (21 vs. 21) Analyzed: 35 at 4 w	A: Epidural injection with 80 mg methylprednisolone acetate, approach and other details not provided (n=21) B: Epidural injection with 40 mg methylprednisolone acetate, approach and other details not provided (n=21)	A vs. B: Age (mean): 53 vs. 51 Male: 62% vs. 76% Duration of back pain: 2.9 vs. 3.4 years Baseline VAS (0-100): 80 vs. 78	A vs. B Pain ≥30% improvement in 0-100 VAS: 62% (13/21) vs. 47% (9/19) at w 1 (p=0.362); 56% (10/18) vs. 35% (7/20) (p=0.210) at w 3, 39% (7/18) vs. 6% (1/17) at w 4 (p=0.049) Other outcomes Serum cortisol levels and number of patients with secondary adrenal insufficiency (serum corticol <18 ng/ml 30 minutes after ACTH stimulation test): 86% (18/21) vs. 53% (10/19) at w 1 (p=0.024), 22% (4/18) vs. 15% (3/20) at w 3 (p=0.87), 17% (3/18) vs. 12% (2/17) at w 4 (p=0.72)
Helliwell, 1985[76] 3 months Poor	Epidural corticosteroid vs. placebo	Radiograph of lumbar spine	Randomized: 39 Analyzed: 39	A: Interlaminar epidural injection with 80 mg methylprednisolone in saline (10 ml) (n=20) B: Interspinous ligament injection with saline (5 ml) (n=19)	A vs. B: Age (mean): 45 vs. 47 years Male: 25% vs. 20% Baseline pain: Not reported Baseline function: Not reported Duration of symptoms (months): 8.5 vs. 13	A vs. B: <u>Pain</u> Pain, mean change from baseline (0-10 VAS, estimated from figure): at 1 month –2.6 vs. –0.7; at 3 months –2.7 vs. –0.3 (p<0.01 at both time points) <u>Other outcomes</u> Analgesic consumption decreased by ≥50%: at 3 months 64% (7/11) vs. 40% (4/10), RR 1.6 (95% CI 0.69 to 4.1) Overall outcome "definite improvement" (vs. no improvement): at 3 months 70% 14/20 vs. 26% (5/19) RR, 2.7 (95% CI 1.3 to 6.2)

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Iversen, 2011[78] 1 year Good	Epidural corticosteroid vs. placebo Epidural corticosteroid vs. other	MRI or CT	Randomized: 116Analyzed: 116	A: Caudal epidural injection with 40 mg triamcinolone in 0.9% saline (29 ml), with ultrasound guidance (n=37) B: Caudal epidural injection with 0.9% saline (30 ml), with ultrasound guidance (n=39) C: Subcutaneous injection superficial to the sacral hiatus and outside spinal canal with 0.9% saline (2 ml), with ultrasound guidance (n=40)	A vs. B vs. C:Age (mean): 40 vs. 43 vs. 43 yearsMale: 54% vs. 62% vs. 60% Baseline back pain (0-100 VAS): 47 vs. 50 vs. 46 Baseline leg pain (0-100 VAS): 50 vs. 54 vs. 48 Baseline ODI (0-50): 32 vs. 31 vs. 26 Duration of leg pain (weeks): 42 vs. 57 vs. 27	A vs. B vs. C: <u>Pain</u> Leg pain: at 6 weeks 3.2 (–9.1 to 16) ; at 12 weeks 2.5 (–9.6 to 15); at 52 weeks 3.1 (–9.6 to 16)Low back pain: at 6 weeks –5.0 (–17 to 6.7); at 12 weeks –7.8 (–19 to 3.8); at 52 weeks –2.0 (–14 to 10) EuroQol: at 6 weeks –0.02 (–0.13 to 0.09); at 12 weeks –0.05 (–0.17 to 0.06); at 52 weeks –0.01 (–0.12 to 0.11) A vs. C: <u>Function</u> ODI: (mean difference, 0-50) A vs. B: at 6 weeks; –0.5 (–6.3 to 5.4); at 12 weeks; 1.4 (–4.5 to 7.2); at 52 weeks; –1.9 (–8.0 to 4.3); A vs. C: at 6 weeks; –2.9 (–9.7 to 3.0); at 12 weeks; 4.0 (–1.9 to 9.9); at 52 weeks; 1.9 (–4.2 to 8.0) EuroQol: (mean difference, –0.594 to 1) A vs. B: at 6 weeks; –0.02 (–0.13 to 0.09); at 12 weeks; –0.05 (–0.17 to 0.06); at 52 weeks; –0.01 (–0.12 to 0.11). A vs. C: at 6 weeks; –0.05 (–0.16 to 0.06); at 12 weeks; –0.12 (–0.23 to –0.00); at 52 weeks; –0.05 (–0.17 to 0.06) <u>Other outcomes</u> Morphine use at 6 weeks: 8.1% (3/37) vs. 17% (6/35) vs. 11% (4/37): A vs. B RR 0.47 (95% CI 0.13 to 1.74); A vs. C RR 0.75 (95% CI 0.18 to 3.12); B vs. C RR 1.59 (95 % CI 0.49 to 5.15) Receiving sickness benefit at 52 weeks: 32% (11) vs. 30% (10) vs. 22% (7)(p=0.69) Underwent back surgery: 2.7% (1/37) vs. 15% (6/39) vs. 20% (8/40) (p=0.07): A vs. B, RR 1.72 (95% CI 0.72 to 4.12); A vs. C, RR 1.33 (95% CI 0.61 to 2.88); B vs. C, RR 0.77 (95% CI 0.29 vs. 2.01)

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Jeong, 2007[79] 216-547 days Fair	Approach	CT or MRI documentation of nerve root compression based on consensus of 3 radiologists	Randomized: 239 Analyzed: 222	A: Ganglionic transforaminal epidural injection with 40 mg triamcinolone acetonide (1 ml) plus 0.5% bupivacaine (0.5 cc), with fluoroscopic guidance (n=127) B: Preganglionic transforaminal epidural injection with 40 mg triamcinolone acetonide (1 ml) and 0.5% bupivacaine (0.5 cc), with fluoroscopic guidance (n=112)	A vs. B: Age (mean): 50 vs. 49 years Male: 40% vs. 48% Spinal stenosis: 18% vs. 20% Herniated disc: 82% vs. 80% Duration of symptoms <6 months: 64% vs. 56% Baseline pain: Not reported Baseline function: Not reported Duration of symptoms <6 months: 64% vs. 56%	A vs. B: <u>Pain</u> Overall results excellent (4 category scale poor, fair, good, excellent): 47% (56/127) vs. 73% (82/112) at 1 month, RR 0.60 (95% CI 0.48 to 0.75); 34% (39/116) vs. 37% (39/106) at mid-term (> 6 month) followup, RR 0.91 (95% CI 0.64 to 1.31) Overall results good or excellent: at 1 month 71% (90/127) vs. 88% (99/112), RR 0.80 (95% CI 0.70 to 0.91); at mid-term followup 67% (78/116) vs. 60% (64/106), RR 1.11 (95% CI 0.91 to 1.36) Age, sex, duration of symptoms, cause of radiculopathy were not statistically significant predictors for effectiveness of injection at 1 month or mid-term followup

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Kang, 2011[80] 2 weeks Fair	Dose	Single level disc herniation on MRI	Randomized: 160 Analyzed: 160	A: Transforaminal epidural injection with 40 mg triamcinolone plus 1% lidocaine (total 3 ml), with fluoroscopic guidance (n=40) B: Transforaminal epidural injection with 20 mg triamcinolone plus 1% lidocaine (total 3 ml), with fluoroscopic guidance (n=40) C: Transforaminal epidural injection with 10 mg triamcinolone plus 1% lidocaine (total 3 ml), with fluoroscopic guidance (n=40) D: Transforaminal epidural injection with 5 mg triamcinolone plus 1% lidocaine (total 3 ml), with fluoroscopic guidance (n=40)	A vs. B vs. C vs. D:Age (mean): 47 vs. 53 vs. 52 vs. 53 years Male: 40% vs. 42% vs. 38% vs. 35% Baseline pain: 7.3 vs. 7.2 vs. 7.0 vs. 7.0 Baseline function: Not reported Duration of symptoms: days): 37 vs. 33 vs. 42 vs. 33	A vs. B vs. C vs. D: Pain Pain (0-10 VAS): at baseline 7.3 vs. 7.2 vs. 7.0 vs. 7.0; at 1 week 3.8 vs. 3.9 vs. 4.3 vs. 5.4; at 2 weeks 3.2 vs. 3.3 vs. 3.4 vs. 3.9, (p>0.05)Pain relief (≥67% improvement in VAS pain): at 1 week 75% (30/40) vs.70% (28/40) vs. 65% (26/40) vs. 45% (18/40): A vs. B, RR 1.07 (95% CI 0.88 to 1.40); A vs. C, RR 1.15 (95% CI 0.86 to 1.54); A vs. D, RR 1.67 (95% CI 1.13 to 2.46); B vs. C RR, 1.08 (95% CI 0.79 to 1.47); B vs. D, RR 1.56 (95% CI 1.04 to 2.32); C vs. D, RR 1.44 (95% CI 0.96 to 2.18) (p<0.05 for A, B, or C vs. D); at 2 weeks 85% (34/40) vs. 80% (32/40) vs. 75% (30/40) vs. 68% (27/40): A vs. B, RR 1.06 (95% CI 0.87 to 1.30); A vs. C, RR 1.13 (95% CI 0.91 to 1.41); A vs. D, RR 1.26 (95% CI 0.98 to 1.62); B vs. C, RR 1.07 (95% CI 0.84 to 1.35); B vs. D, RR 1.19 (95% CI 0.91 to 1.54); C vs. D, RR 1.11 (95% CI 0.84 to 1.49)

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Karppinen, 2001[81] Karppinen, 2001[82] 1 year Good	Epidural corticosteroid vs. placebo	MRI scans at baseline	Randomized: 163 Analyzed: 158	A: Transforaminal (periradicular) injection with 2-3 cc of methylprednisolone 40 mg/cc plus bupivacaine 5 mg/cc, with fluoroscopic guidance (n=78) B: Transforaminal (periradicular) injection with isotonic (0.9%) saline (2-3 cc), with fluoroscopic guidance (n=80)	A vs. B: Age (mean): 44 vs. 44 years Male: 64% vs. 58% Baseline leg pain (0 to 100 VAS): 71 vs. 75 Baseline back pain (0 to 100 VAS): 53 vs. 60 Baseline ODI (0-100): 43 vs. 44 Duration of symptoms (months): 2.4 vs. 2.6	A vs. B: (difference ANCOVA adjusted for level of symptomatic disc and days on sick leave) Pain Leg pain (0-100 VAS): 71 vs. 75 at baseline; 39 vs. 54 at 2 w, difference –12 (95% CI –23.4 to 1.6); 37 vs. 44 at 4 w, difference –2.3 (95% CI –13.4 to 8.7); 31 vs. 34 at 3 m, difference 0.5 (95% CI –11 to 12); 31 vs. 22 at 6 m, difference 16 (95% CI 5.6 to 27); 24 vs. 24 at 12 m, difference 5.3 (–5.0 to 16); by MRI subgroups: bulges no differences at any time point; contained herniation difference –24 (95% CI –8 to –41) at 2 w; –19 (95% CI –36 to –3) at 4 w; –1.4 (95% CI –23 to 20) at 3 m; 22 (95% CI 5 to 40) at 6 m; 0.3 (95% CI –16 to 16) at 1 y Back pain (0-100 VAS): 53 vs. 60 at baseline; 26 vs. 36 at 2 w, difference –5.8 (95% CI –17 to 5.1); 27 vs. 31 at 4 w, difference 6.1 (95% CI –5.0 to 17); 26 vs. 23 at 3 m, difference 12 (95% CI 1.0 to 24); 23 vs. 20 at 6 m, difference 14 (95% CI 2.4 to 25); 19 vs. 19 at 12 m, difference 8.4 (95% CI –2.1 to 19); extrusions no differences except at 6 m, difference 17 (95% CI 1 to 32); disc level L3-L4/L4-L5 –25 difference –25 (95% CI –40 to –10) at 2w, –20 (95% CI –35 to 5) at 4 w, no differences at other time points >75% improvement in leg pain (only reported for some subgroups): contained herniations: 35% (9/26) vs. 9% (2/23) at 2 w (p=0.04), otherwise no differences; extrusions: No differences at any time point; disc level L3-L4/L4-L5: 68% (21/36) vs. 31% (16/51) at 4 w (p=0.02), otherwise no differences

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Karppinen, 2001[82] 1 year Good Continued						Function ODI (0-100): 43 vs. 44 at baseline; 29 vs. 34 at 2 w, difference –5.1 (95% CI –10 to 0.3); 27 vs. 29 at 4 w, difference –1.5 (95% CI -7.3 to 4.4); 23 vs. 23 at 3 m, difference 1.3 (95% CI -6.1 to 8.6); 19 vs. 16 at 6 m, difference 5.9 (95% CI –0.7 to 12); 16 vs. 16 at 12 m, difference 0.4 (95% CI -6.2 to 7.0); by MRI subgroups: bulges no differences at any time point; contained herniation difference –8.0 (–16 to 0.3) at 2 w, –2.7 (95% CI –10 to 5) at 4 w, 2.3 (95% CI –9 to 13) at 3 m, 14 (95% CI 3 to 24) at 6 m, 1.2 (95% CI –9 to 12) at 1 y; extrusion no differences at any time point; disc level L3-L4 or L4-L5 –9.6 (95% CI –17 to –2) at 2 w, no differences at other time points Other outcomes Sick leave (days/month): 8.9 vs.10 at 4 w, difference –0.5 (95% CI –3.9 to 4.9); 7.3 vs. 7.4 at 3 m, difference –0.2 (95% CI –4.4 to 3.9); 3.6 vs. 4.9 at 6 m, difference 1.7 (95% CI –1.7 to 5.1); 1.9 vs. 1.2 at 12 m, difference –0.6 (95% CI –2.4 to 1.2) Therapy visits: 0.4 vs. 1.9 at 4 w, difference 1.7 (95% CI –0.5 to 3.9); 3.7 vs. 5.9 at 12 m, difference 1.7 (95% CI –2.9 to 6.3) Underwent surgery: 22% (18/80) vs. 19% (15/80) at 12 m, RR 1.2 (95% CI 0.65 to 2.21); contained herniation subgroup 20% vs. 42% (p=0.10), extrusion subgroup 32% vs. 13% (p=0.05)

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Kennedy, 2014[83] 6 months Fair	Epidural corticosteroid vs. epidural corticosteroid	MRI single level below L3 corresponding with symptoms	Randomized: 78 Analyzed: Unclear	A: Transforaminal epidural injection with 15 mg dexamethasone (1.5 ml) plus 1% lidocaine (2 ml), with fluoroscopic guidance (n=41) B: Transforaminal epidural injection with 60 mg triamcinolone (1.5 ml) plus 1% lidocaine (2 ml), with fluoroscopic guidance (n=37)	A vs. B: Age (mean): 36 vs. 36 years Male: 66% vs. 65% Baseline pain (0-10): 6.3 vs. 6.5 Baseline ODI (0-100): 46 vs. 42 Duration of symptoms (weeks): 10 vs. 8.6	A vs. B: <u>Pain</u> Pain (mean 3 day average NRS, 0-10): 7.0 vs. 6.9 at baseline 4.1 vs. 4.1 at 7-14 days; 1.6 vs. 1.8 at 3 months; 1.4 vs. 1.2 at 6 months Pain improved >50%: 32% (13/41) vs. 43% (16/37) at 7-14 days, RR 0.73 (95% CI 0.41 to 1.31)27; 73% (30/41) vs. 73% (27/37) at 3 months, RR 1.0 (95% CI 0.77 to 1.31); 73% (30/41) vs. 76% (28/37) at 6 months, RR 0.97 (95 % CI 0.75 to 1.25) <u>Function</u> ODI improved >51%: 27% (11/41) vs. 35% (13/37) at 7-14 days, RR 0.60 (95% CI 0.30 to 1.92); 68% (28/41) vs. 68% (30/37) at 3 months, RR 0.84 (95% CI 0.65 to 1.09); 71% (27/41) vs. 65% (24/37) at 6 months, RR 1.07 (95% CI 0.78 to 1.46) <u>Other outcomes</u> Underwent surgery: 15% (6/41) vs. 19% (7/37) at 6 months, RR 0.77 (95% CI 0.29 to 2.09)
Kim, 2011[84] 1-2 monthsFair	Epidural corticosteroid vs. epidural corticosteroid	Lumbar radicular symptoms below the knee corresponding to MRI findings	Randomized: 61Analyzed: 60	A: Interlaminar epidural injection with 15 mg dexamethasone phosphate, 0.25% bupivacaine (2 ml), and saline (total 10 ml), with fluoroscopic guidance (n=30)B: Interlaminar epidural injection with 80 mg methylprednisolone acetate, 0.25% bupivacaine (2 ml), and saline (total 10 ml), with fluoroscopic guidance (n=30)	A vs. B:Age (mean): 66 vs. 64 yearsMale: 13% vs. 20%Baseline pain (0-100 VAS): 78 vs. 77Baseline function: Not reported	A vs. B:<u>Pain</u>Pain (0-100 VAS): 78 vs. 77 at baseline, 61 vs. 54 at 1-2 months; percent change from baseline –20% vs. –27% (p=0.37)Decrease in pain: 90% (27/30) vs. 87% (26/30), RR 1.04 (95% CI 0.86 to 1.25)<u>Other outcomes</u>Pain medication use, emergency room visits for pain, new treatment for pain: No differences, data not provided

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Klenerman, 1984[85] 2 month Fair	Epidural corticosteroid vs. placebo	Not specified	Randomized: 74 Analyzed: 63	A: Epidural injection with 80 mg methylprednisolone plus normal saline (20 ml total) (n=19) B: Epidural injection with 0.25% bupivacaine (20 ml) (n=16) C: Epidural injection with normal saline (20 ml) (n=16) D: Interspinous ligament needling without injection (n=12)	A vs. B: Age: Not reported Male: Not reported Baseline pain (0-100 VAS): 48 vs. 53 vs. 65 vs. 65 Baseline function: Not reported Duration of symptoms: Not reported (≤6 months by inclusion criteria)	A vs. B vs. C vs. D: <u>Pain</u> Pain (0-100 VAS, estimated from graph): at baseline 48 vs. 53 vs. 65 vs. 65; at 2 weeks 30 vs. 39 vs. 39 vs. 53; at 2 months 25 vs. 19 vs. 20 vs. 25 <u>Global assessment</u> "Improved" or "cured" (failed, improved, cured) at 2 months: 79% (15/19) vs. 69% (11/16) vs. 69% (11/16) vs. 83% (10/12): A vs. B: RR 0.19 (95% CI 0.77 to 1.72); A vs. C RR 1.15 (95% CI 0.66 to 1.60); A vs. D RR 0.95 (95% CI 0.67 to 1.34); B vs. C: RR 1.00 (95% CI 0.77 to 1.72); B vs. D: RR 0.83 (95% CI 0.54 to 1.25); C vs. D RR 0.83 (95% CI 0.54 to 1.25) <u>Other outcomes</u> Underwent surgery: 0% (0/19) vs. 12% (2/16) vs. 0% (0/16) vs. 0% (0/12): A vs. B: RR 0.17 (95% CI 0.00 to 3.30); A vs. C RR 0.85 (95% CI 0.02 to 40.60); A vs. D RR 0.65 (95% CI 0.01 to 30.77); B vs. C: RR 5.00 (95% CI 0.26 to 96.59); B vs. D: RR 3.83 (95% CI 0.20 to 73.00); C vs. D RR 0.76 (95% CI 0.02 to 36.04)

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Koh 2013[86] 6 months Fair	Transforaminal epidural injection with saline	MRI findings of lateral canal spinal stenosis (including lateral recess and foraminal spinal stenosis)	Randomized: 68 (34 vs. 34) Analyzed: 53 (27 vs. 53) at 3 m, 25 (13 vs. 12) at 6 m	A: Transforaminal epidural steroid injection with 20 mg triamcinolone acetonide plus 2 mL 10% hypertonic saline (sodium chloride solution) (n=27) B: Transforaminal epidural steroid injection with 20 mg triamcinolone acetonide plus 2 mL 0.9% normal saline (n=26)	A vs. B: Age (mean): 66 vs. 63.7 years Male: 30% vs. 27% Duration of symptoms (months): 18.3 vs. 22.3 Baseline NRS (0-10): 7.26 vs. 6.60 Baseline ODI (1-100): 42.6 vs. 37.5	A vs. B Pain NRS (0-10): At baseline 7.26 vs. 6.60. Difference at 1 month –3.13 vs. –2.56 (p=0.25), at 2 months –3.22 vs. –1.94 (p=0.02), at 3 months –2.93 vs. –1.52 (p=0.01), at 4 months –2.78 vs. –1.50 (p=0.05), at 6 months –2.15 vs. –0.58 (p=0.17) Global assessment GPE mean values (1-7 Likert scale where 7=best ever and 1=worst ever). Difference at 1 month 5.82 vs. 5.65 (p=0.24), at 3 months 5.41 vs. 4.73 (p=0.02), at 6 months 4.59 vs. 4.22 (p=0.40) Function ODI, Korean version (0-100). At baseline 42.6 vs. 37.5. Difference at 1 month -13.22 vs. –10.08 (p=0.56), at 2 months –13.81 vs. –10.31 (p=0.45), at 3 months –12.70 vs. –8.08 (p=0.34), at 4 months –12.22 vs. –6.90 (p=0.41), at 6 months –6.85 vs. –3.83 (p=0.34)

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Kolsi, 2000[87] 4 weeks; 8 months for surgery outcome Fair	Approach	Impingement of disc on nerve root by CT or MRI	Randomized: 30 Analyzed: 30	A: Transforaminal nerve root injection with 3.75 mg cortivazol (1.5 ml) plus 0.10 g lidocaine (2 ml), with fluoroscopic guidance (n=17) B: Interlaminar epidural injection with 3.75 mg cortivazol (1.5 ml) plus 0.10 g lidocaine (2 ml), with fluoroscopic guidance (n=13)	A vs. B: Age (mean): 45 vs. 40 years Male: 41% vs. 38% Baseline leg pain (0-10 VAS): 7.0 vs. 6.3 Baseline back pain (0-10 VAS): 3.9 vs. 4.2 Baseline RDQ (French version) (0-24): 16 vs. 15 Duration of symptoms (months): 3.7 vs. 4.4	A vs. B: <u>Pain</u> Radicular pain (0-10 VAS, estimated from graph): at 2 weeks 7.0 vs. 6.3 at baseline, 2.6 vs. 1.6; at 4 weeks 2.0 vs. 1.5 Radicular pain, percent improvement from baseline (estimated from graph): at 1 week 78% vs. 73%; at 4 weeks 70% vs. 78% Back pain (0-10 VAS, estimated from graph): at baseline 3.9 vs. 4.2; at 2 weeks 1.5 vs. 2.4; at 4 weeks1.6 vs. 2.0 <u>Function</u> RDQ (French version, 0-24): at 4 weeks 16 vs.16 at baseline, 10 vs. 7.6 <u>Other outcomes</u> Underwent surgery: at 8 months 18% (3/17) vs. 23% (3/13) RR 0.76 (95% CI 0.18 vs. 3.20)
Kraemer, 1997, study 1[88] 3 months Poor	Epidural corticosteroid vs. placebo Approach	Disk protrusion with nerve root compression seen on MRI and/or CT	Randomized: 133Analyzed: 133	A: Epidural perineural injection via oblique interlaminar approach with 10 mg triamcinolone + local anesthetic (1 ml, drug not specified) (n=47)B: Interlaminar epidural steroid injection using conventional technique (medications and doses not reported) (n=40)C: Paravertebral local anesthetic injection (medications and doses not reported) (n=46)	A vs. B:Age (mean): Not reportedMale: Not reported Baseline pain: Not reported Baseline function: Not reportedDuration of symptoms: Not reported	A vs. B vs. C: <u>Pain</u>*(Based on modified MacNab criteria; p-values not reported)*Modified MacNab criteria "good" (leg <10%, back pain <20%, return to work, sports as before; some results estimated from graph): 68% (32/47) vs. 53% (21/40) vs. 26% (12/46) at 3 months: A vs. B: 68% (32/47) vs. 53% (21/40), RR, 1.30 (95% CI 0.91 to 1.85); A vs. C: 68% (32/47) vs. 26% (12/46), RR 2.61 (95 % CI 1.55 to 4.41): B vs. C: 53% (21/40) vs. 26% (12/46), RR 2.02 (95% CI 1.14 to 3.55)<u>Other outcomes</u>Surgery: 8.5% (4/47) vs. 18% (7/40) vs. 13% (6/46) at 3 months; A vs. B: (4/47) vs. 18% (7/40), RR, 0.49 (5% CI 0.15 to 1.54); A vs. C: 8.5% (4/47) vs. 13% (6/46), RR 0.65 (95% CI 0.20 vs. 2.16); B vs. C: 18% (7/40) vs. 13% (6/46), RR 1.34 (95% CI 0.51 to 3.54)

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Kraemer, 1997, study 2[88] 3 months Fair	Epidural corticosteroid vs. placebo	Disk protrusion with nerve root compression seen on MRI and/or CT	Randomized: 49 Analyzed: 49	A: Epidural perineural injection via oblique interlaminar approach with 10 mg triamcinolone plus saline (volume not reported) (n=24) B: Epidural perineural injection via oblique interlaminar approach with saline alone plus intramuscular injection with 10 mg triamcinolone (n=25)	Age (mean): Not reported Male: Not reported Duration of symptoms: Not reported Baseline pain: Not reported Baseline function: Not reported. Duration of symptoms: Not reported	A vs. B: <u>Pain</u> Modified MacNab criteria "good" (leg <10%, back pain <20%, return to work, sports as before; estimated from graph): at 3 months 54% (13/24) vs. 40% (10/25), RR 1.35 (95% CI 0.74 to 2.48) <u>Other outcomes</u> Surgery: at 3 months 4% (1/24) vs. 4% (1/25), RR 1.04 (95% CI 0.07 to 15.73)
Laiq, 2009[89] 6 months Fair	Epidural corticosteroid vs. other	Single lumbar intervertebral disc herniation on recent MRI	Randomized: 52 Analyzed: 50	A: Interlaminar epidural injection with 80 mg methylprednisolone plus 2% Xylocaine (3 ml), preceded by 2% lidocaine (3 ml) (n=26) B: Ibuprofen 400 mg tid x 1 m, tramadol SR 100 mg qd x 2 m, tizanidine 2 mg bid x 3 m, famotidine 40 mg throughout treatment, bed rest and limited activity x 1 m with gradual increase to walking 2-3 h/day, heavy lifting and strenuous exercise not permitted for 3-6 m (n=25)	Age (mean): 40 vs. 41 years Male: 68% vs. 60%Baseline pain: Not reported Baseline function: Not reported Duration of symptoms: Not reported	A vs. B: Pain (0-10 VAS): 2 vs. 4 at 2 weeks, (p<0.0001); 2 vs. 4.5 at 1 month, (p<0.0001); 4.5 vs. 5.0 at 3 months, (p=0.19); 6 vs. 6.5 at 6 months, (p=0.21) Pain score ≥6 (0-10 VAS): 16% (4/25) vs. 24% (6/25), RR 0.67 (95% CI 0.22 to 2.1) Patient satisfaction with improvement in pain: at 2 weeks 80% (20/25) vs. 52% (13/25), RR 1.54 (95 % CI 1.01 to 2.35) (p=0.38); at 1 month 76% (19/25) vs. 48% (12/25), RR 1.59 (95% CI 1.00 to 2.52) (p=0.36); at 3 months 52% (13/25) vs. 56% (14/25), RR 0.93 (95 % CI 0.56 to 1.55) (p=1.0); at 6 months 68% (17/25) vs. 64% (16/25), RR 106 (95% CI 0.71 to 1.58) (p = 1.0)

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Manchikanti, 2014[90-92] 24 months Poor	Epidural corticosteroid vs. placebo	Not specified	Randomized: 120 Analyzed: 120	A: Interlaminar epidural injection with 6 mg betamethasone (1 ml) plus 0.5% lidocaine (5 ml), with fluoroscopic guidance (n=60) B: Interlaminar epidural injection with 0.5% lidocaine (6 ml), with fluoroscopic guidance (n=60)	A vs. B: Age (mean): 41 vs. 49 years Male: 62% vs. 38% Baseline pain (0 to 10 NRS): 8.0 vs. 8.2 Baseline ODI (0-50): 30 vs. 30 Duration of symptoms (months): 133 vs. 135	A vs. B: Pain Pain scores (0-10): at baseline 8.0 vs. 8.2; at 3 months 3.5 vs. 3.9; at 6 months 3.5 vs. 4.1; at 12 months 3.4 vs. 4.0; at 24 months 3.7 vs. 4.1 (p>0.05 at all time points) Pain relief >=50%: at 3 months 88% (53/60) vs. 78% (47/60), RR 1.13 (95% CI 0.96 to 1.33); at 6 months 88% (53/60) vs. 70% (42/60), RR 1.26 (95% CI 1.04 to 1.53); at 12 months 85% (51/60) vs. 72% (43/60), RR 1.19 (95% CI 0.98 to 1.44); at 24 months 70% (42/60) vs. 63% (38/60), RR 1.11 (95% CI 0.86 to 1.42) Function ODI (0-50): at baseline 30 vs. 30, at 3 months 14 vs. 16; at 6 months 14 vs. 16; at 12 months 13 vs. 16; at 24 months 14 vs. 16 (p>0.05 at all time points) ODI improved >=50%: at 3 months 82% (49/60) vs. 73% (44/60), RR 1.11 (95% CI 0.92 to 1.35); at 6 months 87% (52/60) vs. 63% (38/60), RR 1.37 (95% CI 1.10 to 1.70); at 12 months 87% (52/60) vs. 68% (41/60), RR 1.27 (95% CI 1.04 to 1.55); at 24 months 73% (44/60) vs. 63% (38/60), RR 1.16 (95% CI 0.91 to 1.48) Other outcomes Opioid use (mg MED/day): at baseline 47 vs. 50; at 3 months 42 vs. 34; at 6 months 36 vs. 37; at 12 months 36 vs. 37; at 24 months 37 vs. 36 (p>0.05 at all time points)

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Manchikanti, 2012[93] Manchikanti 2011[94] Manchikanti 2008[95] 24 months Fair	Epidural corticosteroid vs. placebo	Not specified	Randomized: 120 Analyzed: 120	A: Caudal epidural injection with 6 mg betamethasone or 40 mg methylprednisolone plus 0.5% lidocaine (9 ml), with fluoroscopic guidance (n=60) B: Caudal epidural injection with 0.5% lidocaine (10 ml), with fluoroscopic guidance (n=60)	A vs. B:Age (mean): 43 vs. 49 years Male: 38% vs. 32% Baseline pain (0-10 NRS): 7.8 vs. 8.1 Baseline ODI (0 to 50): 28 vs. 29 Duration of pain (months): 81 vs. 93	A vs. B: Pain Pain (mean NRS, 0 to 10): at baseline 7.8 vs. 8.1; at 3 months 3.4 vs. 4.1; at 6 months 3.5 vs. 3.9; at 12 months 3.5 vs. 4.1; at 24 months 3.6 vs. 4.2: (p=0.80 for group difference) Pain improved ≥50% from baseline: at 3 months 80% (48/60) vs. 77% (46/60); at 6 months 82% (49/60) vs. 77% (46/60); at 12 months 77% (46/60) vs. 70% (42/60); at 24 months 68% (41/60) vs. 63% (38/60) Function ODI (0 to 50): at baseline 28 vs. 29; at 3 months 14 vs. 16; at 6 months 14 vs. 16; at 12 months 13 vs. 16; at 24 months 14 vs. 16: (p=0.71 for group difference)ODI improved ≥50% from baseline: at 3 months 73% (44/60) vs. 62% (37/60); at 6 months 73% (44/60) vs. 72% (43/60), RR 1.02 (95% CI 0.82 vs. 1.28); at 12 months 72% (43/60) vs. 67% (40/60), RR 108 (95% CI 0.85 to 1.37); at 24 months 70% (42/60) vs. 60% (36/60), RR 1.08 (95% CI 0.82 to 1.43) Other outcomes Opioid use (mg MED/day): at baseline 45 vs. 52; at 3 months 30 vs. 33; at 6 months 31 vs. 33; at 12 months 31 vs. 33; at 24 months 31 vs. 33: (p=0.75 for group difference) Success (pain improved ≥50% and ODI improved ≥50%): at 6 months 73% (44/60) vs. 72% (43/60); at 12 months 72% (43/60) vs. 67% (40/60); at 24 months 65% (39/60) vs. 60% (36/60)

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Mathews, 1987[96] 1 year Fair	Epidural corticosteroid vs. placebo	Not specified	Randomized: 57 Analyzed: 57	A: Caudal epidural injection with 80 mg methylprednisolone (2 ml) and 0.125% bupivacaine (20 ml) (n=23) B: Soft tissue injection at sacral hiatus or tender point with lignocaine (2 ml, concentration not reported) (n=34)	A vs. B: Age (median): 38 vs. 41 years Male: 83% vs. 71% Baseline pain: Not reported Baseline function: Not reported Duration of symptoms (median, weeks): 4 vs. 4 weeks	A vs. B: <u>Pain</u> Pain score (6 point NRS): at 1 month 67% (14/21) vs. 56% (18/32), RR 1.67 (95% CI 1.23 to 2.28) (p>0.05); No further pain: at 1 year 39% (9/23) vs. 41% (14/34), RR 0.95 (95% CI 0.49 to 1.8) <u>Other outcomes</u> Spinal surgery: 4% (1/23) vs. 0% (0/34), RR 4.38 (95% CI 0.19 to 102.94)
McCahon, 2011[97] 12 weeks Fair	Dose	Not specified	Randomized: 38 Analyzed: 33	A: Caudal epidural injection with 80 mg methylprednisolone acetate (2 ml), 0.25% levobupivacaine (10 ml), and saline (8 ml) (n=19) B: Caudal epidural injection with 40 mg methylprednisolone acetate (1 ml), 0.25% levobupivacaine (10 ml), and saline (9 ml) (n=19)	A vs. B: Age (mean): 56 yearsMale: 39% Baseline leg pain (0-100 VAS): 57 vs. 54 Baseline back pain (0-100 VAS): 67 vs. 66 Baseline ODI (0-100): 55 vs. 54 Duration of symptoms (years): 19	A vs. B: <u>Function</u> Change in ODI from baseline (0-100, estimated from graph): –7 vs. –7 at 4 weeks; 0.5 vs. –3 at 8 weeks; 1 vs. 0 at 12 weeks <u>Other outcomes</u> Analgesic use: No difference between groups

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Murakibhavi, 2011[98] 6 months Poor	Epidural corticosteroid vs. other	MRI showed lumbar disc disease	Randomized: 102 Analyzed: 100	A: Caudal epidural injection with 80 mg triamcinolone acetate (2 ml), 2% lidocaine (2 ml), and normal saline (20 ml), with fluoroscopic guidance (n=52) B: Conservative treatment (tizanidine 6-12 mg/d, diclofenac 50-100 mg/d, amitriptyline 10-50 mg qhs, bilateral skin traction, physiotherapy including TENS, short-wave diathermy, back extension exercises) (n=50)	A vs. B: Age (mean): 45 years (overall) Male: 66% Baseline pain (0-10 VAS): 8.1 vs. 8.1 Baseline ODI (0-100): 36 vs. 36 Duration of symptoms (months): 21 overall	A vs. B: <u>Pain</u> Pain (0-10 VAS): 8.1 vs. 8.1 at baseline; 2.7 vs. 6.1 at 6 months <u>Function</u> ODI (0-100): 36 vs. 36 at baseline; 12 vs. 25 at 6 months Beck Depression Inventory (0-63): 18 vs. 19 at baseline; 8.6 vs. 13 at 6 months <u>Other outcomes</u> Complete pain relief (complete, partial, no relief): 92% (46/50) vs. 32% (16/50) at 3 weeks, RR 2.88 (95 % CI 1.90 to 4.34); 86% (43/50) vs. 24% (12/50) at 6 months, RR 3.58 (95% CI 2.16 to 5.94)
Owlia, 2007[99] 3 months Poor	Dose	MRI showing disc herniation with or without canal stenosis	Randomized: 84 Analyzed: 84	A: Interlaminar epidural injection with 80 mg methylprednisolone acetate (8-10 ml) plus 2% lidocaine (2-4 ml), with fluoroscopic guidance (n=43) B: Interlaminar epidural injection with 40 mg methylprednisolone acetate (8-10 ml) plus 2% lidocaine (2-4 ml), with fluoroscopic guidance (n=41)	A vs. B: Age (mean): 38 vs. 36 years Male: 51% vs. 66% Baseline pain: Not reported Limitation in daily activities: 28% vs. 49% Duration of symptoms (weeks): 12 vs. 9	A vs. B: <u>Pain</u> Improvement in pain (not defined): at 2 weeks, 70% (30/43) vs. 61% (25/41), RR 1.14 (95% CI 0.84 to 1.57); at 1 month, 74% (32/43) vs. 76% (31/41), RR 0.98 (95% CI 0.77 to 1.25); at 3 months, 65% (28/43) vs. 51% (21/41), RR 1.27 (95% CI 0.88 to1.84)

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Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Park, 2010[100] 1 month Fair	Epidural corticosteroid vs. epidural corticosteroid	MRI showing nerve root compromise	Randomized: 106 Analyzed: 106	A: Transforaminal injection with 7.5 mg dexamethasone plus 1% lidocaine (1 ml), with fluoroscopic guidance (n=53)B: Transforaminal injection with 40 mg triamcinolone acetonide plus 1% lidocaine (1 ml), with fluoroscopic guidance (n=53)	A vs. B:Age (mean): 56 vs. 62 years Male: 49% vs. 45% Baseline pain (0-10 VAS): 7.5 vs. 8.3 Baseline ODI (0-100: 52 vs. 58 Duration of symptoms: Not reported	A vs. B: <u>Pain</u> Pain (0-10 VAS): 7.4 vs. 8.3 at baseline, 4.1 vs. 2.4 at 1 month (p<0.0005) McGill Pain Questionnaire summary score (0–45): 15 vs. 13 at baseline, 13 vs. 20 at 1 month (p>0.05) <u>Function</u> ODI (0-100): 52 vs. 58 at baseline, 45 vs. 59 at 1 month (p>0.05)
Park, 2013[101] 12 weeks Fair	Ultrasound + fluoroscopy vs. fluoroscopy alone	Not required	Randomized: 120 Analyzed: 110	A: Caudal epidural injection with 10 mg dexamethasone (2 ml) plus 0.5% lidocaine (13 ml) and 5 ml of iodinated contrast, with Doppler ultrasound and fluoroscopy guidance (n=60) B: Caudal epidural injection with 10mg dexamethasone (2 ml) plus 0.5% lidocaine (13 ml) with 5 ml of iodinated contrast, with fluoroscopic guidance (n=60)	A vs. B: Age (mean): 57 vs. 58 years Male: 29% vs. 44% Baseline pain (0-10 NRS): 6.4 vs. 6.4 Baseline ODI (0-100): 51 vs. 52 Duration of symptoms (months): 6.6 vs. 7.0	A vs. B: <u>Pain</u> Pain (0-10 NRS): 6.4 vs. 6.4 at baseline; 3.1 vs. 3.2 at 2 weeks; 2.5 vs. 2.6 at 12 weeks, (p>0.05) <u>Function</u> ODI (0-100): 51 vs. 52 at baseline; 33 vs. 31 at 2 weeks; 29 vs. 29 at 12 weeks, (p>0.05) <u>Global assessment</u> Pain score improvement >50% and ODI improvement >40%: at 2 weeks 87% (48/55) vs. 89% (49/55), RR 0.98 (95% CI 0.85 to 1.12); at 12 weeks 76% (42/55) vs. 74% (41/55), RR 1.02 (95% CI 0.83 to 1.27)

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Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Rados, 2011[102] 24 weeks Fair	Approach	MRI and EMG	Randomized: 70 Analyzed: 64	A: Transforaminal epidural injection with 40 mg methylprednisolone plus 0.5% lidocaine (3 ml), with fluoroscopic guidance (n=35) B: Interlaminar epidural injection with 80 mg methylprednisolone plus 0.5% lidocaine (8 ml), with fluoroscopic guidance (n=35)	A vs. B: Age (mean): 49 vs. 49 years Male: 62% vs. 66% Baseline pain (0-10 VAS): 6.7 vs. 7.4 Baseline ODI (0-100): 53 vs. 52 Duration of symptoms: Not reported (<1 year and >6 weeks by inclusion criteria)	A vs. B: <u>Pain</u> Pain (0-10 VAS, estimated from graph): at baseline 6.7 vs. 7.4; at 2 weeks, 5.0 vs. 5.0; at 4 weeks, 4.2 vs. 4.0; 12 weeks, 3.8 vs. 4.0 Pain improved ≥2 (0-10 VAS): 84% (27/32) vs. 75% (24/32): RR, 1.13 (95% CI 0.88 to 1.44) Pain improved >50%: 63% (20/32) vs. 53% (17/32) at 24 weeks: RR, 1.18 (95% CI 0.77 to 1.79) <u>Function</u> ODI (0-100, estimated from graph): at baseline, 53 vs. 52; at 2 weeks, 47 vs. 47; at 4 weeks, 46 vs. 44; at 12 weeks, 42 vs. 42; at 24 weeks, 39 vs. 40 ODI improved >10 points: 66% (21/32) vs. 50% (16/32), RR, 1.31 (95% CI 0.86 to 2.01)
Ridley 1988[103] 2 weeks Fair	Epidural corticosteroid vs. placebo	Not specified	Randomized: 39 Analyzed: 35	A: Interlaminar epidural injection with 80 mg methylprednisolone (2 ml) and saline (10 ml) (n=19) B: Interspinous ligament injection with saline (2 ml) (n=16)	A vs. B:Age (mean): 40 vs. 39 years Male: 42% vs. 44% Baseline pain: Not reported Baseline function: Not reported Duration of symptoms >6 months: 47% vs. 56%	A vs. B: <u>Pain</u> Rest pain, improvement from baseline (median, 0-10 VAS): at 2 weeks 46% vs. 0%, (p<0.01) Walking pain, improvement from baseline (median, 0-10 VAS): at 2 weeks 69% vs. 0%, (p<0.01)

Table 1. Trials of epidural corticosteroid injections for radicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Riew, 2000[104] Riew, 2006[105] Mean 23 months; range 13 to 28 months Fair	Epidural corticosteroid vs. placebo	Disc herniation or spinal stenosis confirmed by MRI or CT	Randomized: 55 Analyzed: 55	A: Transforaminal nerve root injection with 6 mg betamethasone (1 ml) plus 0.25% bupivacaine (1 ml), with fluoroscopic guidance (n=28) B: Transforaminal nerve root injection with 0.25% bupivacaine (1 ml), with fluoroscopic guidance (n=27)	A vs. B: Age: Not reported (states no difference) Male: 49% overall (states no difference) Baseline pain: Not reported Baseline function: Not reported Duration of symptoms: Not reported	A vs. B: <u>Other outcomes</u> Underwent surgery: 29% (8/28) vs. 67% (18/27) at 13 to 28 months, RR 0.43 (95% CI 0.22 to 0.82); 39% (11/28) vs. 70% (19/27) at ≥5 years, RR 0.56 (95% CI 0.33 to 0.94) (assuming none lost to followup had surgery); 68% (19/28) vs. 70% (19/27), RR 0.96 (95% CI 0.66 to 1.4) (assuming all lost to followup had surgery)
Rogers 1992[106] 1 month; 20-21 months for surgery outcome Poor	Epidural corticosteroid vs. placebo	Not specified	Randomized: 30 Analyzed: 30	A: Interlaminar epidural injection with 80 mg methylprednisolone (2 ml) plus 2% lignocaine (14 ml) plus saline (4 ml) (n=15) B: Interlaminar epidural injection with 2% lignocaine (14 ml) + saline (6 ml) (n=15)	A vs. B: Age (mean): 42 vs. 41 years Male: 47% vs. 47% Baseline pain "severe" or "very severe": 87% vs. 67% Baseline function: Not reported Duration of symptoms (months): 23 vs. 25	A vs. B: <u>Pain</u> Pain "none" (none, mild, moderate, severe): 20% (3/15) vs. 6.7% (1/15), RR 3.0 (95% CI 0.35 to 26) Pain "none" or "mild": 47% (7/15) vs. 20% (3/15), RR 2.33 (95% CI 0.74 to 7.35) <u>Function</u> Full ability to work: 53% (8/15) vs. 33% (5/15), RR 1.6 (95% CI 0.68 to 3.80) <u>Other outcomes</u> Reduced analgesic intake: 53% (8/15) vs. 40% (6/15, RR 1.33 (95% CI 0.61 to 2.9) Subsequent surgery: 27% (4/15) vs. 27% (4/15), RR 1.0 (95% CI 0.31 to 3.28)

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Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Sayegh, 2009[107] 1 year Fair	Epidural corticosteroid vs. placebo	Disc degeneration or herniation on MRI	Randomized: 183 Analyzed: 151	A: Caudal epidural injection with betamethasone (2 mg/dL betamethasone dipropionate + 5 mg/dL betamethasone phosphate) (1 ml) + 2% Xylocaine (12 ml) (n=93) B: Caudal epidural injection with 2% Xylocaine (12 ml) + water for injection (8 ml) (n=90)	A vs. B:Age (mean): 51 vs. 48 yearsMale: 65% vs. 70% Baseline pain: Not reported Baseline ODI (0-100): 39 vs. 39 Duration of symptoms (days): 53 vs. 51	A vs. B: <u>Function</u> ODI (scale NR): 39 vs. 39 at baseline (p=0.75); 13 vs. 6.2 at 1 week (p<0.0005); 12 vs. 9.6 at 1 month (p<0.0005); 5.8 vs. 14 at 6 months (p<0.0005); 4.9 vs. 13 at 1 year (p<0.0005) <u>Other outcomes</u> Surgery (overall): 16% (13/83) vs. 22% (19/85) at 1 month, RR 0.70 (95% CI 0.37 to 1.3) Surgery (disc herniation group): 17% (7/42) vs. 24% (8/33) at 1 month, RR 0.69 (95% CI 0.28 to 1.70)
Snoek, 1977[108] 8-20 months Poor	Epidural corticosteroid vs. placebo	Not specified	Randomized: 51 Analyzed: Unclear	A: Interlaminar epidural injection with 80 mg methylprednisolone (2 ml) (n=27) B: Interlaminar epidural injection with saline (2 ml) (n=24)	A vs. B: Age (mean): 44 vs. 46 years Male: 48% vs. 54% Baseline pain: Not reported Baseline function: Not reported Duration of symptoms (weeks): 12 vs. 11	A vs. B: <u>Other outcomes</u> Subsequent surgery: 52% (14/27) vs. 58% (14/24), RR 0.89 (95% CI 0.54 to 1.5)

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Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Tafazal, 2009[109] Ng, 2005[110] 12 weeks; 1 year for surgery outcome Fair	Epidural corticosteroid vs. placebo	MRI diagnosis of lumbar disc herniation or foraminal stenosis	Randomized: 150 (74 vs. 76)Analyzed: 124 (65 vs. 59) at 3 months	A. Transforaminal periradicular injection with 40 mg methylprednisolone plus 0.25% bupivacaine (2 ml), with fluoroscopic guidance (n=74) B. Transforaminal periradicular injection with 0.25% bupivacaine (2 ml), with fluoroscopic guidance (n=76)	A vs. B:Age (mean): 52 vs. 51 years Male: 60% vs. 54%Baseline leg pain (0-100 VAS): 73 vs. 76 Baseline back pain (0-100 VAS): 44 vs. 48 Baseline ODI (0-100): 43 vs. 47 Duration of symptoms (months): 20 vs. 18 months	A vs. B: <u>Pain</u> Leg pain, change from baseline (mean, 0-100 VAS): 26 vs. 19 at 6 weeks, 24 vs. 23 at 12 weeks (p=0.74) Back pain, change from baseline (mean, 0-100 VAS): 9.8 vs. 6.4 at 6 weeks, 6.9 vs. 9.9 at 12 weeks (p=0.57) Leg pain improved ≥20 points (0-100 VAS) (from Ng): at 12 weeks 42% (18/43) vs. 48% (20/43): RR, 0.90 (95% CI 0.56 to 1.50) <u>Function</u> ODI, change from baseline (mean, 0-100 VAS): 9.3 vs. 11 at 12 weeks (p=0.69) Low Back Outcome Score, change from baseline (mean, 0-75): 8.8 vs. 8.5 at 6 weeks, 9.1 vs. 9.4 at 12 weeks (p=0.93) ODI improved ≥ 10% (from Ng): at 12 weeks 35% (15/43) vs. 55% (24/43; RR 0.63 (95% CI 0.38 to 1.0) Change in walking distance from baseline (yards) (from Ng): at 6 weeks 89 vs. 220 (0.12); 200 vs. 240 at 12 weeks (p=0.72) <u>Global assessment</u> Satisfaction excellent or good (from Ng): at 12 weeks 45% (18/40) vs. 49% (20/4) RR, 0.92 (95% CI 0.58 to 1.5) <u>Other outcomes</u> Subsequent peri-radicular injection: 13% (8/64) vs. 15% (10/65) at 1 year, RR 0.81 (95% CI 0.34 to 1.93)Surgery a 12 weeks (from Ng): 2.5% (1/40) vs. 0% (0/41): RR, 3.07 (95% CI 0.13 to 73.28) (4 of 5 patients who withdrew at 6 weeks also had surgery, not reported by treatment arm) Surgery at 1 year: 14% (9/64) vs. 22% (14/65)], RR 0.65 (95% CI 0.30 to 1.40)

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Tauheed 2014[111] 12 weeks Fair	Transforaminal epidural injection with clonidine	1 or 2 level disc herniation at L3-L4, L4-L5, L5-S1 on MRI	Randomized: 180 (60 vs. 60 vs. 60) Analyzed: 177 (60 vs. 58 vs. 59) at 12 w	A: Transforaminal sleeve root injection with 60 mg methylprednisolone (n=60) B: Transforaminal sleeve root injection with 60 mg methylprednisolone plus 0.5 mcg/kg clonidine (n=60) C: Transforaminal sleeve root injection with 60 mg methylprednisolone plus 1 mcg/kg clonidine (n=60)	A vs. B vs. C: Age (mean): 39 vs. 42 vs. 41 Male: 63% vs. 72% vs. 67% Duration of pain: 128 vs. 130 vs. 127 days	A vs. B vs. C: Pain Global pain score (VAS, 0-100): At baseline 7.83 vs. 7.60 vs. 7.72, at 1 week 5.41 vs. 4.62 vs. 4.41, at 2 weeks 3.97 vs. 3.61 vs. 2.02, at 4 weeks 4.37, 3.91 vs. 2.23, at 6 weeks 4.46 vs. 4.11 vs. 2.41, and 12 weeks 4.66 vs. 4.24 vs. 2.65 (p >0.05 at all followup)
Thomas, 2003[112] 6 months Fair	Approach	Disc herniation confirmed by CT or MR	Randomized: 31 Analyzed: 22	A: Transforaminal injection with 5 mg dexamethasone acetate (2 ml), with fluoroscopic guidance (n=15) B: Interlaminar epidural injection with 5 mg dexamethasone acetate (2 ml), with fluoroscopic guidance (n=16)	A vs. B: Age (mean): 50 vs. 51 years Male: 53% vs. 31% Baseline leg pain (0-100 VAS): 74 vs. 72 Baseline RDQ (0-24): 12 vs. 14 Duration of symptoms (weeks): 6.5 vs. 6.8	A vs. B: Pain Leg pain (0-100 VAS): 74 vs. 72 at baseline; at 1 month 17 vs. 31(p=0.04); at 6 months 22 vs. 44 (p=0.04) Function RDQ (0-24): 12 vs. 14 at baseline; at 1 month, 7.9 vs. 9.6 (p>0.05); at 6 months, 5.3 vs.10 at (p=0.05) Dallas Daily Activities: 84 vs. 84 at baseline; at 1 month 52 vs. 59 (p>0.05); at 6 months, 46 vs. 69 (p=0.05) Dallas Work and Leisure Activities: at baseline 99 vs. 96, (p>0.05); at 6 months, 37 vs. 60 (p=0.02) Dallas Anxiety-Depression: at baseline 50 vs. 64; at 1 month 36 vs. 40, (p>0.05); at 6 months 34 vs. 55, (p=0.04) Dallas Sociability: at baseline 47 vs. 54; at 1 month 33 vs. 32, (p>0.05); at 6 months 30 vs. 44, (p>0.05) Other outcomes Surgery at 6 months:33% (5/15) vs. 25% (4/16), RR, 1.33 (95% CI 0.44 to 4.05)

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Valat, 2003[113] 35 days Fair	Epidural corticosteroid vs. epidural corticosteroid	Not specified	Randomized: 85 Analyzed: 63	A: Interlaminar epidural injection with 50 mg prednisolone acetate (2 ml) (n=43) B: Interlaminar epidural injection with saline (2 ml) (n=42)	A vs. B:Age (mean): 44 vs. 38 years Male: 60% vs. 62% Baseline pain (0-100 VAS): 58 vs. 58 Baseline RDQ (0-24): 15 vs. 14 Duration of symptoms (days): 15 vs. 17	A vs. B: <u>Pain</u> Pain (0-100 VAS): 58 vs. 58 at baseline; 28 vs. 40 at day 20, difference –11 (95% CI –23 to 1.3); 22 vs. 25 at day 35, difference –5.1 (95% CI –19 to 8.4) Success (recovery or marked improvement on four category scale and not requiring NSAID): 51% (22/43) vs. 36% (15/42), RR 1.43 (95% CI (p=0.15) at day 20; 49% (21/43) vs. 48% (20/42) at day 35, RR 1.03 (95% CI 0.66 to 1.59) <u>Function</u> RDQ (0-24): 15.1 vs. 14.2 at baseline; 10.9 vs. 11.7 at day 20, difference –1.8 (95% CI –4.6 to 1.0); 8.5 vs. 9.1 at day 35, difference –2.1 (95% CI –5.0 to 0.8) Dallas Daily Activities: 66 vs. 69 at baseline; 41 vs. 49 at day 20, difference –3 (95% CI –18 to 5.7), 31 vs. 40 at day 35, difference –5.7 (95% CI –18 to 7.1) Dallas Work and Leisure Activities: at baseline 73 vs. 78; 50 vs. 62 at day 20, difference –7.2 (95% CI –21 to 6.2); 41 vs. 47at day 35 , difference –7.3 (95% CI –22 to 7.1) Dallas Anxiety-Depression: 29 vs. 34 at baseline; 21 vs. 30 at day 20, difference –3.2 (95% CI –16 to 9.8); 16 vs. 26 at day 35, difference –5.3 (95% CI –19 to 8.4) Dallas Sociability: 29 vs. 25 at baseline; 18 vs. 20 at day 20, difference –10 (95% CI –20 to –0.9); 14 vs. 20 at day 35, difference –12 (95% CI –22 to –2.5) <u>Other outcomes</u> Surgery: 2.3% (1/43) vs. 4.7% (2/42), RR 0.49 (95% CI 0.05 to 5.19)

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Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Wilson-MacDonald, 2005[114] 2 years Fair	Epidural corticosteroid vs. placebo	MRI showing disc prolapse and/or spinal stenosis	Randomized: 93 Analyzed: 72	A: Interlaminar epidural steroid injection with 80 mg methylprednisolone (2 ml) plus 40 mg 0.5% bupivacaine (8 ml) (n=44) B: Intramuscular/interspinous ligament injection with 80 mg methylprednisolone (2 ml) plus 40 mg 0.5% bupivacaine (8 ml) (n=48)	A vs. B: Age (mean): 49 vs. 49 years Male: 40% (entire cohort) Baseline pain: Not reported Baseline ODI (0-100): 44 vs. 40 Duration of symptoms: Not reported (>6 weeks for all)	A vs. B: <u>Pain</u> Pain relief: Favored intervention A (p<0.004), data not provided <u>Other outcomes</u> Underwent surgery: 41% (18/44) vs. 31% (15/48) at ≥2 years, RR: 1.31 (95% CI 0.76 to 2.27)
el Zahaar,1991[115] 20-21 months Poor	Epidural corticosteroid vs. placebo	MRI or CT	Randomized: 63 Analyzed: Unclear	A: Caudal epidural injection with hydrocortisone (5 ml), 4% Carbocaine (4 ml), and saline (21 ml) (n=37) B: Caudal epidural injection with 4% Carbocaine (4 ml) plus saline (26 cc) (n=26)	A vs. B:Age (mean): 46 vs. 49 years Male: 54% vs. 65%Baseline pain: Not reported Baseline function: Not reported Duration of symptoms (months): 17 vs. 14	A vs. B: <u>Other outcomes</u> Treatment success (>75% improvement in preinjection symptoms and no spinal surgery): 49% (18/37) vs.50% (13/26) at 13-36 months, RR 0.97 (95% CI 0.59 to 1.62); 58% (11/19) vs. 64% (9/14) in patients with herniated disc, RR 0.90 (95% CI 0.52 to 1.56) Subsequent surgery: 13/37 (35%) vs. 10/26 (38%) at 13-36 months, RR 0.91 (95% CI 0.47 to 1.76); 26% (5/19) vs. 21% (3/14) in patients with herniated disc, RR 1.23 (95% CI 0.35 to 4.30)

ACS=acute coronary syndrome; BMI=body mass index; cc=cubic centimeters; CI=confidence interval; CT=computed tomography; DLG=poly(DL-lactide-co-glycolide); DLR=digital luminescence radiography; EMG=electromyography; ER=emergency room; ESI=epidural steroid injection; F=female; FABQ=Fear-Avoidance Beliefs Questionnaire; FL=fetal length; gD=growth and development; h=hours; HAD=healthcare alternatives development; IL=interlaminar; L=angular momentum; m=months; MED=morphine equivalent dose; MIL=midline interlaminar; MRI=magnetic resonance imaging; NIAMS=National Institute of Arthritis and Musculoskeletal and Skin Diseases; NIH=National Institutes of Health; NR=no results; OR=not reported; NRS=Numeric Rating Scale; NS=not significant; NSAID=nonsteroidal antiinflammatory drug; ODI=Oswestry Disability Index; PIL=pre-illness level; PLC=pityriasis lichenoides chronica; PT=physical therapy; RDQ=Roland Disability Questionnaire; RR=relative risk; S=Diabetes; SF-36=Short Form (36) Health Survey; SLR=straight leg raise; SR=systematic review; TENS=transcutaneous electrical nerve stimulation; TFESI=transformational epidural steroid injection; tid=three times daily; USA=United States of America; VA=Veteran's Affairs; VAS=visual analog scale; w=weeks; y=years.

Table 2. Trials of epidural corticosteroid injections for spinal stenosis

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Patient Characteristics	Type of Intervention	Results
Brown, 2012[116] 6 weeks Fair	Epidural corticosteroid vs. other	Required (CT or MRI showing central canal stenosis and hypertrophic ligamentum flavum)	Randomized: 38 Analyzed: 38	Age (mean): 74 vs. 79 years Male: 62% vs. 47% Baseline pain: Not reported Baseline function: Not reported Duration of symptoms: Not specified; mean duration not reported, 62% to 76% had medical management for >6 months	A: Interlaminar epidural injection with 80 mg triamcinolone acetate (40 mg in diabetic patients) plus NS (6 ml), with fluoroscopic guidance (n=17) B: Minimally invasive lumbar decompression (mild) to access the interlaminar space and remove portions of the lamina and ligamentum flavum, with fluoroscopic guidance (n=21)	A vs. B Pain ≥2 point improvement in VAS pain (0-10): 35% (6/17) vs. 76% (16/21) at 2 weeks, RR 0.46 (95% CI 0.23 to 0.92) Pain (mean, 0-10 VAS): 6.4 vs. 6.4 at baseline, 6.3 vs. 3.8 at 6 weeks Function ODI: 40 vs. 39 at baseline, 35 vs. 27 at 6 weeks Other Outcomes Zurich Claudication Questionnaire patient satisfaction (mean, 1-6): 2.8 vs. 2.2 at 6 weeks, patient satisfaction ≤2.5: 41% (7/17) vs. 59% (12/21) at 6 weeks, RR 0.72 (95% CI 0.36 to 1.74)
Cuckler, 1985[66] Mean 20-21 months Fair	Epidural corticosteroid vs. placebo	Required (myelography, CT, or epidural venography consistent with symptoms and neurological findings)	Spinal stenosis subgroup Randomized: 37 Analyzed: 37	Age (years): 49 vs. 50 Male: 48% vs. 55% Baseline pain: Not reported Baseline function: Not reported Duration of symptoms: mean 14-17 months	A: Interlaminar epidural injection with 80 mg methylprednisolone (2 ml) and 1% procaine (5 ml) (n=23) B: Interlaminar epidural injection with saline (2 ml) and 1% procaine (5 ml) (n=14)	A vs. B (spinal stenosis subgroup) Pain Pain improved ≥75%: 22% (5/23) vs. 14% (2/14) at mean 20 months, RR 1.52 (95% CI 0.34 to 6.81) Other Outcomes Surgery: 26% (6/23) vs. 29% (4/14) at mean 20 months, RR 0.91 (95% CI 0.31 to 2.68)

Table 2. Trials of epidural corticosteroid injections for spinal stenosis

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Patient Characteristics	Type of Intervention	Results
Friedly, 2014[117] 6 weeks Good	Epidural corticosteroid vs. placebo	Required (MRI or CT with central canal stenosis)	Randomized: 400 (200 vs. 200)Analyzed: 386 (193 vs. 193)	Age (mean): 68 vs. 68 years Male: 42% vs. 48% Baseline leg pain (0-10 NS): 7.2 vs. 7.2 Baseline RDQ (0-24): 16 vs. 16 Duration of symptoms: 12% to 20% had symptoms <3 months, 21% to 34% for >5 years	A: Interlaminar (n=143) or transforaminal (n=57) injection with 1 to 3 ml triamcinolone (60 to 120 mg), betamethasone (6 to 12 mg), dexamethasone (8 to 10 mg), or methylprednisolone (60 to 120 mg) plus 0.25% to 1% lidocaine (3 ml), with fluoroscopic guidance (n=200) B: Interlaminar (n=139) or transforaminal (n=61) injection with 0.25% to 1% lidocaine, with fluoroscopic guidance (2 to 6 ml) (n=200)	A vs. B <u>Pain</u> Leg pain improved ≥30%: 49.2% (96/193) vs. 49.7% at 6 weeks (96/193), RR 1.0 (95% CI 0.82 to 1.22 Leg pain improved ≥50%: 38.3% (74/193) vs. 38.3% (74/193) at 6 weeks, RR 1.0 (95% CI 0.78 to 1.29) Leg pain (0-10): 7.2 vs. 7.2 at baseline; 4.4 vs. 5.0 at 3 weeks, difference –0.6 (95% CI –1.2 to –0.10; 4.4 vs. 4.6 at 6 weeks, 95% CI –0.2 (95% CI –0.8 to 0.4) BPI, SSQ symptoms and physical function, EQ-5D, GAD-7: No differences <u>Function</u> RDQ (0-24): 16 vs. 16 at baseline; 12 vs. 13 at 3 weeks, difference –1.8 (95% CI –2.8 to –0.9); 12 vs. 12 at 6 weeks, difference –1.0 (95% CI –2.1 to 0.1) RDQ improved ≥30%: 37.3% (72/193) vs. 31.6% (61/193) at 6 weeks, RR 1.18 (95% CI 0.90 to 1.56) RDQ improved ≥50%: 23.8% (46/193) vs. 20.2% (39/193) at 6 weeks RR 1.14 (95% CI 0.78 to 1.69) <u>Other Outcomes</u> PHQ-8: More improvement in group A (p=0.007) SSQ satisfaction "very" or "somewhat" satisfied: 67% (129/193) vs. 54% (104/191), RR 1.23 (95% CI 1.04 to 1.45)

Table 2. Trials of epidural corticosteroid injections for spinal stenosis

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Patient Characteristics	Type of Intervention	Results
Friedly, 2014[117] (cont.)						Interlaminar <u>Pain</u> Leg pain (0-10): 7.3 vs. 7.4 at baseline; 4.1 vs. 5.0 at 3 weeks, difference –0.9 (95% CI –1.5 to –0.3); 4.2 vs. 4.5 at 6 weeks, difference –0.3 (95% CI –1.0 to 0.4) <u>Function</u> RDQ (0-24): 17 vs. 16 at baseline; 11 vs. 13 at 3 weeks, difference –2.5 (95% CI –3.7 to –1.3); 12 vs. 13 at 6 weeks, difference –1.4 (95% CI –2.8 to –0.1) Transforaminal <u>Pain</u> Leg pain (0-10): 7.0 vs. 7.0 at baseline; 5.0 vs. 5.1 at 3 weeks, difference 0.0 (95% CI –0.9 to 0.9); 4.9 vs. 4.9 at 6 weeks, difference 0.1 (95% CI –0.9 to 1.0) <u>Function</u> RDQ (0-24): 14 vs. 15 at baseline; 13 vs. 13 at 3 weeks, difference –0.1 (95% CI –1.7 to 1.6); 12 vs. 12 at 6 weeks, difference 0.3 (95% CI –1.9 to 1.8) No interaction between race and treatment effects

Table 2. Trials of epidural corticosteroid injections for spinal stenosis

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Patient Characteristics	Type of Intervention	Results
Fukusaki, 1998[118] 3 months Poor	Epidural corticosteroid vs. placebo	Required (CT or MRI with central or lateral spinal canal stenosis)	Randomized: 53 Analyzed: 53	Mean age (years): 72 vs. 69 vs. 70 Male: 68% vs. 72% vs. 75% Baseline pain: Not reported Baseline function: Not reported Duration of symptoms: not reported	A: Interlaminar epidural injection with 40 mg methylprednisolone and 1% mepivacaine (8 ml) (n=19) B: Interlaminar epidural injection with 1% mepivacaine (8 ml) (n=18)C: Interlaminar epidural injection with normal saline (8 ml) (n=16)	A vs. B vs. C Function Walking distance: 87 vs. 92 vs. 23 at 1 week, 26 vs. 28 vs. 18 at 1 month, 10 vs. 13 vs. 11 at 3 months ($p<0.05$ for A and B vs. C at week 1 only) Good or excellent results (walk >20 meters): 63% (12/19) vs. 56% (10/18) vs. 12% (2/16) at 1 week: A vs. B, RR 1.14 (95% CI 0.66 to 1.94); A vs. C, RR 5.05 (95% CI 1.32 to 19.31); B vs. C, RR 4.44 (95% CI 1.14 to 17.33); 16% (3/19) vs. 17% (3/18) vs. 6.3% (1/16) at 1 month: A vs. B, RR 0.94 (95% CI 0.22 to 4.10); A vs. C, RR 2.53 (95% CI 0.29 to 21.98); B vs. C RR 2.67 (95% CI 0.30 to 23.14); 5.3% (1/19) vs. 5.6% (1/18) vs. 6.3% (1/16) at 3 months: A vs. B, RR 0.95 (95% CI 0.06 to 14.03); A vs. C RR 0.84 (95% CI 0.06 to 12.41); B vs. C, RR 0.89 (95% CI 0.06 to 13.07)
Huda, 2010[119] 6 months Fair	Steroid vs. steroid	Not specified	Randomized: 70 Analyzed: 70	Age (mean): 45 vs. 42 yearsMale: 54% vs. 66% Baseline pain (0-10 VAS): 6.4 vs. 6.3 Baseline function: Not reported Duration of symptoms: 18 vs. 17 months	A: Caudal epidural injection with 80 mg methylprednisolone (2 ml) plus 0.125% bupivacaine (5 ml) and normal saline (13 ml) (n=35) B: Caudal epidural injection with 80 mg triamcinolone acetate (80 mg) plus 0.125% bupivacaine (5 ml) and normal saline (13 ml) (n=35)	A vs. B Pain Pain (0-10 VAS): 6.3 vs. 6.4 at baseline; 5.6 vs. 5.4 at 1 month; 4.9 vs. 4.7 at 3 months; 3.6 vs. 4.8 at 6 months (p-values not reported and SD's not provided)Pain score improved >2 points on 0-10 VAS: 94% (33/35) vs. 86% (30/35) at 1 month, RR 1.10 (95% CI 0.94 to 1.30); 30/35 (86%) vs. 26/35 (74%) at 3 months, RR 1.15 (95 % CI 0.91 to 1.46); 28/35 (80%) vs. 21/35 (60%) at 6 months, RR 1.33 (95% CI 0.97 to 1.83) Function Claudication distance (m): 163 vs. 170 at baseline; 467 vs. 280 at 1 month; 587 vs. 312 at 3 months; 637 vs. 350 at 6 months (p-values not reported)

Table 2. Trials of epidural corticosteroid injections for spinal stenosis

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Patient Characteristics	Type of Intervention	Results
Koc, 2009[120] 6 months Fair	Epidural corticosteroid vs. placebo Epidural corticosteroid vs. other	Required (MRI with spinal canal stenosis)	Randomized: 33 Analyzed: 29	Age (mean): 61 vs. 63 vs. 53 years Male: 80% vs. 50% vs. 89% Baseline pain (0-100 VAS): 56 vs. 54 vs. 59 Baseline Roland Morris Disability Index (estimated from graph): 18 vs. 19 vs. 15 Duration of symptoms: 5.0 vs. 5.7 vs. 5.7 months	A: Interlaminar epidural injection with 60 mg triamcinolone acetonide (1.5 ml), 15 mg 0.5% bupivacaine (3 ml), and 0.9% NS (5.5 ml), with fluoroscopic guidance (n=10) B: Physical therapy 5 days/week for 2 weeks, including ultrasound for 10 minutes, hot pack for 20 minutes, and TENS for 20 minutes (n=10) C: No injection or physical therapy (n=9)	A vs. B vs. C <u>Pain</u> Pain intensity (mean VAS, 0 to 100; estimated from graph): 53 vs. 55 vs. 58 at baseline; 20 vs. 31 vs. 47 at 2 weeks; 21 vs. 32 vs. 56 at 1 month; 23 vs. 24 vs. 38 at 3 months; 26 vs. 22 vs. 33 at 6 months <u>Function</u> RDQ (mean, 0-24; estimated from graph): 18 vs. 19 vs. 15 at baseline; 8 vs. 12 vs. 12 at 2 weeks; 13 vs. 14 vs. 11 at 1 month; 11 vs. 11 vs. 10 at 3 months; 13 vs. 12 vs. 9 at 6 months NHP, pain (median, 0-100): 56 vs. 54 vs. 59 at baseline; 7.3 vs. 19 vs. 33 at 2 weeks; 36 vs. 31 vs. 20 at 1 month, 20 vs. 18 vs. 28 at 3 months; 23 vs. 23 vs. 20 at 6 months

Table 2. Trials of epidural corticosteroid injections for spinal stenosis

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Patient Characteristics	Type of Intervention	Results
Koc, 2009[120] (cont.)						Function NHP, physical mobility (median, 0-100): 42 vs. 42 vs. 42 at baseline; 22 vs. 31 vs. 31 at 2 weeks; 32 vs. 37 vs. 20 at 1 month; 31 vs. 32 vs. 31 at 3 months; 31 vs. 37 vs. 20 at 6 months NHP, energy (median, 0 to 100): 100 vs. 88 vs. 63 at baseline; 61 vs. 30 vs. 63 at 2 weeks; 100 vs. 24 vs. 61 at 1 month; 62 vs. 30 vs. 100 at 3 months; 82 vs. 49 vs. 63 at 6 months, (p>0.05 at all time points) NHP, sleep (median, 0 to 100): 58 vs. 56 vs. 56 at baseline; 26 vs. 32 vs. 12 at 2 weeks; 45 vs. 12 vs. 12 at 1 month; 14 vs. 12 vs. 29 at 3 months; 26 vs. 12 vs. 29 at 6 months, (p>0.05 at all time points) NHP, social isolation (median, 0 to 100): 42 vs. 29 vs. 0 at baseline; 22 vs. 18 vs. 0 at 2 weeks; 22 vs. 19 vs. 0 at 1 months; 32 vs. 11 vs. 0 at 3 months; 32 vs. 0 vs. 0 at 6 months, (p>0.05 at all time points) NHP, emotional reactions (median, 0 to 100): 45 vs. 33 vs. 24 at baseline; 13 vs. 17 vs. 0 at 2 weeks; 46 vs. 15 vs. 9.7 at 1 month; 41 vs. 0 vs. 9.7 at 3 months; 28 vs. 6.9 vs. 0 at 6 months, (p>0.05 at all time points)No differences across groups in total ambulation time, time to first symptoms

Table 2. Trials of epidural corticosteroid injections for spinal stenosis

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Patient Characteristics	Type of Intervention	Results
Manchikanti, 2009[121] 12 months Poor	Epidural corticosteroid vs. other	Not specified	Randomized: 82 Analyzed: 50, including 8 patients (8 vs. 0) missing data (preliminary analysis)	Age (mean): 62 vs. 61 years Male: 44% vs. 40% Baseline pain (0-10 NRS): 8.0 vs. 7.8 Functional status: Not reported Duration of symptoms: 114 vs. 164 months	A: Caudal epidural injection with 6 mg betamethasone, normal saline (6 mL), and 2% lidocaine (5 ml), with fluoroscopic guidance (n=25) B: Epidural adhesiolysis with fluoroscopic guidance, followed by injection of 6 mg betamethasone, 10% sodium chloride (6 ml), and 2% lidocaine (5 ml), with fluoroscopic and lumbar epidurogram guidance (n=25)	A vs. B <u>Pain</u> Pain (mean NRS, 0 to 10): 8.0 vs. 7.8 at baseline (p=0.47); 5.4 vs. 3.6 at 3 months, (p<0.0005); 6.0 vs. 3.8 at 6 months, (p<0.0005); 6.2 vs. 3.9 at 12 months Pain relief ≥50% from baseline: 28% (7/25) vs. 80% (20/25) at 3 months, RR 0.35 (95% CI 0.18 to 0.67); 12% (3/25) vs. 80% (20/25) at 6 months, RR 0.15 (95% CI 0.50 to 0.44); 4% (1/25) vs. 76% (19/25) at 12 months RR 0.05 (95% CI 0.00 to 0.36) <u>Function</u> ODI (0 to 50): 30 vs. 31 at baseline (p=0.80), 23 vs. 16 at 3 months, (p<0.0005), 25 vs. 16 at 6 months, (p<0.0005), 25 vs. 16 at 12 months, (p<0.0005) ODI improved ≥40% from baseline: 24% (6/25) vs. 80% (20/25) at 3 months, RR 0.30 (95% CI 0.14 to 0.62); 8% (2/25) vs. 76% (19/25) at 6 months RR 0.11 (95% CI 0.03 to 0.41); 0% (0/25) vs. 80% (20/25) at 12 months RR 0.02 (95% CI 0.00 to 0.38)

Table 2. Trials of epidural corticosteroid injections for spinal stenosis

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Patient Characteristics	Type of Intervention	Results
Manchikanti, 2012[122] 12 months Fair	Epidural corticosteroid vs. placebo	Not specified	Randomized: 120 Analyzed: 60, including 6 (3 vs. 30) with missing data (preliminary analysis)	Age (mean): 50 vs. 54 years Male: 63% vs. 40% Baseline pain (0 to 10 NRS): 8.1 vs. 8.1 Baseline ODI (0 to 50): 29 vs. 31 Duration of symptoms: 121 vs. 138 months	A: Interlaminar epidural injection with betamethasone (1 ml, dose not specified) plus 0.5% lidocaine (5 ml), with fluoroscopic guidance (n=30)B: Interlaminar epidural injection with 0.5% lidocaine (6 ml), with fluoroscopic guidance (n=30)	A vs. B Pain Pain (mean NRS, 0 to 10): 8.1 vs. 8.1 at baseline, (p=0.90); 4.1 vs. 3.7 at 3 months, (p=0.37); 4.2 vs. 3.8 at 6 months, (p=0.38); 4.2 vs. 4.0 at 12 months, (p=0.67) Pain relief ≥50% from baseline: 77% (23/30) vs. 77% (23/30) at 3 months, RR 1.0 (95% CI 0.76 to 1.32); 73% (22/30) vs. 73% (22/30) at 6 months, RR 1.0 (95% CI 0.74 to 1.36); 63% (19/30) vs. 70% (21/30) at 12 months, RR 0.90 (95% CI 0.63 to 1.30) Function ODI (0 to 50): 29 vs. 31 at baseline, (p=0.18); 16 vs.15 at 3 months, (p=0.73); 15 vs.16 at 6 months, (p=0.92); 16 vs.16 at 12 months, (p=0.84) ODI improved ≥50% from baseline: 63% (19/30) vs. 80% (24/30) at 3 months, RR 0.79 (95% CI 0.57 to 1.10); 67% (20/30) vs. 67% (20/30) at 6 months, RR 1.0 (95% CI 0.70 to 1.43); 60% (18/30) vs. 70% (21/30) at 12 months, RR 0.86 (95% CI 0.59 to 1.25)

Table 2. Trials of epidural corticosteroid injections for spinal stenosis

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Patient Characteristics	Type of Intervention	Results
Manchikanti 2012[123] See also: Manchikanti 2012[124] and Manchikanti 2008[95] 24 months Fair	Epidural corticosteroid vs. placebo	Not specified	Randomized: 100 Analyzed: 100, including 29 (14 vs. 15) with missing data	Age (mean): 56 vs. 57 years Male: 50% vs. 32% Baseline pain (NRS 0 to 10): 7.6 vs. 7.9 Baseline ODI (0 to 50): 28 vs. 40 Duration of symptoms: 105 vs. 94 months	A: Caudal epidural injection with betamethasone 6 mg (1 ml) plus lidocaine 0.5% (9 ml) with fluoroscopic guidance (n=50) B: Caudal epidural injection with lidocaine 0.5% (10 ml) with fluoroscopic guidance (n=50)	**A vs. B** Pain Pain (mean NRS, 0 to 10): 7.6 vs. 7.9 at baseline; 4.1 vs. 4.1 at 3 months; 4.2 vs. 4.1 at 6 months; 4.3 vs. 4.4 at 12 months; 4.7 vs. 4.6 at 24 months, (p=0.80 for group difference) Pain relief ≥50% from baseline: 62% (31/50) vs. 66% (33/50) at 3 months RR 0.94 (95% CI 0.70 to 1.26); 56% (28/50) vs. 58% (29/50) at 6 months, RR 0.97 (95% CI 0.63 to 145); 46% (23/50) vs. 48% (24/50) at 12 months, RR 0.97 (95% CI 0.63 to 145); 44% (22/50) vs. 42% (21/50) at 24 months, RR 1.05 (95% CI 0.67 to 1.65) Function ODI (0 to 50): 28 vs. 30 at baseline; 17 vs. 17 at 3 months; 7 vs.17 at 6 months; 17 vs.18 at 12 months; 17 vs.18 at 24 months, (p=0.60 for group difference) ODI improved ≥50% from baseline: 49% (24/50) vs. 58% (29/50) at 3 months, RR 0.83 (95% CI 0.57 to 1.20); 50% (25/50) vs. 54% (27/50) at 6 months RR 0.93 (95% CI 0.64 to 1.35); 50% (25/50) vs. 50% (25/50) at 12 months RR 1.0 (95 % CI 0.68 to 1.48); 46% (23/50) vs. 42% (21/50) at 24 months RR 1.10 (95 % CI 0.70 to 1.71)

Table 2. Trials of epidural corticosteroid injections for spinal stenosis

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Patient Characteristics	Type of Intervention	Results
Manchikanti, 2012[123] (cont.)						Global Assessment Success (pain improved ≥50% and ODI improved ≥50%): 48% (24/50) vs. 58% (29/50) at 3 months; 50% (25/50) vs. 54% 927/50) at 6 months; 46% (23/50) vs. 44% (22/50) at 12 months; 44% (22/50) vs. 38% (19/50) at 24 months Other Outcomes Opioid use (mg MED/day): 49 vs. 46 at baseline; 33 vs. 33 at 3 months; 34 vs. 34 at 6 months; 33 vs. 36 at 12 months; 32 vs. 36 at 24 months, (p>0.05 at all time points)
Nam, 2011[126] 3 months Poor	Epidural corticosteroid vs. placebo	Required (spinal stenosis on CT or MRI)	Randomized: 48 Analyzed: 36	Age (mean): 75 vs. 71 years Male: 24% vs. 26% Baseline pain (0-10 VAS): 7.3 vs. 7.4 Baseline ODI (0-100): 63 vs. 63 Duration of symptoms: 7.7 vs. 6.7 months	A: Transforaminal epidural injection with 20 mg triamcinolone (0.5 ml) plus 0.5% lidocaine (1.5 ml), with fluoroscopic guidance (n=17) B: Transforaminal epidural injection with 0.5% lidocaine (2 ml), with fluoroscopic guidance (n=19)	A vs. B Pain Pain (mean, 0-10 VAS): 7.3 vs. 7.4 at baseline; 3.4 vs. 4.0 at 2 weeks; 3.5 vs. 4.4 at 1 month; 3.8 vs. 4.7 at 3 months (p<0.05 a 2 weeks, 1 month, and 3 months) Function ODI (mean, 0-100): 63 vs. 63 at baseline; 42 vs. 44 at 2 weeks; 39 vs. 46 at 1 month; 37 vs. 49 at 3 months (p<0.05 at 2 weeks; 1 month; and 3 months) Global Assessment Success (pain improved >40%, ODI improved >20%, patient satisfaction good or excellent): 76% (13/17) vs. 42% (8/19), RR 1.82 (95% CI 1.0 to 3.27) In multiple regression, sex, age, BMI, duration, and radiographic findings not associated with likelihood of success

Table 2. Trials of epidural corticosteroid injections for spinal stenosis

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Patient Characteristics	Type of Intervention	Results
Ohtori, 2012[127] 1 month Fair	Epidural corticosteroid vs. other	Required (central stenosis, lateral recess, or foraminal stenosis) on x-ray and MRI	Randomized: 80 Analyzed: Not reported	Age (mean): 67 vs. 65 years Male: 45% vs. 55% Baseline pain (0-10 VAS): 7.5 vs. 7.9 Baseline ODI (0-100): 40 vs. 38 Duration of symptoms: 2.3 vs. 2.5 months	A: Transforaminal epidural injection with 3.3 mg dexamethasone plus 1% lidocaine (2 ml), with fluoroscopic guidance (n=40) B: Transforaminal epidural injection with 10 mg etanercept plus 1% lidocaine (2 ml), with fluoroscopic guidance (n=40)	A vs. B Pain Leg pain (0-10 VAS): 7.5 vs. 7.9 at baseline, 5.2 vs. 3.5 at 1 m (p=0.026) Leg numbness (0-10 VAS): 6.0 vs. 6.9 at baseline, 4.9 vs. 4.8 at 1 m (p>0.05) Function ODI (0-100): 40 vs. 38 at baseline, 30 vs. 28 at 1 m (p>0.05)
el Zahaar, 1991[115] Mean 20-21 months Poor	Epidural corticosteroid vs. placebo	Required (myelography or CT consistent with symptoms and neurological findings)	Spinal stenosis subgroup Randomized: 30 Analyzed: 30	Age (mean): 46 vs. 49 years Male: 54% vs. 65% Baseline pain: Not reported Baseline function: Not reported Duration of symptoms: 17 vs. 14 months	A: Caudal epidural injection with hydrocortisone (5 ml), 4% Carbocaine (4 ml), and saline (21 ml) (n=18) B: Caudal epidural injection with 4% Carbocaine (4 ml) plus saline (26 cc) (n=12)	A vs. B (spinal stenosis subgroup) Global Assessment Treatment success (>75% improvement in preinjection symptoms and no spinal surgery): 38% (7/18) vs. 33% (4/12) at 13-36 months; RR 1.17 (95% CI 0.43 to 3.13) Other Outcomes Subsequent surgery: 44% (8/18) vs. 58% (7/12) at 13-36 months, RR 0.68 (95% CI 0.33 to 1.40)

BMI=body mass index; BPI=Brief Pain Inventory; CI=confidence interval; CT=computed tomography; EQ-5D=EuroQoL five-level version; GAD-7=Generalized Anxiety Disorder 7-item scale; MED=morphine equivalent dose; MRI=magnetic resonance imaging; NHP=Nottingham Health Profile; NRS=numeric rating scale; NS=normal saline; ODI=Oswestry Disability Index; PHQ-8=Patient Health Questionnaire 8-item; RDQ=Roland-Morris Disability Questionnaire; RR=relative risk; SD=standard deviation; SSQ=Social Support Questionnaire; TENS=transcutaneous electrical nerve stimulation; VAS=visual analog scale.

Table 3. Trials of epidural corticosteroid injections for nonradicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Lee JH 2009[128] 4 months Fair	Transforaminal versus interlaminar epidural injection with corticosteroid plus local anesthetic	Not specified	Randomized: 202 Analyzed: 192 (116 vs. 76) at 2 weeks to 4 months	A: Transforaminal epidural injection with 20 mg triamcinolone acetonide (0.5 ml) with lidocaine 0.5% (4 ml) with fluoroscopic guidance (n=116) B: Interlaminar epidural injection with 40 mg triamcinolone acetonide (1 ml) with lidocaine 0.5% (8 ml) with fluoroscopic guidance (n=76)	A vs. B: Age (mean): 42 vs. 42 in herniated disc group, 62 vs. 62 years in spinal stenosis group Male: 61% vs. 50% in herniated disc group, 35% vs. 26% in spinal stenosis group Duration of pain: 4.5 vs. 3.7 m in herniated disc group, 14 vs. 16 months in spinal stenosis group Baseline pain (0-10 NRS): 6.5 vs. 6.8 in herniated disc group, 6.6 vs. 6.6 in spinal stenosis group Baseline function: Not reported	Herniated disc group Roland pain score (0 to 5): 3.34 vs. 3.25 at baseline, 1.55 vs. 1.53 at 2 w, 1.57 vs. 1.59 at 2 m, 1.66 vs. 1.72 at 4 m Patient Satisfaction Index score 1 or 2 (1 to 4 scale): 78% (46/59) vs. 85% (29/34) at 2 w, RR 0.91 (95% CI 0.75 to 1.11); 83% (49/59) vs. 85% (29/34) at 2 m, RR 0.97 (95% CI 0.81 to 1.17); 76% (45/59) vs. 85% (29/34) at 4 m, RR 0.89 (95% CI 0.73 to 1.09) Pain score improved ≥2 points (0-10 pain NRS): 68% (40/59) vs. 65% (22/34) at 2 w, RR 1.05 (95% 0.77 to 1.42); 75% (44/59) vs. 65% (22/34) at 2 m, RR 1.15 (95% CI 0.86 to 1.54); 66% (39/59) vs. 50% (17/34) at 4 m, RR 1.32 (95% CI 0.90 to 1.94) Spinal stenosis group Roland pain score (0 to 5): 3.39 vs. 3.31 at baseline, 1.6 vs. 2.19 at 2 w, 1.67 vs. 2.12 at 2 m, 1.79 vs. 2.19 at 4 m ($p<0.05$ at 2 w, 2 m, and 4 m) Patient Satisfaction Index score 1 or 2 (1 to 4 scale): 75% (43/57) vs. 64% (27/42) at 2 w, RR 1.17 (95% CI 0.90 to 1.54); 70% (40/57) vs. 57% (25/42) at 2 m, RR 1.18 (95% CI 0.87 to 1.59); 67% (38/57) vs. 52% (22/42) at 4 m, RR 1.27 (95% CI 0.90 to 1.79) Pain score improved ≥2 points (0-10 pain NRS): 54% (31/57) vs. 36% (15/42) at 2 w, RR 1.52 (95% CI 0.95 to 2.44); 61% (35/57) vs. 36% (15/42) at 2 m, RR 1.72 (95% CI 1.09 to 2.71); 51% (29/57) vs. 31% (13/42) at 4 m, RR 1.64 (95% CI 0.98 to 2.76)

Table 3. Trials of epidural corticosteroid injections for nonradicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Manchikanti, 2012[129] See also: Manchikanti 2011[130] and Manchikanti 2008[131] 24 months Fair	Epidural corticosteroid vs. placebo	Not specified	Randomized: 120 Analyzed: 120, including 22 (10 vs. 12) lost to followup	A: Caudal epidural with 6 mg betamethasone or 40 mg methylprednisolone (1 ml) with lidocaine 0.5% (9 ml) with fluoroscopic guidance (n=60) B: Caudal epidural with lidocaine 0.5% (10 ml) with fluoroscopic guidance (n=60)	Age (mean): 44 vs. 48 years Male: 37% vs. 22% Duration of pain (months): 92 vs. 100 Baseline pain (0 to 10 NRS): 7.9 vs. 8.0 Baseline ODI (0 to 50): 28 vs. 28 Duration of symptoms (months): 92 vs. 100	A vs. B <u>Pain</u> Pain (mean NRS, 0 to 10): 7.9 vs. 8.0 at baseline, 3.6 vs. 4.2 at 3 months, 3.7 vs. 4.1 at 6 months, 3.8 vs. 4.3 at 12 months, 4.0 vs. 4.4 at 24 months (p=0.52 for group difference) Pain relief ≥50% from baseline: 80% (48/60) vs. 68% (41/60) at 3 months, 80% (48/60) vs. 68% (41/60) at 6 months, 72% (43/60) vs. 63% (38/60) at 12 months, 65% (39/60) vs. 57% (34/60) at 24 months <u>Function</u> ODI (0 to 50): 28 vs. 28 at baseline, 14 vs. 16 at 3 months, 14 vs. 16 at 6 months, 14 vs. 16 at 12 months, 15 vs. 16 at 24 months (p=0.21 for group difference) ODI improved ≥50% from baseline: 75% (45/60) vs. 60% (36/60) at 3 months, 75% (45/60) vs. 62% (37/60) at 6 months, 72% (43/60) vs. 56% (34/60) at 12 months, 63% (38/60) vs. 56% (34/60) at 24 months <u>Other Outcomes</u> Opioid use (mg MED/day): 36 vs. 34 at baseline, 30 vs. 29 at 3 months, 31 vs. 32 at 6 months, 30 vs. 32 at 12 months, 30 vs. 31 at 24 months (p=0.45 for group difference)

Table 3. Trials of epidural corticosteroid injections for nonradicular pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Manchikanti, 2013[132] See also: Manchikanti 2012[133] 24 months Fair	Epidural corticosteroid vs. placebo	Not specified	Randomized: 120 Analyzed: 120, including 13 (9 vs. 4) with missing data	A: Interlaminar epidural injection with 6 mg betamethasone (1 ml) and lidocaine 0.5% (5 ml) with fluoroscopic guidance (n=60) B: Interlaminar epidural injection with lidocaine 0.5% (6 ml) with fluoroscopic guidance (n=60)	Age (mean): 43 vs. 41 years Male: 40% vs. 23% Race: Not reported Duration of pain (months): 129 vs. 104 Baseline pain (NRS 0 to 10): 7.7 vs. 8.0 Baseline ODI (0 to 50): 29 vs. 31 Duration of symptoms (months): 129 vs. 104	A vs. B <u>Pain</u> Pain (mean NRS, 0 to 10): 7.7 vs. 8.0 at baseline, 3.5 vs. 3.6 at 3 months, 3.6 vs. 3.9 at 6 months, 3.7 vs. 3.7 at 12 months, 3.6 vs. 3.9 at 24 months (p=0.38 for group difference) Pain relief ≥50% from baseline: 80% (48/60) vs. 68% (41/60) at 3 months, 80% (48/60) vs. 68% (41/60) at 6 months, 72% (43/60) vs. 63% (38/60) at 12 months, 65% (39/60) vs. 57% (34/60) at 24 months <u>Function</u> ODI (0 to 50): 29 vs. 31 at baseline, 15 vs. 15 at 3 months, 14 vs. 15 at 6 months, 15 vs. 15 at 12 months, 15 vs. 15 at 24 months (p=0.29 for group difference) ODI improved ≥50% from baseline: 75% (45/60) vs. 60% (36/60) at 3 months, 75% (45/60) vs. 62% (37/60) at 6 months, 72% (43/60) vs. 56% (34/60) at 12 months, 63% (38/60) vs. 56% (34/60) at 24 months <u>Other Outcomes</u> Opioid use (mg MED/day): 53 vs. 57 at baseline, 40 vs. 36 at 3 months, 42 vs. 36 at 6 months, 42 vs. 36 at 12 months, 42 vs. 36 at 24 months (p=0.45 for group difference)

NRS = numeric rating scale; ODI=Oswestry Disability Index.

Table 4. Trials of epidural corticosteroid injections for postsurgery pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Subject Characteristics	Results
Devulder, 1999[135] 6 months Poor	Epidural corticosteroid vs. other	MRI	Randomized: 60 Analyzed: 60	A: Transforaminal epidural injection to nerve root sleeve with 40 mg methylprednisolone, 0.5% bupivacaine (1 ml) (total 2 ml) (n=20) B: Transforaminal epidural injection to nerve root sleeve with 40 mg methylprednisolone, 1,500 U hyaluronidase, and 0.5% bupivacaine (1 ml) (total 2 ml) (n=20) C: Transforaminal epidural injection to nerve root sleeve with 1,500 U hyaluronidase and 0.5% bupivacaine (1 ml), with fluoroscopic guidance (total 2 ml) (n=20)	Age (mean): 48 vs. 47 vs. 44 years Male: 50% vs. 40% vs. 30% Race: Not reported Duration of symptoms: Not reported Baseline pain: Not reported Baseline function: Not reported Duration of symptoms: Not reported	A vs. B vs. C <u>Pain</u> Pain improved >50%: 40% (8/20) vs. 35% (7/20) vs. 35% (7/20) at 1 month (p=0.71), 40% (8/20) vs. 25% (5/20) vs. 25% (5/20) at 3 months (p=0.69), 35% (7/20) vs. 20% (4/20) vs. 25% (5/20) at 6 months (p=0.66)

Table 4. Trials of epidural corticosteroid injections for postsurgery pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Subject Characteristics	Results
Manchikanti 2012[136] 24 months Poor	Epidural corticosteroid vs. other	Not specified	Randomized:180 Analyzed: 120, including 35 (33 vs. 2) with missing data	A: Caudal epidural injection with 6 mg betamethasone, 2% lidocaine (5 ml), normal saline (6 ml), with fluoroscopic guidance (n=60) B: Caudal epidural adhesiolysis with 6 mg betamethasone, 2% lidocaine (5 ml), and hypertonic (10%) saline (6 ml) (n=60)	Age (mean): 52 vs. 52 years Male: 42% vs. 42%Duration of symptoms (months): 186 vs. 196Baseline pain (0-10 NRS): 7.9 vs. 8.1 Baseline ODI (0-50): 29 vs. 31Duration of symptoms (months): 186 vs. 196	A vs. B Pain Pain scores (0-10): 7.9 vs. 8.1 at baseline (p=0.22), 4.9 vs. 3.4 at 3 months (p<0.0005), 5.8 vs. 3.7 at 6 months (p<0.0005), 6.1 vs. 4.0 at 12 months (p<0.0005), 6.2 vs. 3.6 at 24 months Pain relief >50%: 35% (21/60) vs. 90% (54/60) at 3 months; 18% (11/60) vs. 85% (51/60) at 6 months; 12% (7/60) vs. 73% (44/60) at 12 months Function ODI (0-50): 29 vs. 31 at baseline (p=0.001), 20 vs. 15 at 3 months (p<0.0005), 22 vs. 15 at 6 months (p<0.0005), 23 vs. 16 at 12 months (p<0.0005), 23 vs. 14 at 24 months ODI improved >40%: 37% (22/60) vs. 92% (55/60) at 3 months; 25% (15/60) vs. 88% (53/60) at 6 months; 13% (8/60) vs. 77% (46/60) at 12 months Global Assessment Success (pain relief ≥50% and ODI improved >50%): 23% (14/60) vs. 78% (47/60) at 3 months, 7% (4/60) vs. 73% (44/60) at 6 months, 5% (3/60) vs. 70% (42/60) at 12 months, 5% (3/60) vs. 82% (49/60) at 24 months Other Outcomes Opioid intake (mg MED/day): 41 vs. 64 at baseline (p=0.001), 42 vs. 42 at 3 months (p=0.67), 47 vs. 49 at 6 months (p=0.71), 40 vs. 41 at 12 months (p=0.72)

Table 4. Trials of epidural corticosteroid injections for postsurgery pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Subject Characteristics	Results
Meadeb, 2001[137] 4 months Poor	Epidural corticosteroid vs. other	CT or MRI	Randomized: 58 Analyzed: 47	A: Caudal epidural injection with 125 mg prednisolone acetate, with fluoroscopic guidance (n=16) B: Forceful caudal epidural injection with saline (20 ml), with fluoroscopic guidance (n=16) C: Forceful caudal epidural injection with saline (20 ml) plus 125 mg prednisolone acetate, with fluoroscopic guidance (n=15)	Age (mean): 43 vs. 47 vs. 45 years Male: 44% vs. 50% vs. 27% Duration of symptoms (months): 31 vs. 35 vs. 20 Baseline pain (0-100 VAS): 55 vs. 70 vs. 60 Dallas ADL (0-100: 66 vs. 71 vs. 61) Duration of symptoms (months): 31 vs. 35 vs. 20	A vs. B vs. C <u>Pain</u> Pain (mean, 0-100 VAS): 55 vs. 70 vs. 60 at baseline; 48 vs. 66 vs. 58 at 30 days; 53 vs. 62 vs. 52 at 60 days; 45 vs. 60 vs. 58 at 120 days Pain improved ≥15%: 25% (4/16) vs. 44% (7/16) vs. 20% (3/215) at 120 days <u>Function</u> Dallas ADL (mean, 0-100 VAS): 66 vs. 71 vs. 61 at baseline; 58 vs. 69 vs. 62 at 30 days; 60 vs. 68 vs. 60 at 60 days; 58 vs. 67 vs. 65 at 120 days

Table 4. Trials of epidural corticosteroid injections for postsurgery pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Subject Characteristics	Results
Rahimzadeh 2014[138] 4 weeks Poor	Epidural injection with hyaluronidase	MRI	Randomized: 25 Analyzed: 25	A. Transforaminal lumbar epidural injection of bupivacaine 5 mg (1 mL) + triamcinolone 40 mg (1 mL) + saline solution 10% (2 mL) + hyaluronidase 1500 IU reconstituted in 1 mL distilled water (n=12) B. Transforaminal lumbar epidural injection of bupivacaine 5 mg (1 mL) + triamcinolone 40 mg (1 mL) + saline solution 10% (2 mL) + 1 mL distilled water (n=13)	A vs. B : Age (mean): 46 vs. 48 years Male: 58% vs. 54% Duration of symptoms (months): 7 vs. 8 Baseline pain (0-10 VAS): 3.1 vs. 3.4	A vs. B Pain VAS (median IQR, 0-10): 0 vs. 0 at baseline, 1 vs. 1 at week 1, 1 vs. 1.5 at week 2, 1.5 vs. 2.5 at week 4 ($p<0.001$ at week 4) % patients with >50% decrease in numerical rating of pain score (NRS): 100% (12/12) vs. 100% (13/13) at baseline, 92% (11/12) vs. 77% (10/13) at week 1, 92% (11/12) vs. 54% (7/13) at week 2, 83% (10/12) vs. 46% (6/13) at week 4

Table 4. Trials of epidural corticosteroid injections for postsurgery pain

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Subject Characteristics	Results
Rocco, 1989[139] 6 months Fair	Epidural corticosteroid vs. other	Not specified	Randomized: 24 Analyzed: 22	A: Epidural injection with 75 mg triamcinolone diacetate (1.9 ml) plus 5% lidocaine (2 ml) and normal saline (8 ml) (n=8) B: Epidural injection with 8 mg morphine (8 ml) plus 5% lidocaine (2 ml) (n=7) C: Epidural injection with 75 mg triamcinolone diacetate (1.9 ml) and 8 mg morphine (8 ml) plus 5% lidocaine (2 ml) (n=7)	Age (mean): 49 vs. 50 vs. 52 years Male: 50% vs. 29% vs. 57% Duration of symptoms: Not reported Baseline pain: Not reported Baseline function: Not reported Duration of symptoms: Not reported	A vs. B vs. C <u>Pain</u> Pain (mean, 0-10 VAS): 6.4 vs. 4.0 vs. 5.0 at baseline; 4.2 vs. 5.7 vs. 5.8 at 6 months (p>0.05); Pain improved: better, no change, worse, based on number of injections: 12% (1/8) vs. 0% (0/7) vs. 0% (0/7) at 6 months

ADL=Activities of Daily Living; NRS=numeric rating scale; ODI=Oswestry Disability Index; VAS=visual analog scale.

Table 5. Trials of facet joint injections

Author, Year Duration of Followup Quality Rating	Comparison	Facet Joint Block (% pain relief) Requirements	Imaging Requirements for Patient Selection	Number Randomized and Analyzed	Patient Characteristics	Type of Intervention	Results
Ackerman 2008[140] 12 weeks Fair	Intra-articular vs. medial branch corticosteroid injection	Not required	Required (SPECT, excluded if MRI normal)	Randomized: 46 (23 vs. 23) Analyzed: 46 at 12 w	A vs. B Age (mean): 41 vs. 38 years Male: 52% vs. 61% Duration of pain: Not reported by group, mean 7.6 w overall Baseline pain (0-10 NRS): 7.8 vs. 8.1 Baseline function (0-100 ODI): 31 vs. 34	A: Intra-articular facet joint injection with 8 mg triamcinolone (0.2 ml) and 1% lidocaine (0.5 ml), with fluoroscopic guidance B: Medial branch block with at medial branches of doral rami with 8 mg triamcinolone (0.2 ml) and 1% lidocaine (0.5 ml), with fluoroscopic guidance	A vs. B Pain (0-10 NRS): 7.8 vs. 8.1 at baseline, 3.2 vs. 5.4 at 12 w ($p<0.05$) Pain relief ≥50% (0-10 NRS): 61% (14/23) vs. 26% (6/23) at 12 w, RR 2.33 (95% CI 1.09 to 5.00) ODI (0-100): 31 vs. 34 at baseline, 12 vs. 23 at 12 w ($p<0.05$)

Table 5. Trials of facet joint injections

Author, Year Duration of Followup Quality Rating	Comparison	Facet Joint Block (% pain relief) Requirements	Imaging Requirements for Patient Selection	Number Randomized and Analyzed	Patient Characteristics	Type of Intervention	Results
Carette, 1991[141] 6 months Fair	Facet corticosteroid vs. placebo	Single intra-articular facet joint block (≥50% pain relief)	Not required	Randomized: 101 Analyzed: 95	Age (mean): 42 vs. 43 years Male: 51% vs. 58% Duration of pain (median, months): 18 vs. 24 Baseline pain (0-10 VAS): 6.3 vs. 6.2 Baseline Sickness Impact Profile (0 to 100): 11 vs. 13 Duration of symptoms at enrollment: ≥6 months (median 18-24 months)	A: Intra-articular facet joint injection with 20 mg methylprednisolone acetate (1 ml) plus isotonic saline (1 ml), with fluoroscopic guidance B: Intra-articular facet joint injection with isotonic saline (2 ml), with fluoroscopic guidance	A vs. B <u>Pain</u> Pain (0-10 VAS): 4.5 vs. 4.7 at 1 m, 4.0 vs. 5.0 at 6 m (p<0.05) McGill pain questionnaire, pain rating index (scale NR): 19.0 vs. 22.8 at 1 m (p>0.05); 17.1 vs. 21.6 at 6 m (p>0.05) McGill pain questionnaire, present pain intensity (0 to 5): 2.3 vs. 2.6 at 1 m (p>0.05); 2.1 vs. 2.9 at 6 m (p>0.05) <u>Function</u> Sickness Impact Profile, overall (0-100): 9.3 vs. 9.8 at 1 m (p>0.05), 7.8 vs. 10.8 at 6 m (p>0.05) Sickness Impact Profile, physical dimension (0-100): 5.2 vs. 6.3 at 1 m (p>0.05), 4.3 vs. 7.9 at 6 m (p<0.05) Sickness Impact Profile, psychosocial dimension: 8.2 vs. 9.0 at 1 m (p>0.05); 7.7 vs. 9.0 at 6 m (p>0.05) Bed rest in past 2 weeks (days): 0.3 vs. 0.1 at 1 m (p>0.05), 0.2 vs. 0.4 at 6 m (p>0.05) Complete restriction in main activity in past 2 weeks (days): 3.2 vs. 2.2 at 1 m (p>0.05); 1.3 vs. 2.9 at 6 m (p>0.05) <u>Global Assessment</u> Overall effect (7 category scale), "very marked" or "marked improvement": 42% (20/48) vs. 33% (16/48) at 1 m (p=0.53), 46% (22/48) vs. 15% (7/47) at 6 m (p=0.002)

Table 5. Trials of facet joint injections

Author, Year Duration of Followup Quality Rating	Comparison	Facet Joint Block (% pain relief) Requirements	Imaging Requirements for Patient Selection	Number Randomized and Analyzed	Patient Characteristics	Type of Intervention	Results
Civelek, 2012[142] 12 months Fair	Facet corticosteroid vs. other	Facet joint injection group: Not required Facet denervation group: Facet joint block, methods not reported (% pain relief NR)	Unclear	Randomized: 100 Analyzed: 100	Age (mean): 56 vs. 52 years Male: 29% vs. 30% Duration of symptoms (mean months): 19 vs. 19 Baseline pain score (0-10 NRS): 8.5 vs. 8..2 Baseline EQ-5D (5-15): 14 vs. 15 Duration of symptoms: 19 months (mean)	A: Extra-articular facet joint injection to site of medial branch of the dorsal spinal ramus with 40 mg methylprednisolone (1 ml) and 1% lidocaine (8 ml), with fluoroscopic guidance B: Radiofrequency facet denervation at medial branch of the dorsal spinal ramus performed at 80° C for 120 s, with fluoroscopic guidance and electrostimulation confirmation	A vs. B <u>Pain</u> Pain (0-10 VNS): 8.5 vs. 8.2 at baseline, 3.4 vs. 2.2 at 1 m, 4.4 VS. 2.5 at 6 m, 4.9 vs. 2.6 at 12 m ($p<0.01$ at all time points except baseline)Pain improved >50%: 80% vs. 100% at 1 m, 68% vs. 90% at 6 m, 62% vs. 88% at 12 m <u>Other Outcomes</u> NASS patient satisfaction questionnaire (1-4): 1.3 vs. 1.3 at 1 m ($p>0.05$), 1.7 vs. 1.4 at 6 m ($p>0.05$), 2.0 vs. 1.5 at 12 m ($p=0.04$) NASS score 1 or 2: 88% vs. 100% at 1 m, 75% vs. 90% at 6 m, 66% vs. 88% at 12 m EQ-5D (scale, 5-15): 15 vs. 14 at baseline, 6.0 vs. 5.6 at 1 m, 7.2 vs. 6.5 at 6 m, 8.0 vs. 6.7 at 12 m ($p>0.05$ at all time points) EQ-5D <9: 89% vs. 98% at 1 m, 75% vs. 92% at 6 m, 69% vs. 90% at 12 m

Table 5. Trials of facet joint injections

Author, Year Duration of Followup Quality Rating	Comparison	Facet Joint Block (% pain relief) Requirements	Imaging Requirements for Patient Selection	Number Randomized and Analyzed	Patient Characteristics	Type of Intervention	Results
Fuchs, 2005[143] 6 months Fair	Facet corticosteroid vs. other	Not required	Required (CT)	Randomized: 60 Analyzed: 59	Age (mean): 66 vs. 65 years Male: 20% vs. 40%Duration of symptoms: Not reported (minimum 3 mos.) Baseline pain score (0-100 VAS): 69 vs. 69 Baseline RDQ (0-24): 12 vs. 12 Duration of symptoms: >3 months	A: Intra-articular facet joint injection with 10 mg triamcinolone acetonide (1 ml), with CT fluoroscopic guidanceB: Intra-articular facet joint injection with 10 mg sodium hyaluronate (1 ml), with CT fluoroscopic guidance	A vs. B Pain Pain (0-100 VAS): 69 vs. 69 at baseline, 30 vs. 41 at 1 m, 33 vs. 38 at 6 m (p>0.05) Function Roland Morris (0-24): 12 vs. 12 at baseline, 7.2 vs. 8.4 at 1 m, 8.3 vs. 7.1 at 6 m (p>0.05) ODI (0-50): 18 vs. 21 at baseline, 12 vs. 14 at 1 m, 13 vs. 13 at 6 m (p>0.05) Low Back Outcome Score (0-75): 33 vs. 32 at baseline, 44 vs. 43 at 1 m, 44 vs. 46 at 6 m (p>0.05) Other Outcomes SF-36: "Similar improvement" between groups on all subscales

Table 5. Trials of facet joint injections

Author, Year Duration of Followup Quality Rating	Comparison	Facet Joint Block (% pain relief) Requirements	Imaging Requirements for Patient Selection	Number Randomized and Analyzed	Patient Characteristics	Type of Intervention	Results
Galiano, 2007[144] 6 weeks Fair	CT- vs. ultrasound guided	Not required	Required (CT or MRI)	Randomized: 40 Analyzed: Not reported	Age (mean): 49 vs. 49 years Male: 35% vs. 70% Duration of symptoms: Not reported (minimum 6 m) Baseline pain score (0-10 VAS): 71 vs.73 Baseline function: Not reported Duration of symptoms: >6 months	A: CT-guided intra-articular facet joint injection with 4 mg betamethasone (1 ml), 1% lidocaine (1 ml), and 0.5% bupivacaine hydrochloride (1 ml) B: Ultrasound-guided intra-articular facet joint injection with 4 mg betamethasone (1 ml), 1% lidocaine (1 ml), and 0.5% bupivacaine hydrochloride (1 ml)	A vs. B <u>Pain</u> Pain (0-100 VAS, data estimated from graph): 46 vs. 38 at 6 w ($p<0.01$)

Table 5. Trials of facet joint injections

Author, Year Duration of Followup Quality Rating	Comparison	Facet Joint Block (% pain relief) Requirements	Imaging Requirements for Patient Selection	Number Randomized and Analyzed	Patient Characteristics	Type of Intervention	Results
Lakemeier, 2013[145] 6 months Good	Facet corticosteroid vs. other	Single intra-articular facet joint block (≥50% pain relief)	Required (MRI)	Randomized: 56 Analyzed: 52	Age (mean): 56 vs. 58 years Male: 62% vs. 65% Duration of symptoms: Not reported (≥24 months required for inclusion) Baseline pain score (0-10 VAS): 7.0 vs. 6.6 Baseline ODI (0-100): 39 vs. 41 Duration of symptoms: >24 months	A: Intra-articular facet injection with betamethasone 3 mg (1 ml) plus 0.5% bupivacaine (0.5 ml), with fluoroscopic guidance; sham denervation (electrodes not connected to generator) B: Radiofrequency denervation of facet joint: 0.5% bupivacaine (1ml), radiofrequency applied to site of the dorsal ramus medial branch of the target facet joint at 80°C for 90 seconds, with fluoroscopic guidance and electrostimulation confirmation	A vs. B Pain Pain (0-10 VAS): 7.0 vs. 6.6 at baseline, 5.4 vs. 4.7 at 6 m; improvement 1.6 vs. 1.9 (p=0.35) Function Roland Morris Disability Questionnaire (0-24): 1.32 vs. 12.8 at baseline, 9.0 vs. 9.1 at 6 m; improvement 4.2 vs. 3.7 (p=0.51) ODI (0-100): 39 vs. 41 at baseline, 33 vs. 28 at 6 m, improvement 5.7 vs. 13 (p=0.46) Other Outcomes Analgesic intake: "No measurable differences," data not provided

Table 5. Trials of facet joint injections

Author, Year Duration of Followup Quality Rating	Comparison	Facet Joint Block (% pain relief) Requirements	Imaging Requirements for Patient Selection	Number Randomized and Analyzed	Patient Characteristics	Type of Intervention	Results
Lilius, 1989[146] 3 months Poor	Facet corticosteroid vs. placebo Approach	Not required	Not required	Randomized: 109 Analyzed: 104	Age (mean): 44 years overallMale: 44% overall Duration of symptoms: Not reported Baseline pain (0 to 100 VAS): 49 overall Baseline function: Not reported Duration of symptoms: >3 months"No important differences between groups for age, sex, duration of symptoms, previous operations"; data not reported by group	A: Intra-articular facet joint injection with 80 mg methylprednisolone acetate (2 ml) plus 30 mg bupivacaine (6 ml), with fluoroscopic guidance B: Extra-articular (peri-capsular) facet joint injection with 80 mg of methylprednisolone (2 ml) + 30 mg bupivacaine (6 ml), with fluoroscopic guidance C: Intra-articular facet join injection with 8 ml saline, with fluoroscopic guidance	A vs. B vs. C Pain Pain (VAS, 0-100, estimated from graph): 45 vs. 52 vs. 52 at baseline, 31 vs. 35 vs. 41 at 2 w, 40 vs. 40 vs. 42 at 6 w, 44 vs. 42 vs. 43 at 3 m (p=0.33 vs. A vs. B, p=0.72 for A + B vs. C) Function Disability score: Data not reported (p=0.99 for A vs. B, p=0.89 for A + B vs. C)Return to work: No difference between groups (data not reported)

Table 5. Trials of facet joint injections

Author, Year Duration of Followup Quality Rating	Comparison	Facet Joint Block (% pain relief) Requirements	Imaging Requirements for Patient Selection	Number Randomized and Analyzed	Patient Characteristics	Type of Intervention	Results
Manchikanti, 2010[148] See also: Manchikanti, 2008[149] 24 months Fair	Facet corticosteroid vs. placebo	Two medial branch blocks (≥80% pain relief)	Not required	Randomized: 120 Analyzed: 12, including 24 patients with missing data	Age (mean): 46 vs. 48 years Male: 45% vs. 35% Duration of symptoms (months): 108 vs. 108 Baseline pain (0-10 NRS): 7.9 vs. 8.2 Baseline ODI (0-50): 26 vs. 27 Duration of symptoms: >6 months (mean 108 months)	A: Extra-articular facet joint injection with 0.5-1.5 ml solution of 0.15 mg/ml betamethasone and 0.25% bupivacaine or bupivacaine plus Sarapin in equal amounts, with fluoroscopic guidance B: Extra-articular facet joint injection with 0.5-1.5 ml solution of 0.25% bupivacaine or bupivacaine and Sarapin in equal amounts, with fluoroscopic guidance	A vs. B <u>Pain</u> Pain (mean NRS, 0 to 10): 7.9 vs. 8.2 at baseline, 3.5 vs. 3.8 at 3 m, 3.3 vs. 3.6 at 6 m, 3.5 vs. 3.7 at 12 m, 3.2 vs. 3.5 at 24 m (p>0.05 at all time points)Pain relief ≥50% from baseline: 82% (49/60) vs. 83% (50/60) at 3 m, 93% (56/60) vs. 83% (50/60) at 6 m, 85% (51/60) vs. 82% (49/60) at 12 m, 90% (54/60) vs. 85% (51/60) at 24 m <u>Function</u> ODI (0 to 50): 26 vs. 27 at baseline, 14 vs. 13 at 3 m, 12 vs. 13 at 6 m, 12 vs. 12 at 12 m, 11 vs. 12 at 24 m (p>0.05 at all time points) ODI improved ≥40% from baseline: 72% (43/60) vs. 82% (49/60) at 3 m, 78% (47/60) vs. 83% (50/60) at 6 m, 78% (47/60) vs. 85% (51/60) at 12 m, 88% (53/60) vs. 87% (52/60) at 24 m <u>Other Outcomes</u> Opioid use (mg MED/day): 37 vs. 31 at baseline (p=0.29), 33 vs. 29 at 12 m (p=0.41), 30 vs. 27 at 24 m (p=0.55)

Table 5. Trials of facet joint injections

Author, Year Duration of Followup Quality Rating	Comparison	Facet Joint Block (% pain relief) Requirements	Imaging Requirements for Patient Selection	Number Randomized and Analyzed	Patient Characteristics	Type of Intervention	Results
Manchikanti, 2001[147] Unclear (up to 2.5 years) Poor	Facet corticosteroid vs. placebo	Two facet joint blocks (% pain relief NR)	Not required	Randomized: 84 Analyzed: 73	Age (mean): 47 vs. 46 years Male: 44% vs. 36% Duration of symptoms (years): 1.7 vs. 1.8 Baseline pain (0-10 NRS): 7.7 vs. 7.6 Functional status (scale not reported): 3.7 vs. 3.6 Duration of symptoms: >6 months (mean 21 months)	A: Extra-articular facet joint injection of the medial branch of the medial branch block with 0.5-1 ml of 1 mg/ml methylprednisolone and 0.5% lidocaine or 0.25% bupivacaine plus equal volume of Sarapin, with fluoroscopic guidance B: Extra-articular facet joint injection of the medial branch of the medial branch block with 0.5-1 ml of 0.5% lidocaine or 0.25% bupivacaine plus equal volume of Sarapin, with fluoroscopic guidance	A vs. B <u>Pain</u> Pain (0-10 NRS): 7.7 vs. 7.6 at baseline, 3.3 vs. 3.5 post-treatment (duration unclear) (p>0.05) Pain relief >50%: 100% (41/41) vs. 100$ (32/32) at 3 m, 88% (36/41) vs. 75% (24/32) at 6 m, 17% (7/41) vs. 25% (8/32) at 1 y, 5% (2/41) vs. 16% (5/32) at >12 m <u>Function</u> Functional status: (scale not reported) 3.7 vs. 3.6 at baseline, 5.7 vs. 5.3 post-treatment (duration unclear) (p>0.05) <u>Other Outcomes</u> Use of schedule II opioids: 15% (6/41) vs. 19% (6/32) post-treatment (duration unclear)Physical health (scale not reported): 5.1 vs. 4.7 at baseline, 7.1 vs. 6.7 post-treatment (duration unclear) (p>0.05)Mental health (scale not reported): 4.7 vs. 4.2 at baseline; 6.7 vs. 6.3 post-treatment (duration unclear) (p>0.05)Depression (criteria not reported): 73% (30/41) vs. 81% (26/32) (baseline); 58% (24/41) vs. 72% (23/32) (followup unclear) (p>0.05)Generalized anxiety disorder (criteria not reported): 76% (31/41) vs. 72% (23/32) (baseline); 61% (25/41) vs. 63% (20/32) (followup unclear) (p>0.05)Somatization disorder (criteria not reported): 56% (23/41) vs. 41% (13/32) (baseline); 32% (13/41) vs. 18% (9/32) (p<0.05)Symptom magnification (criteria not reported): 34% (14/41) vs. 28% (9/32) (baseline); 22% (9/41) vs. 19% (6/32) (p>0.05)

Table 5. Trials of facet joint injections

Author, Year Duration of Followup Quality Rating	Comparison	Facet Joint Block (% pain relief) Requirements	Imaging Requirements for Patient Selection	Number Randomized and Analyzed	Patient Characteristics	Type of Intervention	Results
Marks, 1992[150] 3 months Fair	Approach	Not required	Not required	Randomized: 86 Analyzed: 86, including 3 (1 vs. 2) with missing data	Age: Not reported Male: Not reported Duration of symptoms: Not reported Baseline pain "severe" or "very severe": 61% vs. 59% Baseline function: Not reported Duration of symptoms: >6 months (mean 8.5 years)	A: Intra-articular facet joint injection with 20 mg methylprednisolone acetate (0.5 ml) and 1% lignocaine (1.0 to 1 .5 ml), with fluoroscopic guidance B: Extra-articular facet joint injection at medial articular branch of posterior primary ramus with 20 mg methylprednisolone acetate (0.5 ml) and 1% lignocaine (1.0 to 1 .5 ml), with fluoroscopic guidance	A vs. B Pain Pain response excellent (none, slight, good, excellent): 7.1% (3/42) vs. 0% (0/44) at 1 m, 4.8% (2/42) vs. 0% (0/44) at 3 mPain response good or excellent: 36% (15/42) vs. 20% (9/44) at 1 m; 22% (9/42) vs. 14% (6/44) at 3 m

Table 5. Trials of facet joint injections

Author, Year Duration of Followup Quality Rating	Comparison	Facet Joint Block (% pain relief) Requirements	Imaging Requirements for Patient Selection	Number Randomized and Analyzed	Patient Characteristics	Type of Intervention	Results
Nash, 1990[151] 1 month Poor	Approach	Not required	Not required	Randomized: 67 Analyzed: 56	Age: Not reported Male: Not reported Duration of symptoms: Not reported Baseline pain "severe" or "very severe": 61% vs. 59% Baseline function: Not reported Duration of symptoms: Not reported	A: Intra-articular facet join injection with 20 mg methylprednisolone and 2% lignocaine (1 ml) and 0.5% bupivacaine (1 ml), with fluoroscopic guidance B: Extra-articular facet joint injection at medial branch of posterior ramus with 2% lignocaine (1 ml) and 0.5% bupivacaine (1 ml), with fluoroscopic guidance	A vs. B Pain Pain moderate to very severe (nil to very severe): 83% (25/30) vs. 85% (22/26) at 1 m Function Functional status full (nil, limited, full): 57% (17/30) vs. 58% (15/26) at 1 m Other Outcomes Drug intake decreased: 30% (9/30) vs. 38% (10/26) at 1 m

Table 5. Trials of facet joint injections

Author, Year Duration of Followup Quality Rating	Comparison	Facet Joint Block (% pain relief) Requirements	Imaging Requirements for Patient Selection	Number Randomized and Analyzed	Patient Characteristics	Type of Intervention	Results
Pneumaticos, 2006[152] 6 months Fair	Use of imaging to determine targets for facet injection	Not required	Required (imaging method not specified)	Randomized: 47 Analyzed: 46	Age (mean): 43 vs. 44 yearsMale: 48% vs. 50% Duration of symptoms: Not reported (minimum 6 months) Baseline AAOS pain score (0 to 100): 46 across groups (NS for between-group difference, data not reported) Baseline function: Not reported Duration of symptoms: >6 months	A: Intra-articular and extra-articular facet joint injection with 3 mg betamethasone (0.5 ml) and 0.5% bupivacaine (2.5 ml) (half within joint and half around posterior facet capsule), guided by single photon electronic computed tomography, with fluoroscopic guidance B: Intra-articular and extra-articular facet joint injection with 3 mg betamethasone (0.5 ml) and 0.5% bupivacaine (2.5 ml) (half within joint and half around posterior facet capsule), at levels specified by referring physician, with fluoroscopic guidance	A vs. B <u>Pain</u> AAOS pain score, change from baseline (0-100, estimated from graph): 20 vs. 12 at 1 m, 23 vs. 15 at 3 m, 16 vs. 11 at 6 m AAOS pain score improved >17 points: 48% (15/31) vs. 45% (5/16) at 1 m, 45% (14/31) vs. 45% (5/16) at 3 m, 39% (12/31) vs. 36% (5/14) at 6 m

Table 5. Trials of facet joint injections

Author, Year Duration of Followup Quality Rating	Comparison	Facet Joint Block (% pain relief) Requirements	Imaging Requirements for Patient Selection	Number Randomized and Analyzed	Patient Characteristics	Type of Intervention	Results
Ribeiro 2013[153] 6 months Good	Intramuscular injection	Not required	Required (lumbar radiograph)	Randomized: 60 (31 vs. 29) Analyzed: 60 (31 vs. 29) at 6 m	A vs. B: Age (mean): 63 vs. 64 years Male: 19% vs. 17% Duration of pain (mean, months): 50 vs. 53 Baseline pain (0-10 VAS): 7.0 vs. 6.8 (p=0.8) Baseline pain on extension (0-10 VAS): 6.8 vs. 6.5 (p=0.53) Baseline RDQ (0-24): 15 vs. 16 (p=0.31)	A: Intra-articular facet joint injection with 20 mg triamcinolone hexacetonide (1 ml) and lidocaine (dose not reported, 1 ml), with fluoroscopic guidance B: Intramuscular injections in the lumbar paravertebral musculature with 20 mg triamcinolone hexacetonide (1 ml) and lidocaine (dose not reported, 1 ml)	A vs. B Pain Pain (0-10 VAS): 7.0 vs. 6.8 at baseline (p=0.54), 4.0 vs. 4.0 at 1 week (p=0.92), 4.0 vs. 3.6 at 1 m (p=0.92), 4.7 vs. 6.1 at 3 m (p=0.06), 5.3 vs. 5.8 at 6 m (p=0.54) Pain on extension (0-10 VAS): 6.8 vs. 6.5 at baseline (p=0.53), 3.6 vs. 4.4 at 1 week (p=0.30), 4.0 vs. 5.1 at 1 m (p=0.17), 5.1 vs. 6.4 at 3 m (p=0.10), 5.3 vs. 6.1 at 6 m (p=0.32) Function RDQ (0-24): 15 vs. 16.4 at baseline (p=0.31), 11.5 vs. 13.4 at 1 week (p=0.24), 10.2 vs. 12.2 at 1 m (p=0.21), 10.6 vs. 14.7 at 3 m (p=0.01), 10.9 vs. 13.4 at 6 m (p=0.17) Global Improvement (5-point Likert scale, options were "much worse, a little worse, unchanged, a little better, or much better), percentage of patients who were "much better": 58% vs. 31% at 1 week (intergroup p=0.029), 55% vs. 52% at 1 m (p=0.4), 55% vs. 45% at 3 m (p=0.82), 48% vs. 24% at 6 m (p=0.26) Quality of life SF-36 Physical Functioning: p=0.21 between the groups over time (data NR) SF-36 Role Physical: p=0.023 between the groups over time (favors group A) (data NR) SF-36 Body Pain: p=0.15 between the groups over time (data NR)

Table 5. Trials of facet joint injections

Author, Year Duration of Followup Quality Rating	Comparison	Facet Joint Block (% pain relief) Requirements	Imaging Requirements for Patient Selection	Number Randomized and Analyzed	Patient Characteristics	Type of Intervention	Results
Ribeiro 2013[153] 6 months Good (Cont)							SF-36 General Health: p=0.52 between the groups over time (data NR) SF-36 Vitality: p=0.45 between the groups over time (data NR) SF-36 Social Functioning: p=0.16 between the groups over time (data NR) SF-36 Role Emotional: p=0.35 between the groups over time (data NR) SF-36 Mental Health: p=0.68 between the groups over time (data NR) Medication usage Acetaminophen daily intake (unit of measurement not reported): 5.2 vs. 3.7 at 1 week (p=0.34), 6.0 vs. 9.4 at 1 m (p=0.40), 19.5 vs. 19.7 at 3 m (p=0.98), 26.4 vs. 28.8 at 6 m (p=0.83) Diclofenac daily intake (unit of measurement not reported): 1.5 vs. 1.4 at 1 week (p=0.98), 4.3 vs. 5.4 at 1 m (p=0.72), 3.1 vs. 10.4 at 3 m (p=0.06), 5.9 vs. 14.9 at 6 m (p=0.04) No differences between groups in terms of the number of patients between groups who used other treatments, including pharmacological treatments, physical therapy, and spine surgery.

AAOS=American Academy of Orthopaedic Surgeons; CT= computed tomography; EQ-5D= EuroQOL Five Dimensions Questionnaire; MRI= magnetic resonance imaging; NASS=North American Spine Society; NS= not sufficient; NR= not reported; NRS=numeric rating scale; ODI= Oswestry Disability Index; VAS= visual analog scale.

Table 6. Trial of sacroiliac injections

Author, Year Duration of Followup Quality Rating	Comparison	Imaging Correlation	Number Randomized and Analyzed	Type of Intervention	Patient Characteristics	Results
Luukkainen, 2002[154] 1 month Fair	Sacroiliac corticosteroid vs. placebo	Not specified	Randomized: 24 Analyzed: 24	A: Peri-articular sacroiliac joint injection with 60 mg methylprednisolone (1.5 ml) and 20 mg/ml lidocaine (1.5 ml) (n=13) B: Peri-articular sacroiliac joint injection with 20 mg/ml lidocaine (1.5 ml) (n=11)	A vs. B Age (mean): 50 vs. 49 years Male: 23% vs. 36% Race: Not reported Duration of symptoms (years): 5.4 vs. 4.4 Baseline pain (median, 0-100 VAS): 53 vs. 53 Baseline function: Not reported Duration of symptoms (years): 5.4 vs. 4.4	A vs. B Pain Improvement in pain (median, 0-100 VAS): –40 vs. –13 at 1 m (p=0.046)

VAS=visual analog scale

Table 7. Pooled results of epidural corticosteroid injections versus placebo interventions for radiculopathy

Outcome	Estimate (95% CI)	Number of Trials	I^2
Pain, mean improvement (WMD) [a]			
• Immediate-term followup	–7.55 (–11.4 to –3.74)	6[56, 68, 71, 81, 85, 113]	30%
• Short-term followup	–3.94 (–9.11 to 1.24)	14[50, 56, 58, 62, 64, 68, 76, 78, 81, 85, 90, 93, 109, 113]	82%
• Intermediate-term followup	–0.07 (–8.41 to 8.26)	4[56, 81, 90, 93]	82%
• Long-term followup	–0.86 (–3.78 to 2.06)	6[50, 58, 78, 81, 90, 93]	0%
Pain, successful outcome (RR)			
• Short-term followup	1.21 (0.98 to 1.49)	8[50, 64, 69, 71, 90, 93, 96, 110]	67%
• Intermediate-term followup	1.12 (0.93 to 1.36)	3[64, 90, 93]	41%
• Long-term followup	1.10 (0.94 to 1.28)	4[50, 66, 90, 93]	0%
Function, mean improvement (SMD)			
• Immediate-term followup	–0.75 (–1.62 to 0.11)	4[56, 81, 107, 113]	94%
• Short-term followup	–0.03 (–0.20 to 0.15)	11[50, 56, 58, 62, 64, 78, 81, 90, 93, 109, 113]	53%
• Intermediate-term followup	–0.30 (–0.74 to 0.15)	5[56, 81, 90, 93, 107]	86%
• Long-term followup	–0.23 (–0.55 to 0.10)	7[50, 58, 78, 81, 90, 93, 107]	82%
Function, successful outcome (RR)			
• Short-term followup	1.01 (0.74 to 1.38)	6[50, 62, 68, 90, 93, 110]	76%
• Intermediate-term followup	1.18 (0.89 to 1.57)	2[90, 93]	71%
• Long-term followup	1.15 (0.97 to 1.35)	3[50, 90, 93]	0%
Surgery (RR)			
• Short-term followup	0.62 (0.41 to 0.92)	8[68, 69, 85, 88, 107, 110, 113b]	0%
• Intermediate-term followup	0.56 (0.12 to 2.68)	1[56]	--
• Long-term followup	0.97 (0.75 to 1.25)	14[50, 58, 64, 66, 71, 78, 81, 96, 105, 106, 108, 109, 114, 115]	23%
Successful outcome (RR)			
• Immediate-term followup	1.05 (0.87 to 1.27)	2[54, 93]	0%
• Short-term followup	1.13 (0.98 to 1.32)	9[56, 62, 64, 76, 85, 88, 106, 113b]	3.5%
• Intermediate-term followup	0.71 (0.34 to 1.48)	1[64]	--
• Long-term followup	1.04 (0.81 to 1.34)	2[93, 115]	0%

RR=relative risk; SMD=standardized mean difference; WMD=weighted mean difference

[a] 0 to 100 scale

[b] One publication[88] reported two trials

Table 8. Pooled results of epidural corticosteroid injections versus placebo interventions for spinal stenosis

Outcome	Estimate (95% CI)	Number of Trials	I^2
Pain, mean improvement (WMD)[a]			
• Immediate-term followup	–22.0 (–36.0 to –8.00)	1[120]	--
• Short-term followup	0.62 (–2.87 to 4.11)	5[117, 120, 122, 123, 126]	0%
• Intermediate-term followup	3.73 (–0.81 to 8.26)	3[122, 123]	0%
• Long-term followup	4.00 (–2.87 to 10.9)	1[123]	--
Pain successful outcome (RR)			
• Short-term followup	0.98 (0.84 to 1.15)	3[117, 122, 123]	0%
• Intermediate-term followup	0.98 (0.78 to 1.24)	2[122, 123]	0%
• Long-term followup	0.97 (0.74 to 1.28)	3[66, 122, 123]	0%
Function, mean improvement			
• Immediate-term followup (SMD)	–0.32 (–0.85 to 0.22)	2[120, 126]	0%
• Short-term followup (SMD)	–0.03 (–0.31 to 0.26)	5[117, 120, 122, 123, 126]	60%
• Intermediate-term followup (WMD)[a]	2.81 (–0.44 to 6.06)	3[120, 122, 123]	0%
• Long-term followup (WMD)[a]	2.78 (–1.24 to 6.79)	2[122, 123]	0%
Function, successful outcome (RR)			
• Short-term followup	0.91 (0.70 to 1.18)	3[117, 122, 123]	37%
• Intermediate-term followup	0.96 (0.74 to 1.25)	2[122, 123]	0%
• Long-term followup	0.95 (0.71 to 1.26)	2[122, 123]	0%
Surgery (RR)			
• Long-term followup	0.76 (0.38 to 1.54)	1[115]	--
Successful outcome (RR)			
• Short-term followup	1.18 (0.55 to 2.55)	2[123, 126]	80%
• Intermediate-term followup	0.93 (0.63 to 1.35)	1[123]	--
• Long-term followup	1.16 (0.76 to 1.78)	2[115, 123]	0%

RR=relative risk; SMD=standardized mean difference; WMD=weighted mean difference
[a] 0 to 100 scale

Table 9. Pooled results, transforaminal versus interlaminar epidural corticosteroid injections

Outcome	Estimate (95% CI)	Number of Trials	I^2
Pain, mean improvement (WMD) [a]			
• Immediate-term followup	–10.1 (–24.8 to 4.63)	5[48, 75, 87, 102, 112]	83%
• Short-term followup	–1.29 (–12.6 to 10.1)	3[87, 102, 112]	54%
• Intermediate-term followup	–11.3 (–44.8 to 22.2)	2[102, 112]	87%
Pain, successful outcome (RR)			
• Short-term followup	No studies	--	--
• Intermediate-term followup	1.18 (0.77 to 1.79)	1[102]	--
• Long-term followup	No studies	--	--
Function, mean improvement			
• Immediate-term followup (SMD)	0.03 (–0.48 to 0.53)	4[48, 75, 102, 112, 117]	68%
• Short-term followup (SMD)	0.39 (–0.36 to 1.13)	3[87, 102, 112]	74%
• Intermediate-term followup (WMD) [a]	–4.60 (–8.85 to –0.35)	1[112]	--
• Long-term followup (WMD) [a]	–2.00 (–8.77 to 4.77)	1[102]	--
Function, successful outcome (RR)	No studies	--	--
Surgery (RR)			
• Short-term followup	0.49 (0.15 to 1.54)	1[88]	--
• Intermediate-term followup	1.08 (0.45 to 2.60)	2[87, 112]	0%
Successful outcome (RR)			
• Short-term followup	1.30 (0.91 to 1.85)	1[88]	--
• Intermediate-term followup	3.00 (0.90 to 10.0)	1[48]	--

RR=relative risk; SMD=standardized mean difference; WMD=weighted mean difference
[a] 0 to 100 scale

Table 10. Epidural corticosteroid injections versus placebo interventions, stratified by approach

Outcome	Transforaminal	Interlaminar	Caudal
Pain, mean improvement (WMD) [a]			
• Immediate-term followup	–13.3 (–19.9 to –6.77), I^2=5.8%, 2 trials[71, 81]	–3.52 (–10.2 to 3.19), I^2=0%, 3 trials[56, 85, 113]	–6.34 (–8.75 to –3.93), 1 trial[68]
• Short-term followup	–1.36 (–7.57 to 4.84), I^2=0%, 3 trials[64, 81, 109]	–3.62 (–11.9 to 4.70), I^2=81%, 7 trials[50, 56, 62, 76, 85, 90, 113]	–5.69 (–15.9 to 4.56), I^2=88%, 4 trials[58, 68, 78, 93]
• Intermediate-term followup	13.3 (5.60 to 21.0); 1 trials[81]	–4.38 (–8.56 to –0.21), I^2=0%, 2 trials[56, 90]	–3.00 (–8.74 to 2.74), 1 trial[93]
• Long-term followup	3.90 (–3.38 to 11.2), 1 trial[81]	–0.88 (–5.18 to 3.43), I^2=0%, 2 trials[50, 90]	–2.86 (–7.61 to 1.89), I^2=0%, 3 trials[58, 78, 93]
Pain, successful outcome (RR)			
• Short-term followup	1.52 (0.68 to 3.41), I^2=86%, 3 trials[64, 71, 110]	1.09 (0.90 to 1.33), I^2=29%, 3 trials[50, 69, 90]	1.07 (0.90 to 1.27), I^2=0%, 2 trials[93, 96]
• Intermediate-term followup	0.71 (0.34 to 1.48), 1 trial[64]	1.26 (1.04 to 1.53), 1 trial[90]	1.07 (0.89 to 1.28), 1 trial[93]
• Long-term followup	No studies	1.11 (0.92 to 1.33), I^2=0%, 3 trials[50, 66, 90]	1.08 (0.83 to 1.40), 1 trial[93]
Function, mean improvement			
• Immediate-term followup (SMD)	–0.33 (–0.64 to –0.02), 1 trial[81]	–0.32 (–0.68 to 0.04), I^2=0%, 2 trials[56, 113]	–1.90 (–2.25 to –1.55), 1 trial[107]
• Short-term followup (SMD)	0.09 (–0.42 to 0.60), I^2=81%, 3 trials[64, 81, 109]	–0.12 (–0.27 to 0.04), I^2=0%, 5 trials[50, 56, 62, 90, 113]	–0.28 (–1.18 to 0.62), I^2=94%, 4 trials[58, 78, 93, 107]
• Intermediate-term followup (WMD) [a]	3.70 (–0.94 to 8.34); 1 trial[81]	–4.12 (–7.67 to –0.57); I^2=0%, 2 trials[56, 90]	–4.67 (–11.3 to 1.97), I^2=85%, 2 trials[93, 107]
• Long-term followup (SMD)	0.01 (–0.30 to 0.32), 1 trial[81]	–0.18 (–0.42 to 0.06), I^2=21%, 2 trials[50, 90]	–0.29 (–0.91 to 0.33), I^2=89%, 4 trials[58, 78, 93, 107]
Function, successful outcome (RR)			
• Short-term followup	0.63 (0.38 to 1.02), 1 trial[110]	0.96 (0.73 to 1.27), I^2=48%, 3 trials[50, 62, 90]	1.56 (0.45 to 5.43), I^2=94%, 2 trials[68, 93]
• Intermediate-term followup	No studies	1.37 (1.10 to 1.70), 1 trial[90]	1.02 (0.82 to 1.28), 1 trial[93]
• Long-term followup	No studies	1.13 (0.92 to 1.39), I^2=0%, 2 trials[50, 90]	1.17 (0.90 to 1.52), 1 trial[93]
Surgery (RR)			
• Short-term followup	0.82 (0.29 to 2.32), I^2=0%, 3 trials[88, 110a]	0.62 (0.28 to 1.37), I^2=0%, 3 trials[69, 85, 113]	0.57 (0.34 to 0.97), I^2=5.4%, 2 trials[68, 107]
• Long-term followup	0.89 (0.55 to 1.43), I^2=56%, 5 trials[64, 71, 81, 105, 109]	1.08 (0.80 to 1.46), I^2=0%, 5 trials[50, 66, 106, 108, 114]	0.69 (0.20 to 2.46), I^2=38%, 4 trials[58, 78, 96, 115]
Successful outcome (RR)			
• Immediate-term followup	No studies	No studies	1.05 (0.87 to 1.27), I^2=0%, 2 trials[54, 93]
• Short-term followup	1.16 (0.79 to 1.71), I^2=0%, 3 trials[64, 88b]	1.16 (0.95 to 1.42), I^2=31%, 6 trials[56, 62, 76, 85, 106, 113]	No studies
• Intermediate-term followup	0.71 (0.34 to 1.48), 1 trial[64]	No studies	No studies
• Long-term followup	No studies	No studies	1.04 (0.81 to 1.34), I^2=0%, 2 trials[93, 115]

RR=relative risk; SMD=standardized mean difference; WMD=weighted mean difference

[a] 0 to 100 scale

[b] One publication[88] reported two trials

Table 11. Epidural corticosteroid injections versus placebo interventions, stratified by type of placebo comparator

Outcome	Epidural Local Anesthetic	Epidural Saline	Soft Tissue Injection
Pain, mean improvement (WMD) [a]			
• Immediate-term followup	–9.64 (–18.8 to –0.51), I^2=61%, 3 trials[68, 71, 85]	–6.66 (–15.8 to 2.54), I^2=66%, 4 trials[71, 81, 85, 113]	–12.1 (–21.4 to –2.79), I^2=0%, 2 trials[71, 85]
• Short-term followup	–4.64 (–11.4 to 2.14), I^2=86%, 5 trials[68, 85, 90, 93, 109]	0.51 (–7.21 to 8.23), I^2=58%, 7 trials[58, 62, 64, 78, 81, 85, 113]	1.35 (–17.0 to 19.7), I^2=90%, 4 trials[50, 76, 78, 85]
• Intermediate-term followup	–3.64 (–7.09 to –0.18), I^2=0%, 2 trials[90, 93]	13.3 (5.60 to 21.0), 1 trial[81]	No studies
• Long-term followup	–2.43 (–6.11 to 1.24), I^2=0%, 2 trials[90, 93]	1.50 (–4.54 to 7.54), I^2=0%, 3 trials[58, 78, 81]	1.47 (–5.55 to 8.49), I^2=0%, 2 trials[50, 78]
Pain, successful outcome (RR)			
• Short-term followup	1.12 (0.85 to 1.47), I^2=68%, 4 trials[71, 90, 93, 110]	1.74 (0.72 to 4.24), I^2=73%, 2 trials[64, 71]	1.46 (0.89 to 2.37), I^2=75%, 4 trials[50, 69, 71, 96]
• Intermediate-term followup	1.16 (0.98 to 1.37), I^2=37%, 2 trials[90, 93]	0.71 (0.34 to 1.48), 1 trial[64]	No studies
• Long-term followup	1.09 (0.91 to 1.31), I^2=0%, 2 trials[90, 93]	1.70 (0.40 to 7.22), 1 trial[66]	1.09 (0.82 to 1.44), 1 trial[50]
Function, mean improvement (SMD)			
• Immediate-term followup	–1.90 (–2.25 to –1.55), 1 trial[107]	–0.30 (–0.55 to –0.05), I^2=0%, 2 trials[81, 113]	No studies
• Short-term followup	–0.35 (–1.22 to 0.51), I^2=96%, 4 trials[90, 93, 107, 109]	–0.04 (–0.26 to 0.18), I^2=37%, 6 trials[58, 62, 64, 78, 81, 113]	0.01 (–0.21 to 0.24), I^2=0%, 2 trials[50, 78]
• Intermediate-term followup	–0.45 (–0.95 to 0.04), I^2=84%, 3 trials[90, 93, 107]	0.25 (–0.07 to 0.56), 1 trial[81]	No studies
• Long-term followup	–0.50 (–1.11 to 0.11), I^2=88%, 3 trials[90, 93, 107]	0.08 (–0.16 to 0.33), I^2=0%, 3 trials[58, 78, 81]	–0.07 (–0.29 to 0.16), I^2=0%, 2 trials[50, 78]
Function, successful outcome (RR)			
• Short-term followup	1.12 (0.72 to 1.74), I^2=84%, 4 trials[68, 90, 93, 110]	0.90 (0.61 to 1.33), 1 trial[62]	0.71 (0.41 to 1.23), 1 trial[50]
• Intermediate-term followup	1.18 (0.89 to 1.57), I^2=71%, 2 trials[90, 93]	No studies	No studies
• Long-term followup	1.16 (0.97 to 1.39), I^2=0%, 2 trials[90, 93]	No studies	1.07 (0.72 to 1.58), 1 trial(Arden)[50]
Surgery (RR)			
• Short-term followup	0.58 (0.35 to 0.95), I^2=0%, 4 trials[68, 85, 107, 110]	0.49 (0.05 to 5.19), 1 trial[113]	0.66 (0.32 to 1.34), I^2=0%, 2 trials[69, 88]
• Long-term followup	0.78 (0.48 to 1.26), I^2=34%, 5 trials[71, 105, 106, 109, 115]	1.07 (0.78 to 1.46), I^2=0%, 7 trials[58, 64, 66, 71, 78, 81, 108]	0.97 (0.44 to 2.10), I^2=48%, 4 trials[50, 71, 78, 96]
Successful outcome (RR)			
• Immediate-term followup	1.05 (0.87 to 1.27), I^2=0%, 2 trials[54, 93]	No studies	No studies
• Short-term followup	1.38 (0.70 to 2.73), I^2=38%), 2 trials[85, 106]	1.05 (0.87 to 1.28), I^2=0%, 3 trials[64, 85, 113, 141]	1.21 (0.55 to 2.70), I^2=71%, 3 trials[76, 85, 88]
• Intermediate-term followup	No studies	0.71 (0.34 to 1.48), 1 trial[64]	No studies
• Long-term followup	1.04 (0.81 to 1.34), I^2=0%, 2 trials[93, 115]	No studies	No studies

RR=relative risk; SMD=standardized mean difference; WMD=weighted mean difference
[a] 0 to 100 scale

Table 12. Placebo response rates in trials of epidural corticosteroid injections

Outcome	Epidural Local Anesthetic	Epidural Saline	Soft Tissue Injections
Pain, mean improvement (WMD) [a]			
• Immediate-term followup	–6.51 (–11.9 to –1.16), I^2=45%, 3 trials[68, 71, 85]	–19.8 (–25.2 to –14.3), I^2=56%, 4 trials[71, 81, 85, 113]	–13.1 (–18.8 to –7.29), I^2=0%, 2 trials[71, 85]
• Short-term followup	–29.5 (–46.1 to –12.9), I^2=99%, 5 trials[68, 85, 90, 93, 109]	–26.7 (–35.6 to –18.2), I^2=83%, 7 trials[58, 62, 64, 78, 81, 85, 113]	–18.8 (–32.0 to –5.72), I^2=93%, 4 trials[50, 76, 78, 85]
• Intermediate-term followup	–40.6 (–43.2 to –37.9), I^2=0%, 2 trials[90, 93]	–53.6 (–59.2 to –48.0), 1 trial[81]	No studies
• Long-term followup	–40.1 (–42.3 to –37.4), I^2=0%, 2 trials[90, 93]	–33.3 (–54.6 to –12.0), I^2=93%, 3 trials[58, 78, 81]	–23.8 (–31.9 to –15.7), 2 trials[50, 78]
Pain, successful outcome (rate)			
• Short-term followup	0.52 (0.16 to 0.88), I^2=98%, 4 trials[71, 90, 93, 110]	0.30 (0.06 to 0.54), I^2=79%, 2 trials[64, 71]	0.35 (0.17 to 0.53), I^2=89%, 4 trials[50, 69, 71, 96]
• Intermediate-term followup	0.73 (0.66 to 0.80), I^2=0%, 2 trials[90, 93]	0.40 (0.23 to 0.57), 1 trial[64]	No studies
• Long-term followup	0.63 (0.55 to 0.72), I^2=0%, 2 trials[90, 93]	0.15 (–0.04 to 0.35), 1 trial[66]	0.44 (0.35 to 0.54), 1 trial[50]
Function, mean improvement (WMD)[a]			
• Short-term followup	–19.9 (–27.7 to –12.1), I^2=99%, 4 trials[90, 93, 107, 109]	–14.6 (–20.0 to –9.23), I^2=77%, 4 trials[62, 64, 78, 81]	–10.3 (–13.9 to –6.71), I^2=31%, 2 trials[50, 78]
• Intermediate-term followup	–26.6 (–28.9 to –24.4), I^2=54%, 3 trials[90, 93, 107]	–27.7 (–30.7 to –24.7), 1 trial[81]	No studies
• Long-term followup	–26.7 (–28.4 to –24.9), I^2=27%, 3 trials[90, 93, 107]	–22.4 (–32.0 to –12.8), I^2=92%, 2 trials[78, 81]	–13.6 (–16.6 to –10.6), I^2=0%, 2 trials[50, 78]
Function, successful outcome (rate)			
• Short-term followup	0.54 (0.32 to 0.75), I^2=91%, 4 trials[68, 90, 93, 110]	0.42 (0.31 to 0.53), 1 trial[62]	0.22 (0.14 to 0.30), 1 trial[50]
• Intermediate-term followup	0.68 (0.59 to 0.76), 2 trials[90, 93]	No studies	No studies
• Long-term followup	0.62 (0.53 to 0.70), 2 trials[90, 93]	No studies	0.30 (0.21 to 0.38), 1 trial[50]

WMD=weighted mean difference

[a] 0 to 100 scale

Table 13. Summary of evidence

Key Question Outcome	Strength of Evidence Grade	Conclusion
Key Question 1. In patients with low back pain, what is the effectiveness of epidural corticosteroid injections, facet joint corticosteroid injections, medial branch blocks, and sacroiliac joint corticosteroid injections vs. epidural nonsteroid injection, nonepidural injection, no injection, surgery or nonsurgical therapies on outcomes related to pain, function and quality of life?		
Epidural injections for radiculopathy		
Epidural corticosteroid injections vs. placebo interventions		
Mean improvement in pain, immediate-term followup	Moderate	Epidural corticosteroid injections associated with greater improvement vs. placebo interventions (6 trials, WMD –7.55 on 0 to 100 scale, 95% CI –11.4 to –3.74, I2=30%)
Mean improvement in pain, short-term followup	Low	No difference (14 trials, WMD –3.94, 95% CI –9.11 to 1.24, I2=82%)
Mean improvement in pain, intermediate-term followup	Low	No difference (4 trials, WMD –0.07, 95% CI –8.41 to 8.26, I2=82%)
Mean improvement in pain, long-term followup	Moderate	No difference (6 trials, WMD –0.86, 95% CI –3.78 to 2.06, I2=0%)
Successful pain outcome, short-term followup	Low	No difference (8 trials, RR 1.21, 95% CI 0.98 to 1.49, I2=67%)
Successful pain outcome, intermediate-term followup	Low	No difference (3 trials, RR 1.12, 95% CI 0.93 to 1.36, I2=41%)
Successful pain outcome, long-term followup	Moderate	No difference (4 trials, RR 1.10, 95% CI 0.94 to 1.28, I2=0%)
Mean improvement in function, immediate-term followup	Low	No difference, based on all trials (4 trials, SMD –0.75, 95% CI –1.62 to 0.11, I2=94%). Excluding an outlier trial eliminated statistical heterogeneity and resulted in a statistically significant effect favoring epidural corticosteroid injections (3 trials, SMD –0.33, 95% CI –0.56 to –0.09, I2=0%)
Mean improvement in function, short-term followup	Moderate	No difference (11 trials, SMD –0.03, 95% CI –0.20 to 0.15, I2=53%)
Mean improvement in function, intermediate-term followup	Low	No difference (5 trials, SMD –0.30, 95% CI –0.74 to 0.15, I2=86%)
Mean improvement in function, long-term followup	Low	No difference (7 trials, SMD –0.23, 95% CI –0.55 to 0.10, I2=82%)
Successful functional outcome, short-term followup	Low	No difference (6 trials, RR 1.01, 95% CI 0.74 to 1.38, I2=76%)
Successful functional outcome, intermediate-term followup	Low	No difference (2 trials, RR 1.18, 95% CI 0.89 to 1.57, I2=71%)
Successful functional outcome, long-term followup	Low	No difference (3 trials, RR 1.15, 95% CI 0.97 to 1.35, I2=0%)
Risk of surgery, short-term followup	Low	Epidural corticosteroid injections were associated with lower risk vs. placebo interventions (8 trials, RR 0.62, 95% CI 0.41 to 0.92, I2=0%), but the estimate was no longer statistically significant after exclusion of poor-quality trials (5 trials, RR 0.69, 95% CI 0.42 to 1.13, I2=0%)
Risk of surgery, intermediate-term followup	Low	No difference (1 trial, RR 0.56, 95% CI 0.12 to 2.68)
Risk of surgery, long-term followup	Moderate	No difference (14 trials, RR 0.97, 95% CI 0.75 to 1.25, I2=23%)

Table 13. Summary of evidence

Key Question Outcome	Strength of Evidence Grade	Conclusion
Successful composite outcome, short-term followup	Moderate	No difference (9 trials, RR 1.13, 95% CI 0.98 to 1.32, I2=3.5%)
Successful composite outcome, intermediate-term followup	Low	No difference (1 trial, RR 0.71, 95% CI 0.34 to 1.48)
Successful composite outcome, long-term followup	Low	No difference (2 trials, 1.04, 95% CI 0.81 to 1.34, I2=0%)
Epidural corticosteroid injections vs. other interventions		
Pain, function, surgery	Insufficient	There was insufficient evidence from two trials to determine effects of epidural corticosteroid injections vs. discectomy, due to methodological shortcomings in the trials
Pain function, surgery	Low	One trial found epidural corticosteroid injections associated with lower likelihood than MILD of achieving ≥ 25 point improvement in leg pain (RR 0.49, 95% CI 0.24 to 1.0), ≥13 point improvement in ODI (RR 0.34, 95% CI 0.34 to 0.95), and ≥5 point improvement in SF-36 (RR 0.34, 95% CI 0.12 to 0.95) through 2 years. There was no difference in risk of undergoing surgery (RR 0.45, 95% CI 0.09 to 2.19)
Pain, function, surgery	Insufficient	There was insufficient evidence from one small (n=26), fair-quality trial to determine effects of epidural corticosteroid injections vs. epidural clonidine injection
Pain, function, analgesic use	Low	One trial found transforaminal epidural corticosteroid injection superior to etanercept on the ODI at 1 month (difference –16 on 0 to 100 scale, 95% CI –26.0 to –6.27). There were no differences on other outcomes, including pain and analgesic use
Pain, function	Low	One trial found no differences between epidural corticosteroid vs. autologous conditioned serum administered via the oblique interlaminar approach in improvement in pain or ODI scores after 22 weeks
Pain, function, surgery	Insufficient	There was insufficient evidence from two trials to determine effects of epidural corticosteroid injections vs. nonsurgical, noninterventional therapies due to methodological shortcomings in the trials and differences in the nonsurgical, noninterventional therapies evaluated
Pain, function	Low	One trial found transforaminal epidural corticosteroid injection with corticosteroid plus hypertonic saline associated with greater decrease in pain intensity through 4 months than a corticosteroid injection alone (difference from baseline –2.78 vs. –1.50 on 0 to 10 NRS, p=0.05), though the effect was smaller and no longer statistically significant at 6 months. There were no differences in global assessment or the ODI
Pain, function	Low	One trial found no difference between transforaminal epidural injection with corticosteroid versus corticosteroid plus low-dose clonidine in pain scores through 12 weeks in patients with subacute low back pain
Epidural injections for spinal stenosis		
Epidural corticosteroid injections vs. placebo interventions		
Mean improvement in pain, immediate-term followup	Low	Epidural corticosteroid injection was superior to placebo at intermediate-term followup (1 trial, WMD –22.0, 95 % –36.0 to –8.0)

Table 13. Summary of evidence

Key Question Outcome	Strength of Evidence Grade	Conclusion
Mean improvement in pain, short-term followup	Moderate	No difference (5 trials, WMD 0.62, 95% CI –2.87 to 4.11, I2=0%)
Mean improvement in pain, intermediate-term followup	Low	No difference (3 trials, WMD 3.73, 95% CI –0.81 to 8.26, I2=0%)
Mean improvement in pain, long-term followup	Low	No difference (1 trial, mean difference 4.00, 95% CI –2.87 to 10.9)
Successful pain outcome, short-term followup	Low	No difference (3 trials, RR 0.98, 95% CI 0.84 to 1.15, I2=0%)
Successful pain outcome, intermediate-term followup	Low	No difference (2 trials, RR 0.98, 95% CI 0.78 to 1.24, I2=0%)
Successful pain outcome, long-term followup	Low	No difference (3 trials, RR 0.97, 95% CI 0.74 to 1.28, I2=0%)
Mean improvement in function, immediate-term followup	Low	No difference (2 trials, SMD –0.32, 95% CI –0.85 to 0.22, I2=0%)
Mean improvement in function, short-term followup	Moderate	No difference (5 trials, SMD –0.03, 95% CI –0.31 to 0.26, I2=60%)
Mean improvement in function, intermediate-term followup	Low	No difference (3 trials, WMD 2.81, 95% CI –0.44 to 6.06, I2=0%)
Mean improvement in function, long-term followup	Low	No difference (2 trials, WMD 2.78, 95% CI –1.24 to 6.79, I2=0%)
Successful functional outcome, short-term followup	Low	No difference (3 trials, RR 0.91, 95% CI 0.70 to 1.18, I2=37%)
Successful functional outcome, intermediate-term followup	Low	No difference (2 trials, RR 0.96, 95% CI 0.74 to 1.25, I2=0%)
Successful functional outcome, long-term followup	Low	No difference (2 trials, RR 0.95, 95% CI 0.71 to 1.26, I2=0%)
Successful composite outcome, short-term followup	Low	No difference (2 trials, RR 1.18, 95% CI 0.55 to 2.55, I2=80%)
Successful composite outcome, intermediate-term followup	Low	No difference (1 trial, RR 0.93, 95% CI 0.63 to 1.35)
Successful composite outcome, long-term followup	Low	No difference (2 trials, RR 1.16, 95% CI 0.76 to 1.78, I2=0%)
Risk of surgery, long-term followup	Low	No difference (1 trial, RR 0.76, 95% CI 0.38 to 1.54)
Epidural corticosteroid injections vs. other interventions		
Pain, function	Low	One trial found an epidural corticosteroid injection associated with lower likelihood of experiencing ≥2 point improvement in pain at 2 weeks vs. the MILD procedure, but the difference was no longer present at 6 weeks. There was no difference in function
Pain, function	Low	One trial found no differences between and epidural corticosteroid injection vs. intense physical therapy in pain intensity or functional outcomes at 2 weeks through 6 months
Pain, function	Low	One trial found epidural corticosteroid injection associated with worse leg pain than epidural etanercept injection at 1 month, with no difference in functional outcomes
Pain, function	Insufficient	There was insufficient evidence from one poor-quality trial to determine effects of epidural corticosteroid injections vs. epidural adhesiolysis
Epidural corticosteroid injections vs. placebo interventions for nonradicular low back pain		
Pain, function, opioid use	Low	Two trials found no differences between epidural corticosteroid injections and epidural local anesthetic injections in pain, function, or opioid use

Table 13. Summary of evidence

Key Question Outcome	Strength of Evidence Grade	Conclusion
Epidural injections for chronic postsurgical pain		
All outcomes	Insufficient	No trial compared an epidural injection with corticosteroid vs. a placebo intervention
All outcomes	Insufficient	Evidence from 4 trials was insufficient to determine effects of epidural corticosteroid injections vs. other interventions, due to methodological limitations, differences in the comparators evaluated, and small sample sizes
Facet joint injections		
Pain, function	Low	Two trials found no clear differences between an intra-articular facet joint injection with corticosteroid vs. saline in pain or function at 1 to 3 months
All outcomes	Insufficient	Evidence from one small, poor-quality trial was insufficient to determine effects of an intra-articular corticosteroid facet joint injection vs. medial branch local anesthetic injection
All outcomes	Insufficient	Evidence from one poor-quality trial was insufficient to determine effects of an extra-articular facet joint corticosteroid injection vs. intra-articular saline injection
Pain, function, opioid use	Low	Two trials found no differences between medial branch corticosteroid injection vs. medial branch local anesthetic injection in pain, function, or opioid use through 12 to 24 months
Pain, function, quality of life	Low	One trial found no clear differences between an intra-articular facet joint versus an intramuscular corticosteroid injection in pain, function, or quality of life through 6 months
Pain, function, quality of life	Low	One trial found no differences between intra-articular facet injection with triamcinolone acetonide vs. hyaluronic acid in pain or function at 1 month or in health-related quality of life at 1 week
Pain, function, analgesic use	Low	One trial found no differences between intra-articular corticosteroid injection plus sham neurotomy vs. medial branch radiofrequency facet neurotomy plus local anesthetic injection in pain, function, or analgesic use at 6 months
Pain, quality of life	Low	One fair-quality trial found medial branch corticosteroid injection inferior to radiofrequency facet denervation on pain at 1, 6, and 12 months, with no differences in quality of life (1, 6, and 12 months), but results may have been confounded by differential use of diagnostic blocks to select patients for inclusion
Sacroiliac joint injections		
All outcomes	Insufficient	There was insufficient evidence from one small (n=24) trial to determine effects of peri-articular sacroiliac corticosteroid injection vs. local anesthetic injection

Table 13. Summary of evidence

Key Question Outcome	Strength of Evidence Grade	Conclusion
Key Question 1a. How does effectiveness vary according to the medication (corticosteroid, local anesthetic) used, the dose or frequency of injections, the number of levels treated, or degree of provider experience?		
Epidural injections		
Epidural corticosteroid injections for radiculopathy		
Effects of different corticosteroids: all outcomes	Low	Four trials that directly compared epidural corticosteroid injections for radiculopathy with different corticosteroids found few differences in outcomes including pain and function, but conclusions were limited by differences in the corticosteroids compared, doses, and some inconsistency
Effects of different local anesthetics: all outcomes	Insufficient	No trial directly compared effects of epidural corticosteroid injections with one local anesthetic vs. another
Effects of corticosteroid dose: all outcomes	Low	Six trials that directly compared epidural injections for radiculopathy using different corticosteroid doses found no clear differences in outcomes including pain and function
Effects of number of injections, number of levels injected, or provider experience: all outcomes	Low for number of injections, insufficient for number of levels and provider experience	No trial directly compared the effectiveness of epidural corticosteroid injections based on the number of injections, number of levels injected, or provider experience. Two trials found no association between receipt of more injections and better outcomes
Epidural corticosteroid injections for spinal stenosis		
Effects of corticosteroids: pain, claudication distance	Low	One trial found no clear differences between caudal epidural injection for spinal stenosis with methylprednisolone vs. triamcinolone in pain or claudication distance through 6 months, though results favored methylprednisolone
Facet joint injections		
Effects of different corticosteroids, local anesthetics, doses, frequency or number of injections, or degree of provider experience	Insufficient	No trial of facet joint injections directly compared effects of different corticosteroids, different local anesthetics, different doses, different frequency or number of injections, or degree of provider experience. Indirect evidence was too limited to reach reliable conclusions

Table 13. Summary of evidence

Key Question Outcome	Strength of Evidence Grade	Conclusion
Key Question 1b. How does effectiveness vary according to use of imaging guidance or route of administration (e.g., for epidural injections interlaminar, transforaminal, caudal for epidural injections and for facet joint injections intra-articular, extra-articular [peri-capsular] or medial branch injections)?		
Epidural injections		
Use of imaging		
Effects of imaging guidance vs. no imaging guidance: All outcomes	Insufficient	No trial directly compared the effectiveness of epidural injections for radiculopathy performed with or without imaging guidance. Indirect evidence was not useful for evaluating effects of imaging guidance on estimates of effects because use of imaging guidance was highly associated with the epidural technique used
Effects of fluoroscopic plus Doppler vs. fluoroscopic imaging guidance: Pain, function	Low	One trial of caudal epidural corticosteroid injections for radiculopathy found no difference between fluoroscopic plus Doppler guidance vs. fluoroscopic guidance alone in pain or ODI scores through 12 weeks
Effects of imaging to guide epidural injection targets: Pain, function, medication use	Low	One trial found no difference between use of MRI vs. history and physical examination without MRI to guide epidural corticosteroid injection treatment and targets on pain, function, or medication use
Transforaminal vs. interlaminar corticosteroid injections		
Mean improvement in pain, immediate-term followup	Low	No difference (5 trials, WMD –10.1, 95% CI –24.8 to 4.6, I2=83%)
Mean improvement in pain, short-term followup	Low	No difference (3 trials, WMD –1.29, 95% CI –12.6 to 10.1, I2=54%)
Mean improvement in pain, intermediate-term followup	Low	No difference (2 trials, WMD –11.3, 95% CI –44.8 to 22.2, I2=87%)
Mean improvement in function, immediate-term followup	Low	No difference (4 trials, SMD 0.03, 95% CI –0.48 to 0.53, I2=68%)
Mean improvement in function, short-term followup	Low	No difference (3 trials, SMD 0.39, 95% CI –0.36 to 1.13, I2=74%)
Mean improvement in function, long-term followup	Low	No difference (1 trial, WMD –2.00, 95% CI –8.77 to 4.77)
Likelihood of undergoing surgery, intermediate-term followup	Low	There were no differences between transforaminal vs. interlaminar epidural corticosteroid injections for radiculopathy in risk of undergoing surgery at intermediate-term followup in two trials (RR 0.76, 95% CI 0.18 to 3.19 and RR 1.33, 95% CI 0.44 to 4.05)
Comparisons of other approaches		
Epidural injections for radiculopathy		
Caudal vs. other approaches: Pain, function, depression	Low	One trial found the transforaminal epidural corticosteroid injections for radiculopathy associated with better pain outcomes than the caudal approach, with no differences in measures of function or depression, but no differences between the interlaminar vs. caudal approaches in measures of pain or depression

Table 13. Summary of evidence

Key Question Outcome	Strength of Evidence Grade	Conclusion
Oblique vs. standard interlaminar approaches: Successful composite outcome, surgery	Low	One trial found no differences between epidural corticosteroid injections for radiculopathy using the oblique interlaminar vs. standard interlaminar approaches in likelihood of achieving a successful outcome or undergoing surgery
Lateral parasagittal vs. standard interlaminar approaches: Pain, function	Low	One trial of epidural corticosteroid injections for radiculopathy found the lateral parasagittal interlaminar approach associated with greater likelihood of achieving >50% pain relief (RR 4.1, 95% CI 1.4 to 12) and greater improvement in pain and function than the standard interlaminar approach through 6 months; a second trial also reported results that favored the lateral parasagittal approach, but differences were smaller and not statistically significant
Lateral parasagittal vs. transforaminal approaches: Pain	Low	Two trials found no differences between epidural corticosteroid injections for radiculopathy using the lateral parasagittal vs. transforaminal approaches in pain or function through 6 or 12 months
Ganglionic vs. preganglionic transforaminal injections: Successful composite outcome	Low	One trial found transforaminal epidural corticosteroid injections for radiculopathy at the ganglionic vs. preganglionic approaches associated with a lower likelihood of a successful outcome at 1 month (RR 0.80, 95% CI 0.70 to 0.91), though differences were no longer present after 5 months
Epidural injections for spinal stenosis		
Transforaminal vs. interlaminar: Leg pain, function	Low	No trial randomized patients with spinal stenosis to different approaches for performing epidural corticosteroid injections. One trial in which epidural corticosteroid injections could be performed by the interlaminar or transforaminal approaches found that interlaminar corticosteroid injections were associated with greater improvement in leg pain and function vs. local anesthetic injections at 3 weeks, but there were no differences between transforaminal corticosteroid vs. local anesthetic injections
Facet joint injections		
Intra-articular facet joint corticosteroid injection: Pain	Low	One trial found intra-articular facet joint corticosteroid injection in patients with subacute low back pain selected on the basis of positive facet joint SPECT findings associated with lower pain intensity (3.2 vs. 5.4 on 0 to 10 NRS, $p<0.05$), greater likelihood of ≥50% pain relief (61% vs. 26%, RR 2.33, 95% CI 1.09 to 5.00), and better ODI score (12 vs. 23, $p<0.05$). versus medial branch injection at 12 weeks
Intra-articular facet joint vs. medial branch corticosteroid injection for chronic low back pain (imaging findings not required): Pain	Low	One trial found intra-articular facet joint corticosteroid injection associated with higher likelihood of pain relief vs. medial branch injection at 1 month (RR 1.68, 95% CI 1.03 to 2.73), but results were no longer statistically significant at 3 months, and there was no difference in likelihood of experiencing good or excellent pain relief
Intra-articular vs. extra-articular (peri-capsular) facet joint corticosteroid injection: All outcomes	Insufficient	There was insufficient evidence from one poor-quality trial to determine effectiveness of intra- vs. extra-articular (peri-capsular) facet joint corticosteroid injections
Effects of imaging guidance vs. no imaging guidance: All outcomes	Insufficient	No trial directly compared the effectiveness of epidural injections for radiculopathy performed with or without imaging guidance

Table 13. Summary of evidence

Key Question Outcome	Strength of Evidence Grade	Conclusion
Effects of CT- vs. ultrasound imaging guidance: Pain	Low	One trial found no difference between CT- vs. ultrasound-guided intra-articular facet joint corticosteroid injections with betamethasone and local anesthetic in pain at 6 weeks
Key Question 2. In patients with low back pain, what patient characteristics predict responsiveness to injection therapies on outcomes related to pain, function, and quality of life?		
Epidural injections		
Effects of duration: Pain, function	Low	Five of six trials of patients with radiculopathy found no association between duration of symptoms and responsiveness to epidural corticosteroid injections
Effects of age, sex, anxiety/depression, opioid use, baseline function, presence of neurological abnormalities, previous episodes, or work status: Pain, function	Low	Trials or patients with radiculopathy found no association between age, sex, anxiety/depression, opioid use, baseline function, presence of neurological abnormalities, previous episodes, or work status and responsiveness to epidural corticosteroid injections
Effects of cause of radicular symptoms: Pain, function	Insufficient	There was insufficient evidence from 4 trials to determine effects of the cause of radicular symptoms on responsiveness to epidural corticosteroid injections for radiculopathy, due to inconsistent results
Effects of smoking status, body mass index, use of opioid therapies or other concomitant therapies: Pain, function	Insufficient	No study evaluated the association between smoking status, body mass index, opioid therapies, or other concomitant therapies on responsiveness to epidural corticosteroid injection therapies for radiculopathy
Effects of pain, function	Low	Based on meta-regression analyses of trials of epidural corticosteroid injections vs. placebo interventions for radiculopathy, there was no clear association between prior lumbar surgery, requirement for imaging correlation with symptoms, or requirement for presence of herniated disc on imaging and estimates of treatment effect
Effects of race: All outcomes	Low	One trial of patients with spinal stenosis found no interaction between race and responsiveness to epidural corticosteroid injections
Effects of pain, patient satisfaction	Low	One trial of patients with nonradicular low back pain found no differences between transforaminal versus interlaminar epidural corticosteroid injection in pain or a patient satisfaction index in the subgroup of patient with imaging findings of a herniated disc, but in patients with spinal stenosis effects on pain favored the transforaminal approach (1.79 vs. 2.19 on the 0 to 5 Roland pain score, $p<0.05$; likelihood of improving ≥2 points 51% vs. 31%, RR 1.64, 95% CI 0.98 to 2.76)
Facet joint injections		
Effects of use of SPECT vs. no SPECT to identify targets for facet joint injections: Pain	Low	One trial found no difference between use of SPECT bone scans vs. no SPECT to identify targets for intra- and extra-articular facet joint corticosteroid injections in pain outcomes through 6 months
Sacroiliac joint injections	Insufficient	No evidence

Table 13. Summary of evidence

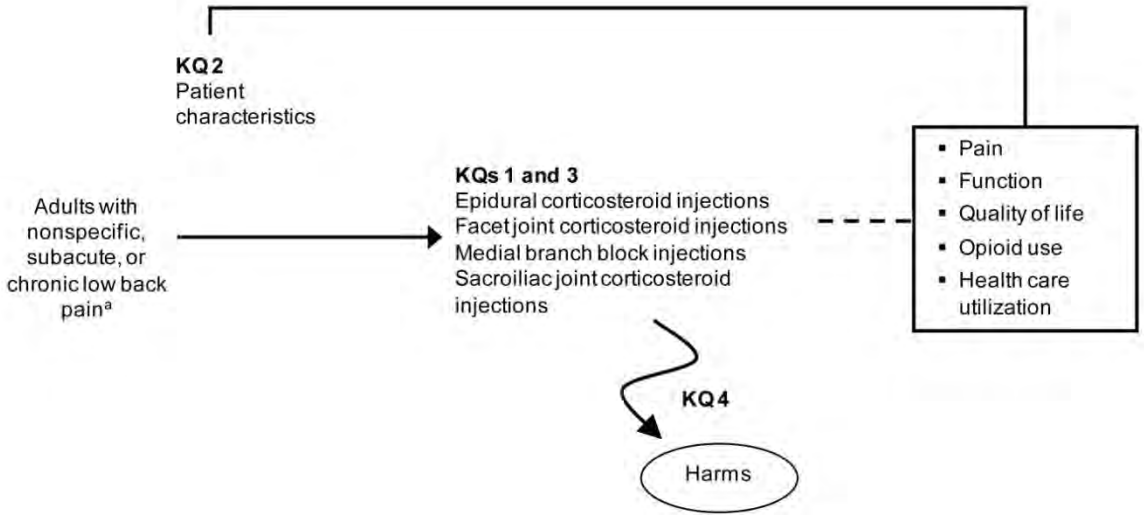
Key Question Outcome	Strength of Evidence Grade	Conclusion
Key Question 3. In randomized trials of low back pain injection therapies, how does effectiveness vary according to the control therapy used (e.g., epidural nonsteroid injection, nonepidural injection, no injection)?		
Epidural injections		
Effects of type of placebo intervention in patients with radiculopathy: Pain, function	Low	In trials of epidural corticosteroid injections vs. placebo injections for radiculopathy, there were no clear differences in estimates for improvement in pain or function, likelihood of a successful pain or functional outcome, or likelihood of undergoing surgery when trials were stratified according to the type of placebo intervention
Effects of type of control intervention in patients with radiculopathy: All outcomes	Insufficient	Trials of epidural corticosteroid injections vs. other interventions were too limited to determine effects on outcome estimates, due to variability in the interventions evaluated, small numbers of trials, and methodological limitations
Effects of type of placebo intervention in patients with other back conditions: All outcomes	Insufficient	There was insufficient evidence from trials of epidural corticosteroid injections for spinal stenosis, nonradicular back pain, or chronic postsurgical pain, to determine effects of comparators on estimates of effect, due to small numbers of trials for specific comparisons
Facet joint injections		
Effects of type of placebo therapy:	Insufficient	There was insufficient evidence from trials facet joint injections to determine effects of comparators on estimates of effect, due to small numbers of trials for specific comparisons
Key Question 3a. How do response rates vary according to the specific comparator evaluated (e.g., saline epidural, epidural with local anesthetic, nonepidural injection, no injection, surgery, nonsurgical therapies)?		
Epidural injections for radiculopathy		
Epidural corticosteroid injections vs. placebo interventions (direct comparisons): Pain, function, successful outcome	Low	Three trials found no differences between epidural local anesthetic vs. epidural saline injections (3 trials) or soft tissue injections (2 trials) in mean improvements in pain or function or the proportion experiencing pain relief or a successful outcome
Epidural corticosteroid injections vs. placebo interventions (indirect comparisons): Pain function	Low	In trials of epidural corticosteroid injections for radiculopathy, improvement in pain was smaller in patients who received epidural local anesthetic injections (3 trials, WMD –6.51, 95% CI –11.9 to –1.16, I2=45%) than epidural saline injections (4 trials, WMD –19.8, 95% CI –25.1 to –14.3, I2=56%) at immediate-term followup; there were no clear differences at other time points, but analyses were limited by small numbers of trials and statistical heterogeneity
Epidural corticosteroid injections vs. other interventions: Pain, function	Insufficient	Trials were too limited to determine effects on response rates, due to variability in the interventions evaluated, small numbers of trials, and methodological limitations

Table 13. Summary of evidence

Key Question Outcome	Strength of Evidence Grade	Conclusion
Key Question 4. What are the harms of epidural corticosteroid, facet joint corticosteroid injections, medial branch blocks, and sacroiliac joint corticosteroid injection compared to epidural nonsteroid injection, nonepidural injection, no injection, surgery, or nonsurgical therapies?		
Epidural injections		
Harms	Moderate	29 trials of epidural corticosteroid injections vs. placebo for radiculopathy reported no serious adverse events and few harms, but methods for assessing harms were not well reported and harms data were sparse. Observational studies were consistent with the trials in showing a low risk of serious adverse events
Harms	Moderate	Nine trials of epidural corticosteroid injections vs. other therapies for radiculopathy reported no serious adverse events and few harms
Harms	Low	Two trials of transforaminal vs. interlaminar epidural corticosteroid injections for radiculopathy reported no serious adverse events
Harms	Insufficient	There was insufficient evidence from four trials that compared epidural injections for radiculopathy with different corticosteroids to determine effects on harms
Harms	Insufficient	There was insufficient evidence from six trials of epidural corticosteroid injections for radiculopathy that compared different doses to determine effects on harms
Harms	Low	Eight trials of epidural corticosteroid injections vs. placebo injections for spinal stenosis reported no serious harms and few adverse events, but methods for assessing harms were not well reported and harms data were sparse
Harms	Low	Two trials of epidural corticosteroid injections for nonradicular back pain reported no serious harms
Harms	Insufficient	There was insufficient evidence from four trials of epidural corticosteroid injections for chronic postsurgical back pain to determine effects on harms
Facet joint injections		
Harms	Low	Ten trials of facet joint corticosteroid injections reported no serious harms and few adverse events, but methods for assessing harms were not well reported and harms data sparse
Sacroiliac joint injections		
Harms	Insufficient	Harms were not reported in one small trial of peri-articular sacroiliac joint injections

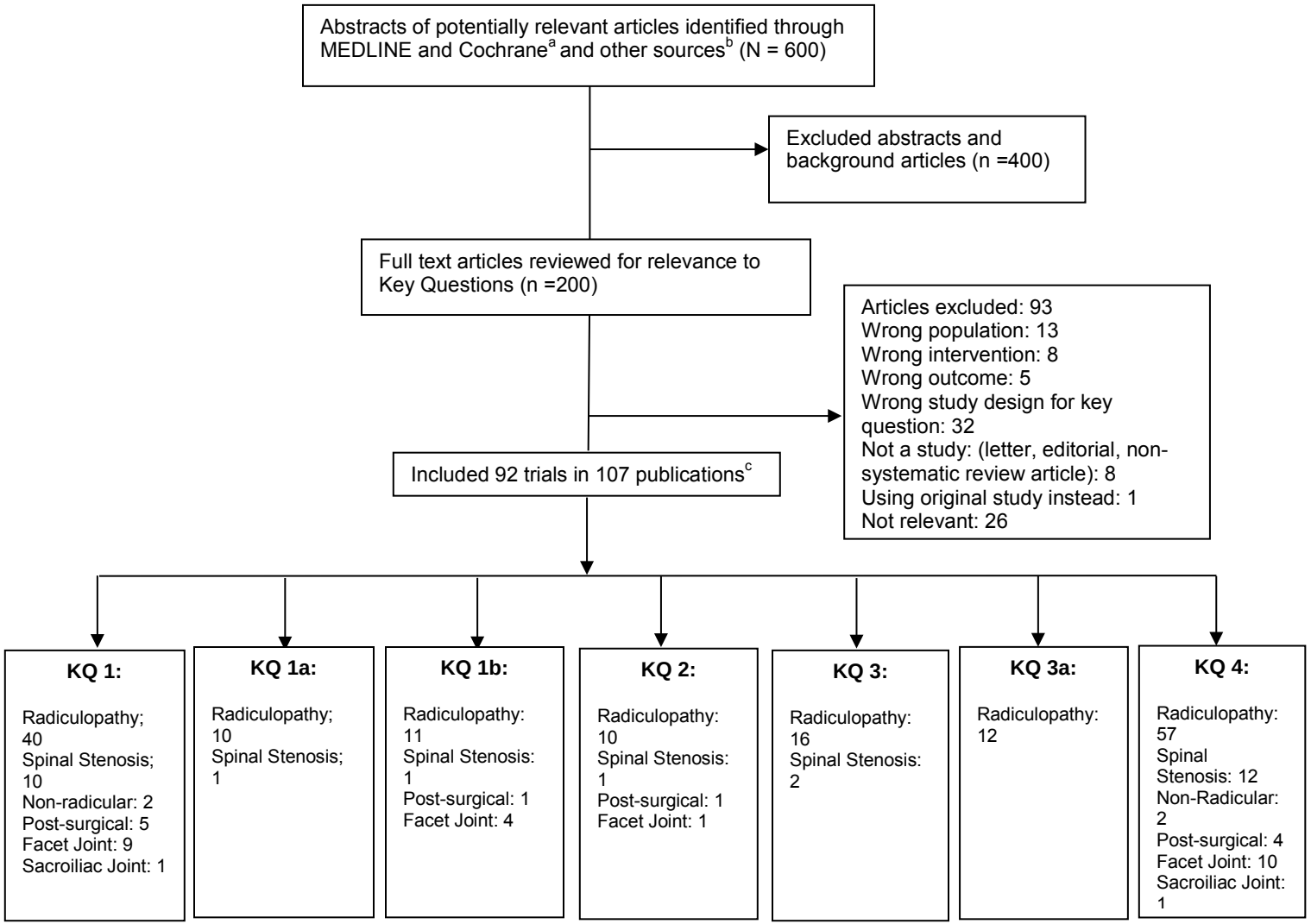
CI, confidence interval; MILD, minimally invasive lumbar decompression; ODI, Oswestry Disability Index; RR, relative risk; SF-36, Short Form-36; SMD, standardized mean difference; SPECT= single photon electronic computed tomography; WMD, weighted mean difference.

Figure 1. Analytic framework for pain management injection therapies for low back pain



[a] Patients with nonradicular low back pain, low back pain with radiculopathy, and low back pain with spinal stenosis.

Figure 2. Literature flow diagram



[a] Cochrane databases include the Cochrane Central Register of Controlled Trials and the Cochrane Database of Systematic Reviews.
[b] Other sources include reference lists of relevant articles, systematic reviews, etc.
[c] Some studies are included for more than one Key Question.

Figure 3. Meta-analysis of epidural corticosteroid injections versus placebo interventions for radiculopathy: Immediate-term improvement in pain

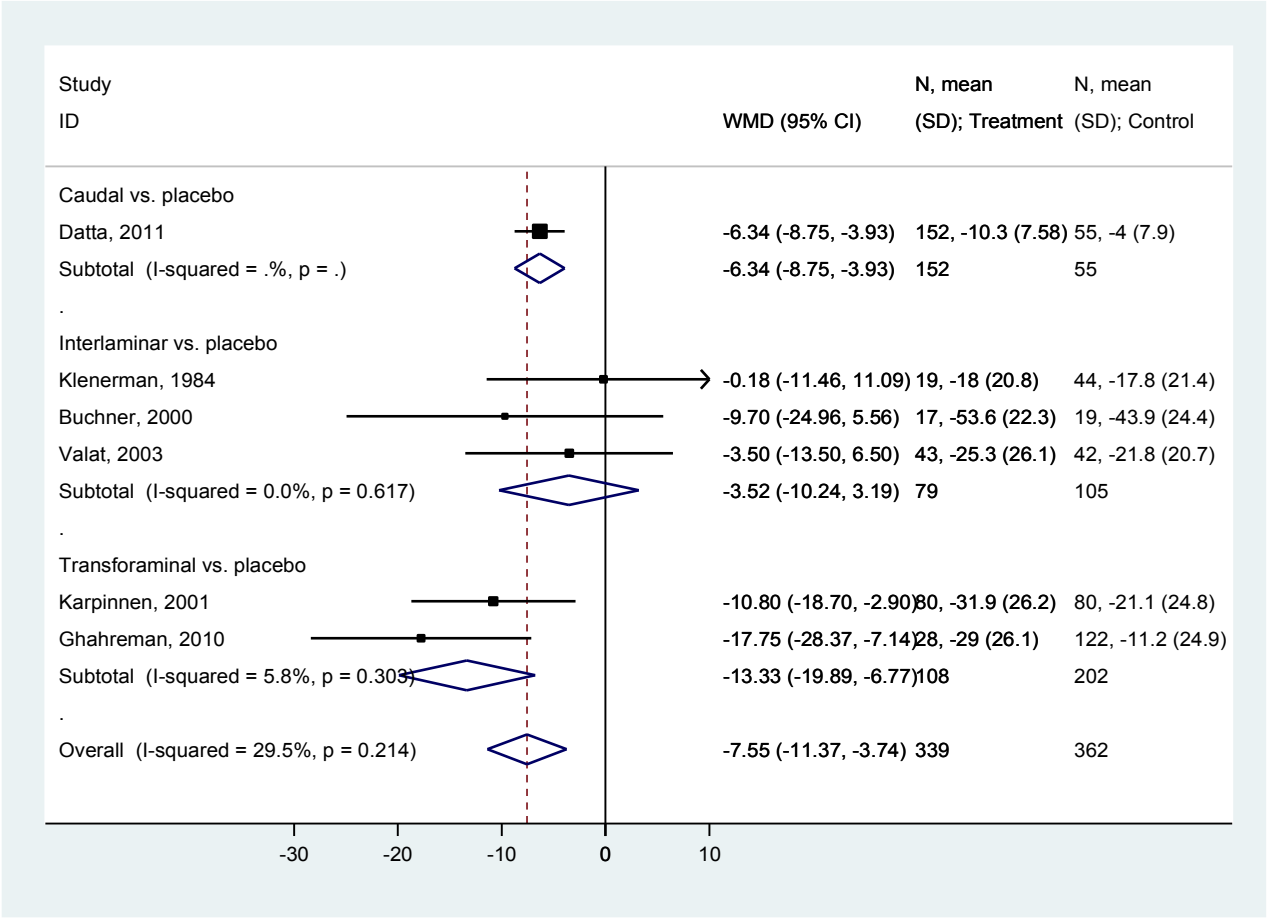


Figure 4. Meta-analysis of epidural corticosteroid injections versus placebo interventions for radiculopathy: Short-term improvement in pain

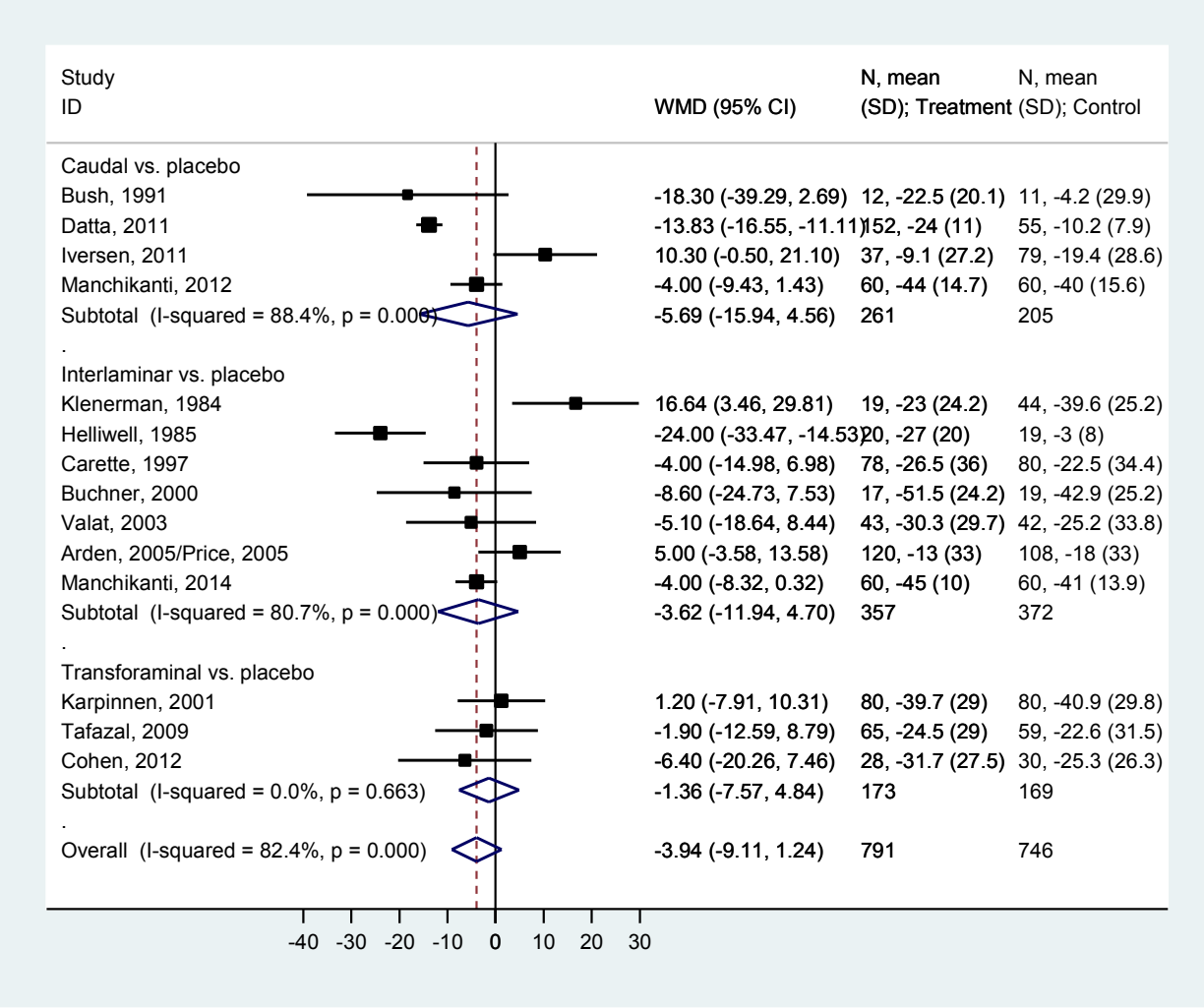


Figure 5. Meta-analysis of epidural corticosteroid injections versus placebo interventions for radiculopathy: Intermediate-term improvement in pain

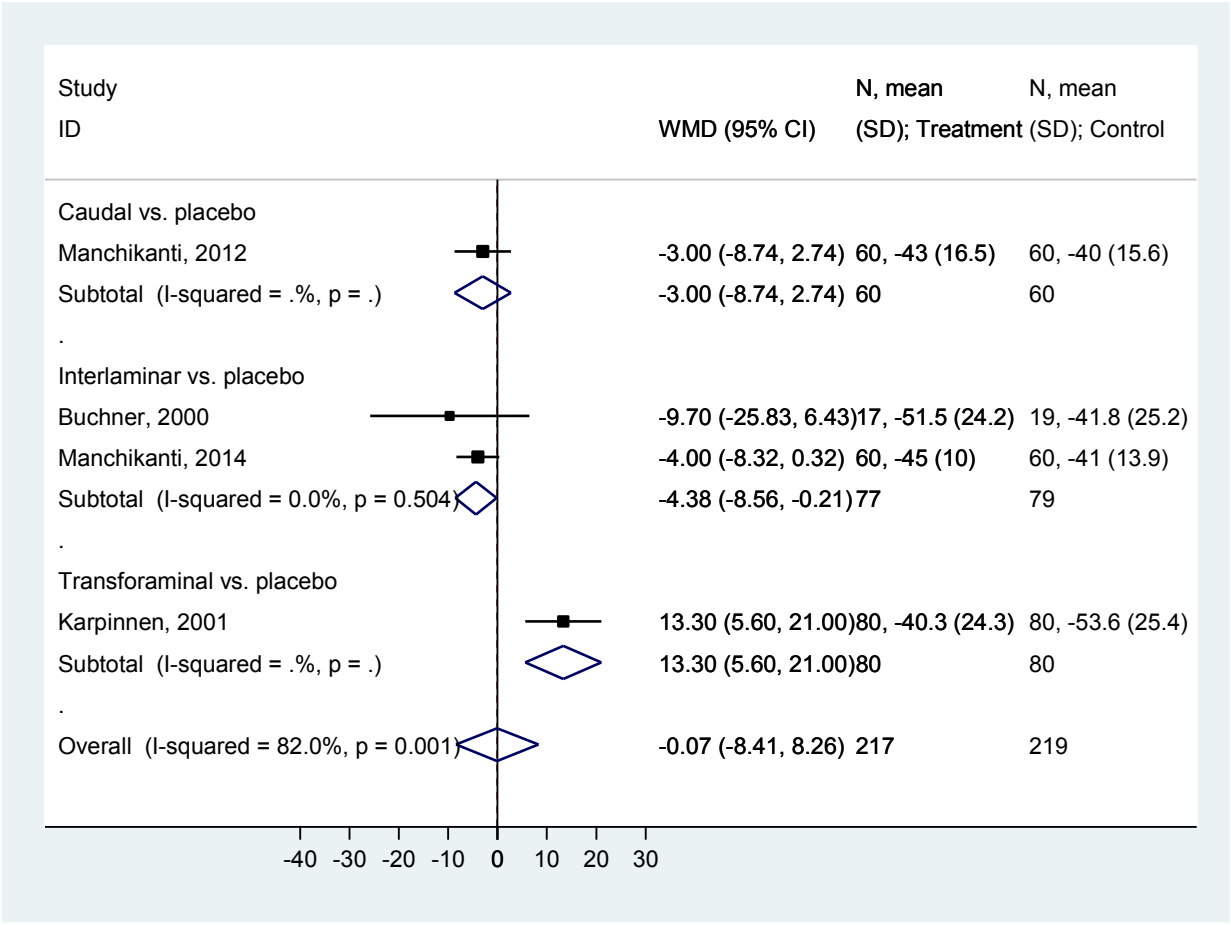


Figure 6. Meta-analysis of epidural corticosteroid injections versus placebo interventions for radiculopathy: Long-term improvement in pain

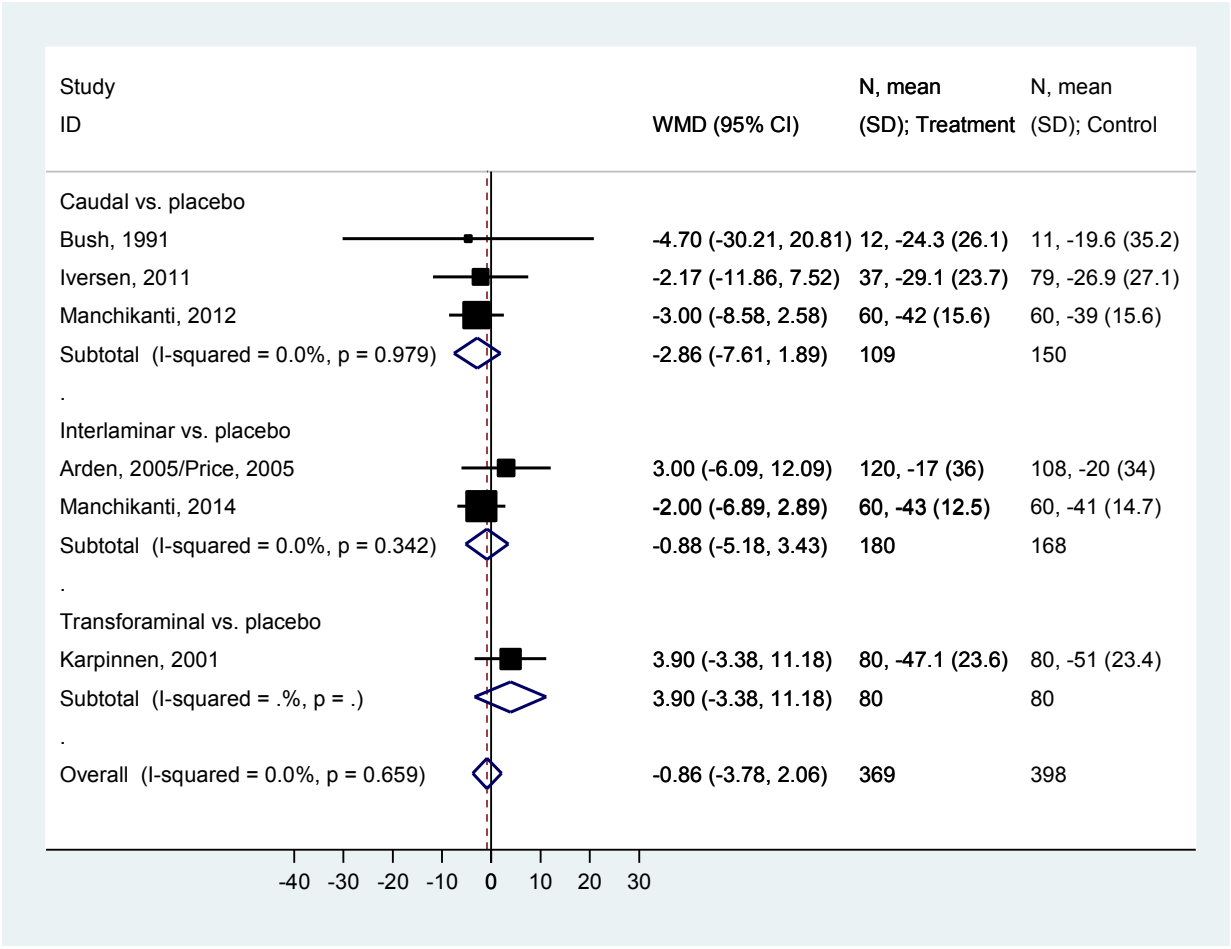


Figure 7. Meta-analysis of epidural corticosteroid injections versus placebo interventions for radiculopathy: Successful short-term pain outcome

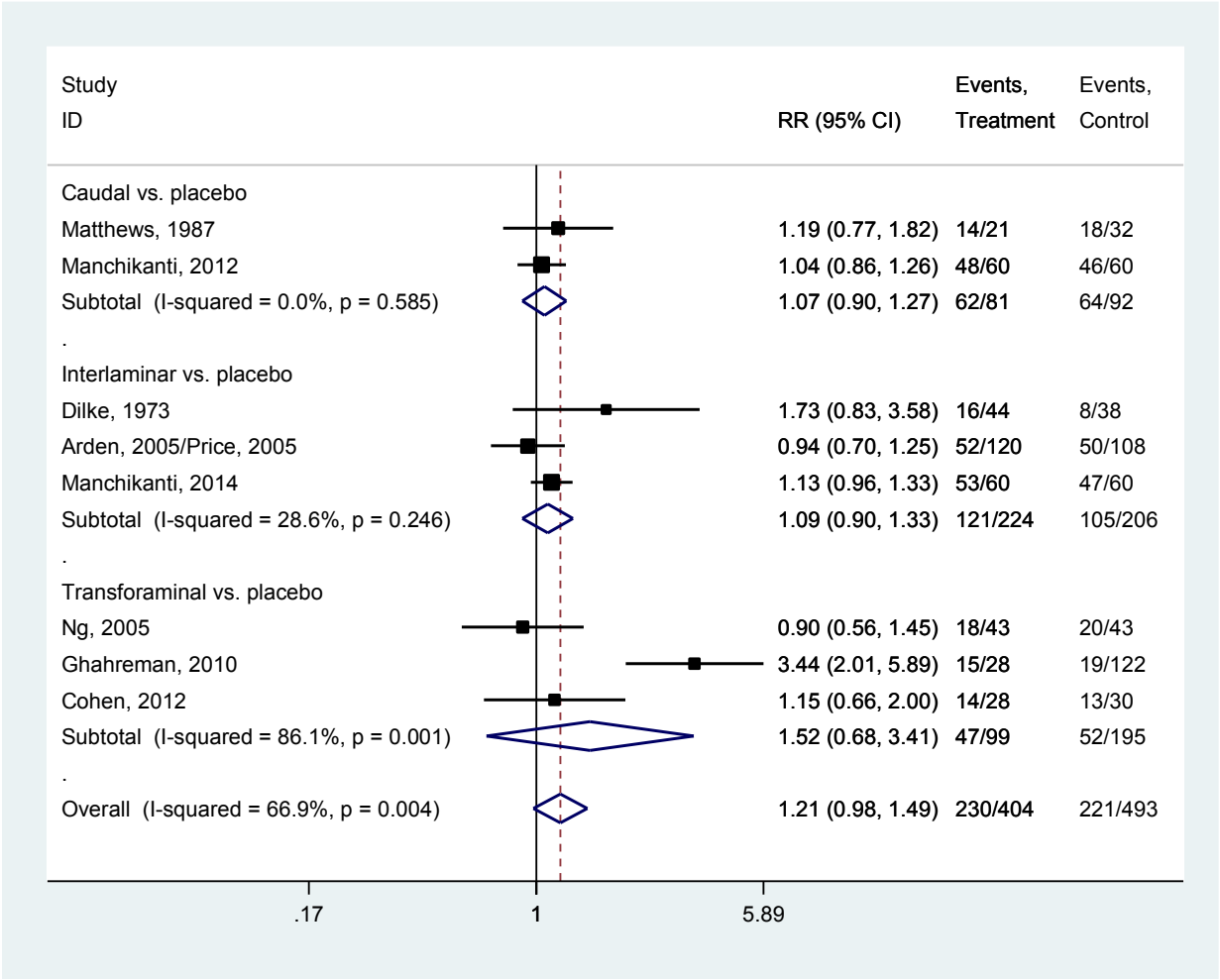


Figure 8. Meta-analysis of epidural corticosteroid injections versus placebo interventions for radiculopathy: Successful intermediate-term pain outcome

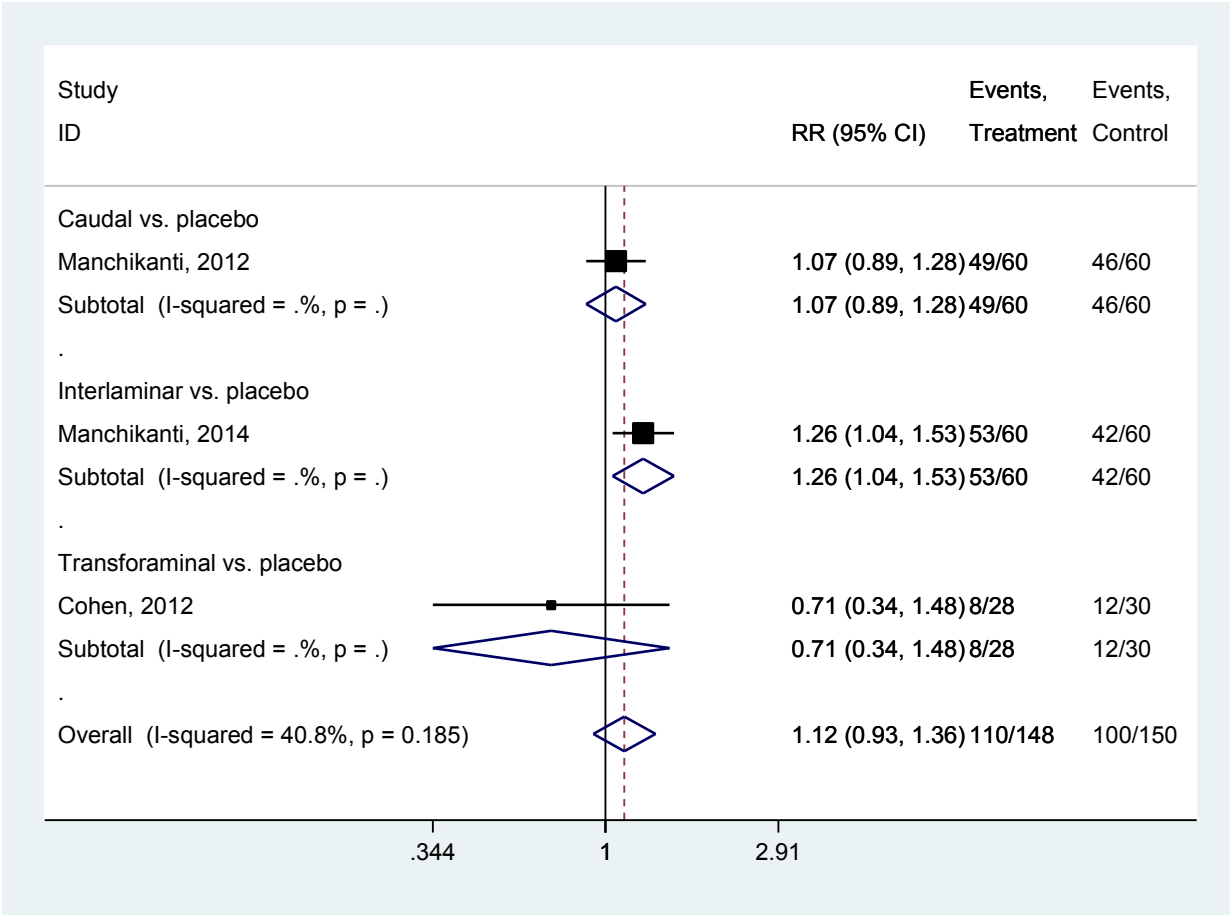


Figure 9. Meta-analysis of epidural corticosteroid injections versus placebo interventions for radiculopathy: Successful long-term pain outcome

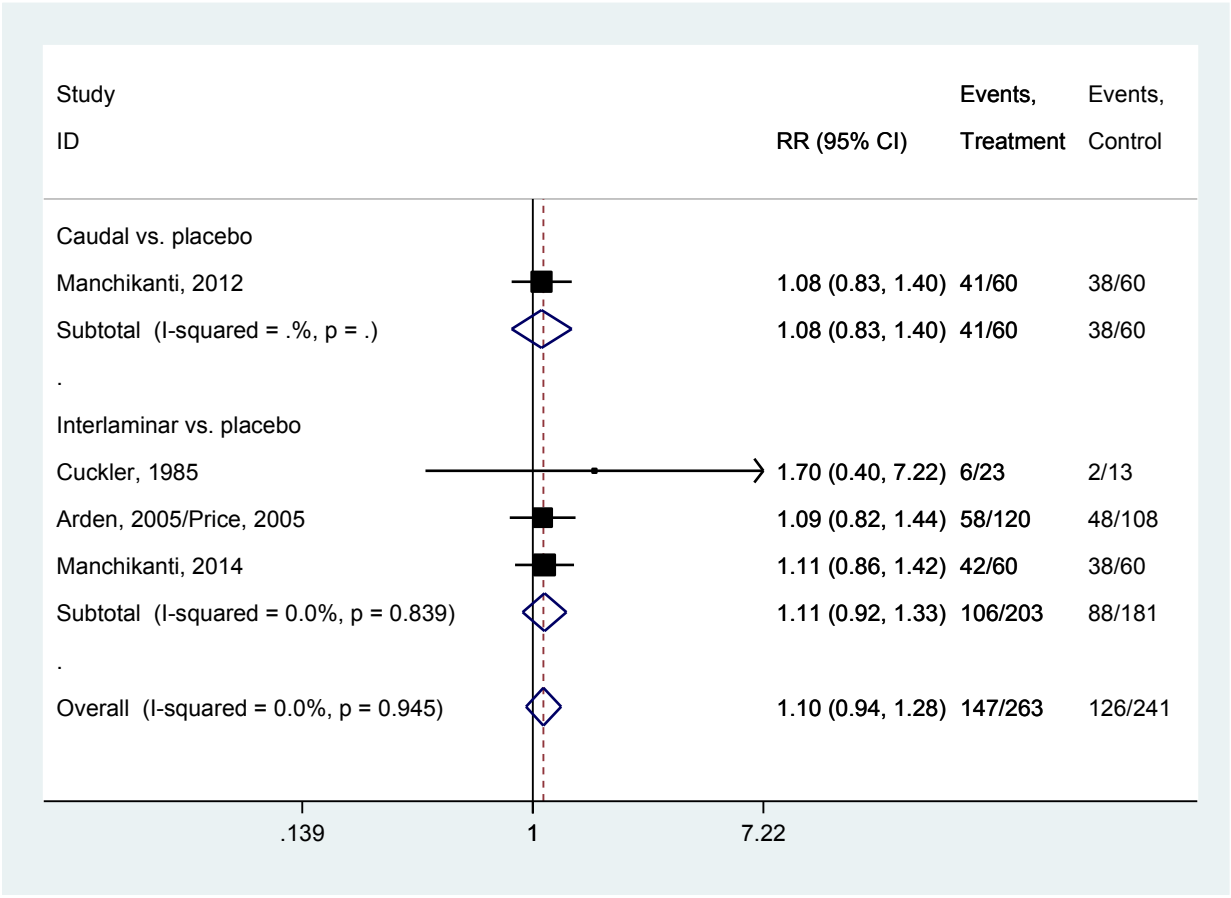


Figure 10. Meta-analysis of epidural corticosteroid injections versus placebo interventions for radiculopathy: Immediate-term improvement in function

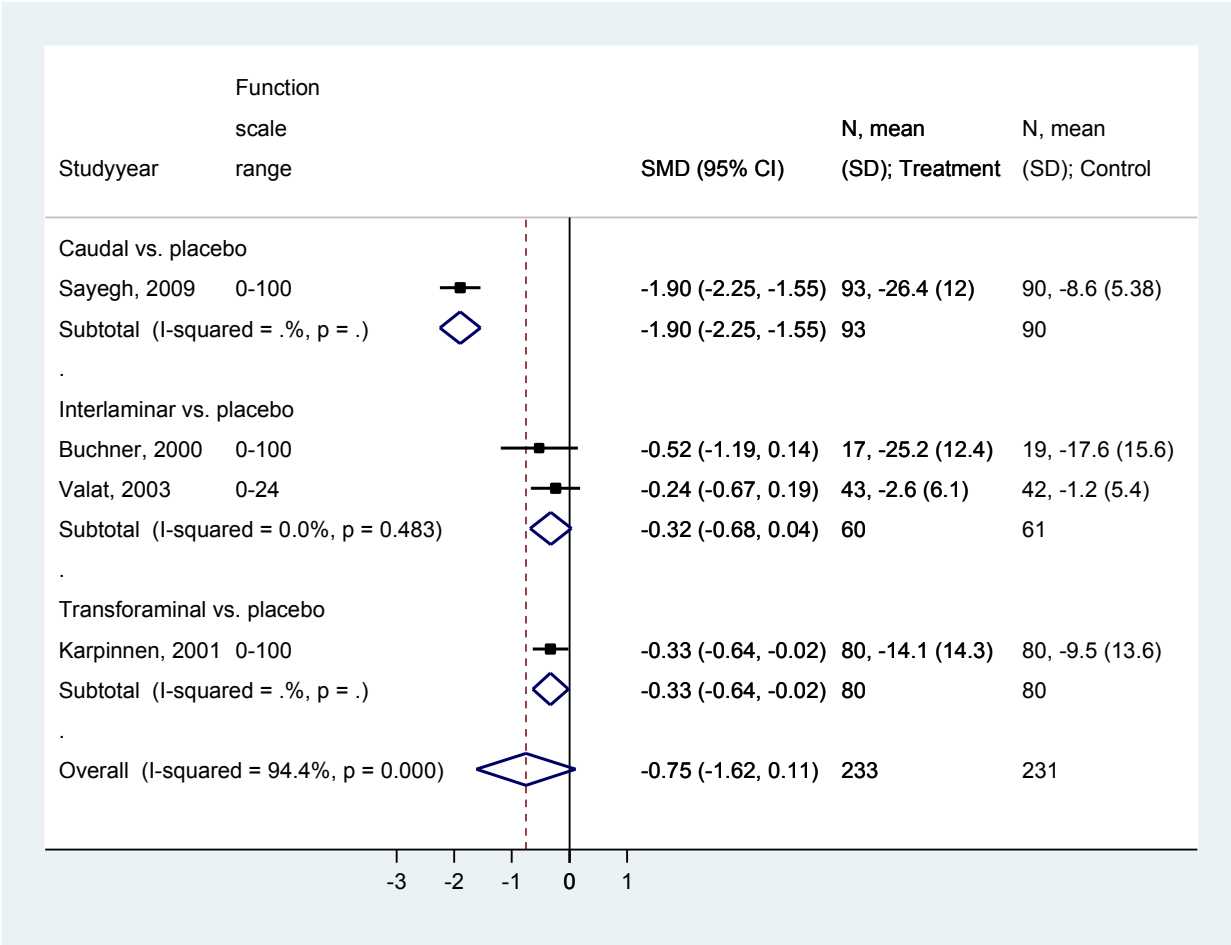


Figure 11. Meta-analysis of epidural corticosteroid injections versus placebo interventions for radiculopathy: Short-term improvement in function

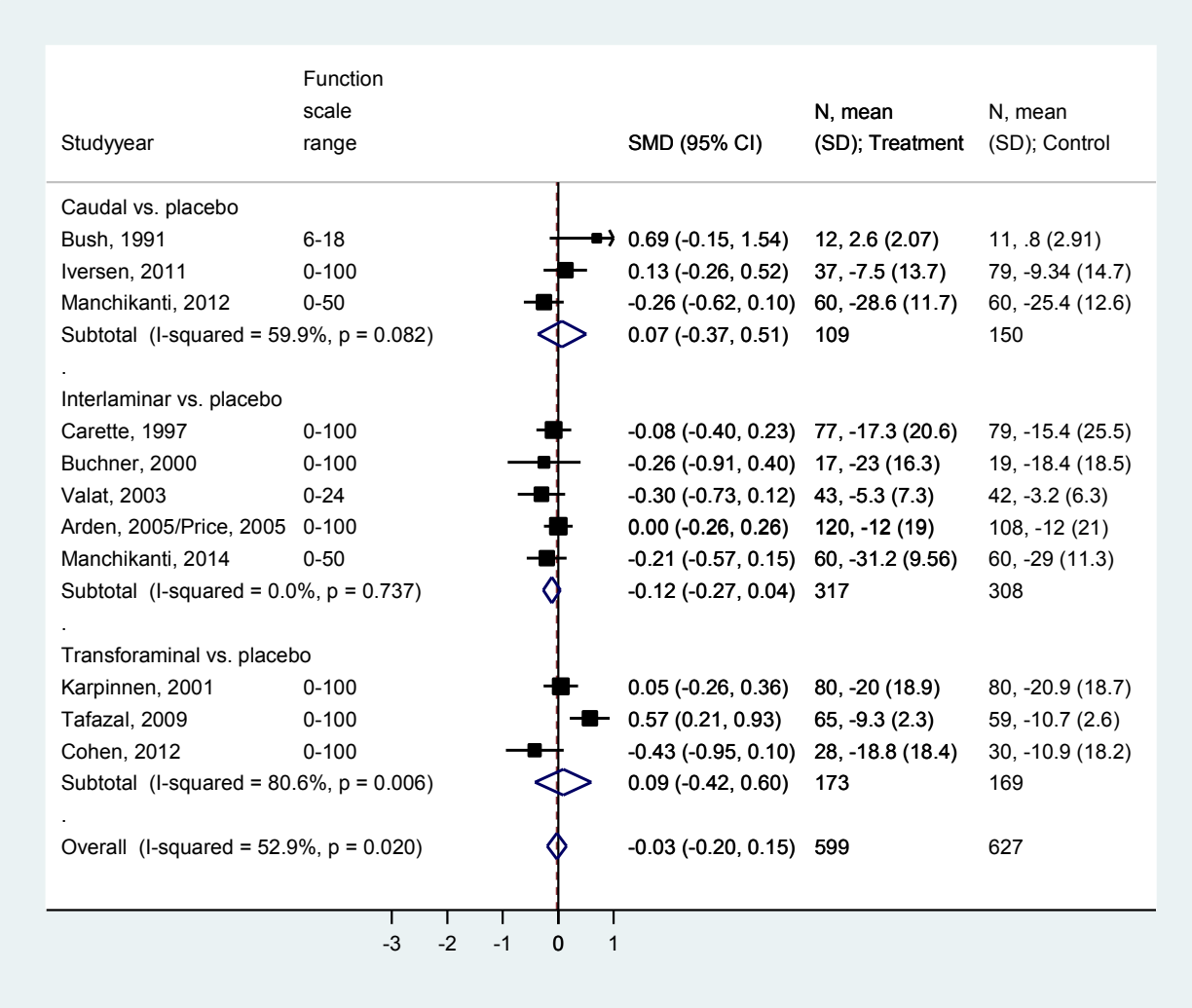


Figure 12. Meta-analysis of epidural corticosteroid injections versus placebo interventions for radiculopathy: Intermediate-term improvement in function

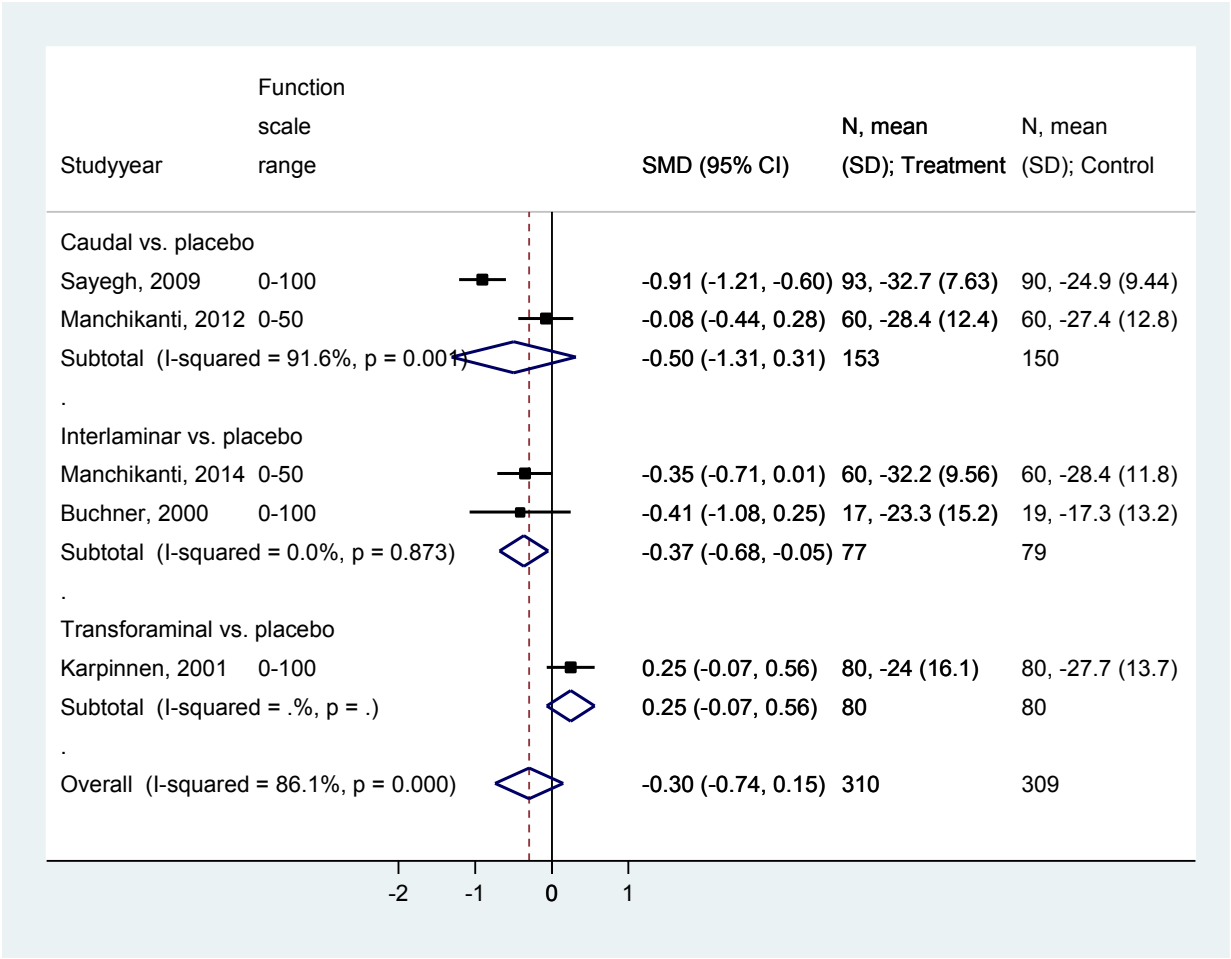


Figure 13. Meta-analysis of epidural corticosteroid injections versus placebo interventions for radiculopathy: Long-term improvement in function

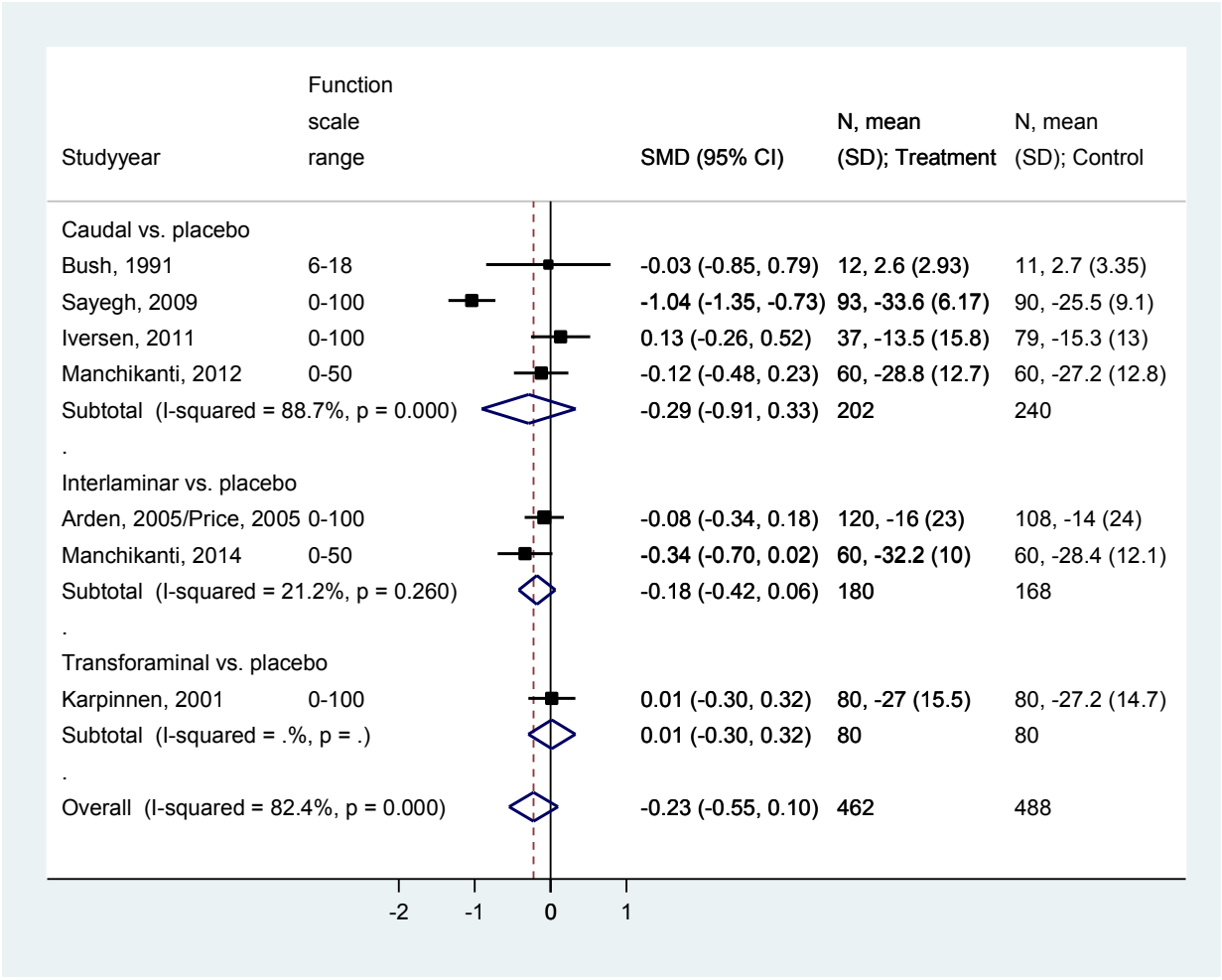


Figure 14. Meta-analysis of epidural corticosteroid injections versus placebo interventions for radiculopathy: Successful short-term functional outcome

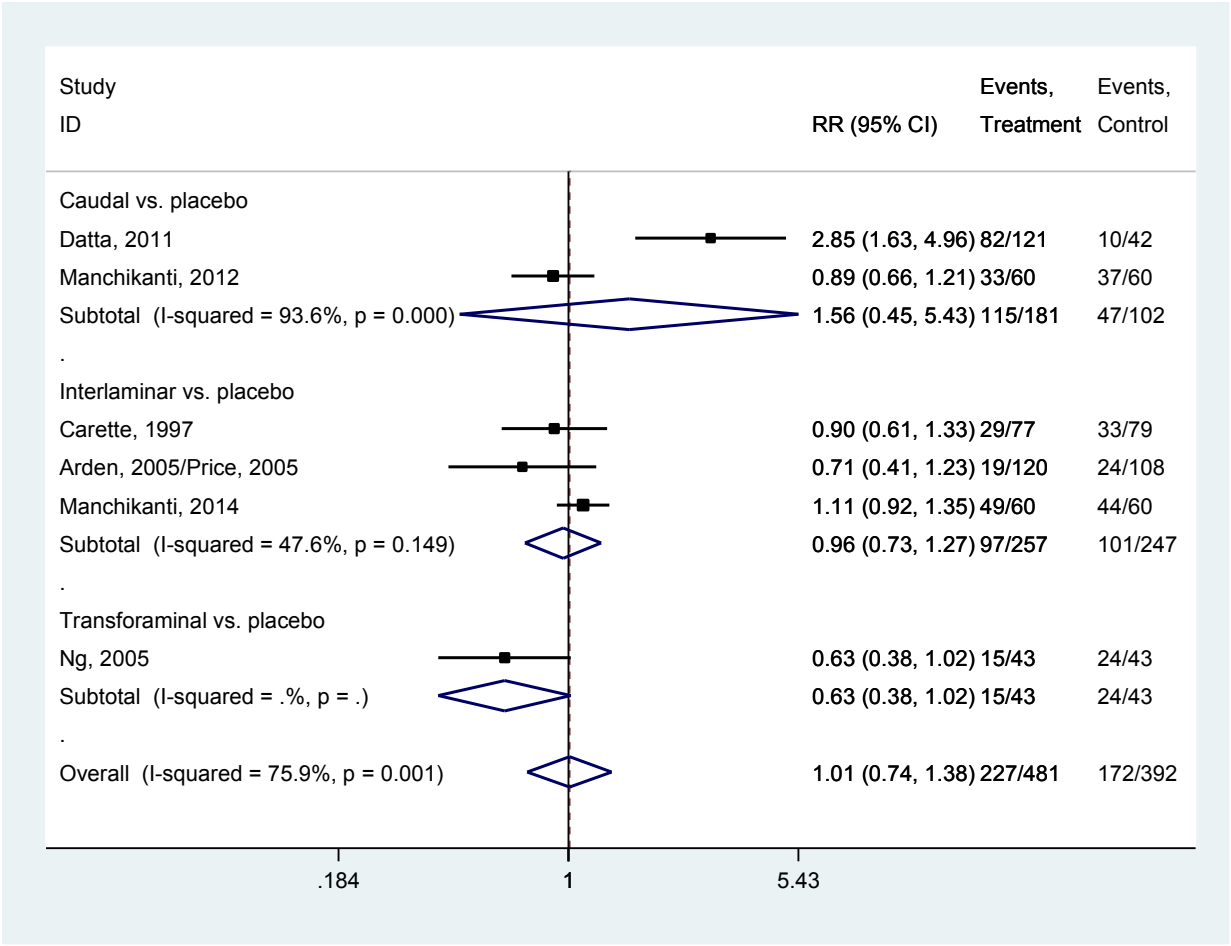


Figure 15. Meta-analysis of epidural corticosteroid injections versus placebo interventions for radiculopathy: Successful intermediate-term functional outcome

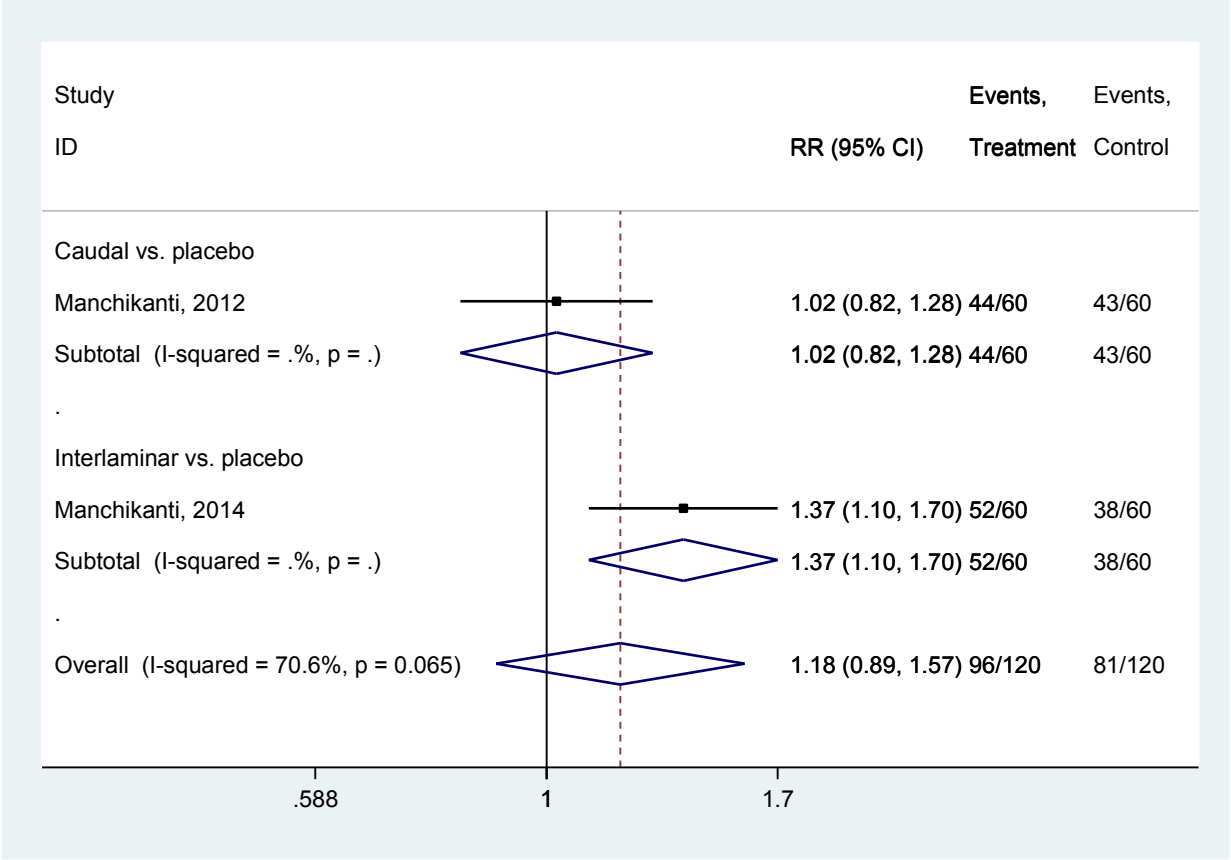


Figure 16. Meta-analysis of epidural corticosteroid injections versus placebo interventions for radiculopathy: Successful long-term functional outcome

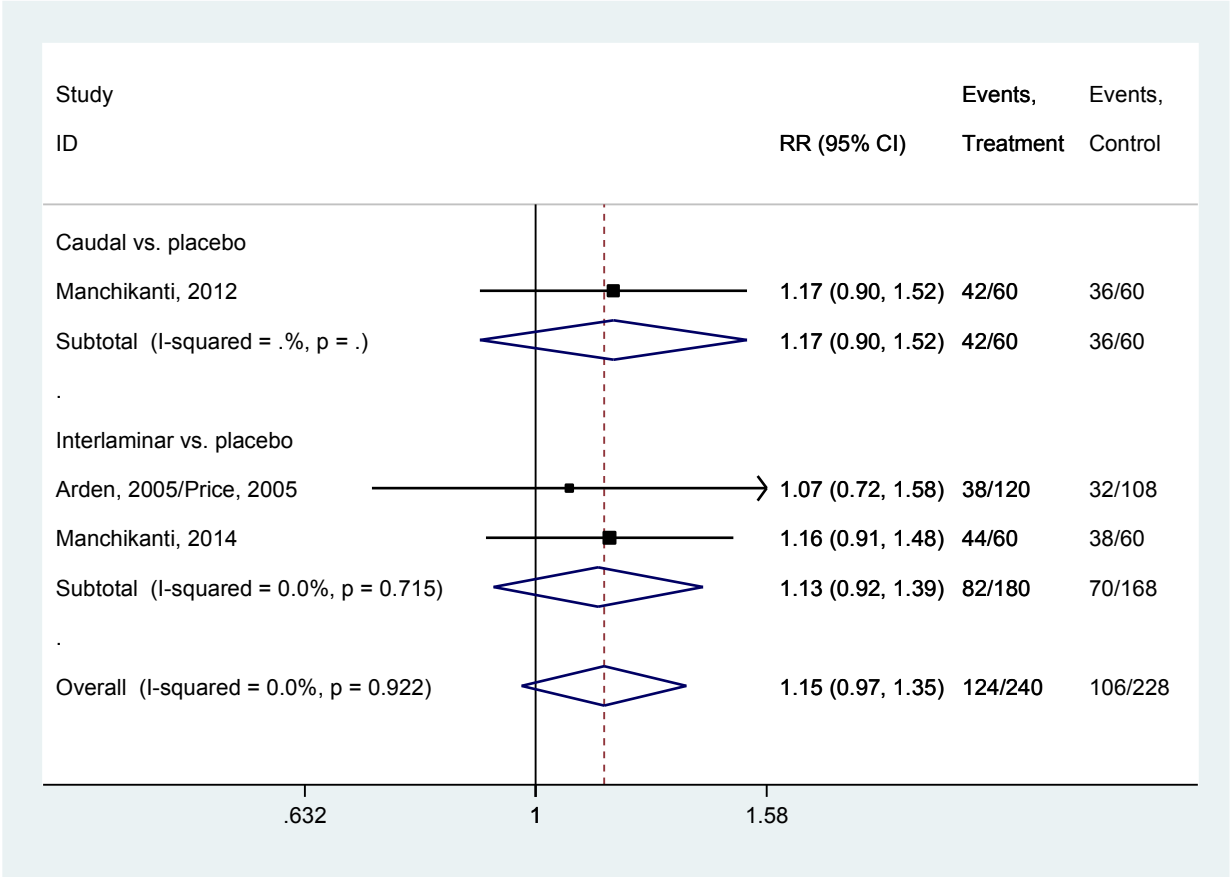


Figure 17. Meta-analysis of epidural corticosteroid injections versus placebo interventions for radiculopathy: Short-term risk of surgery

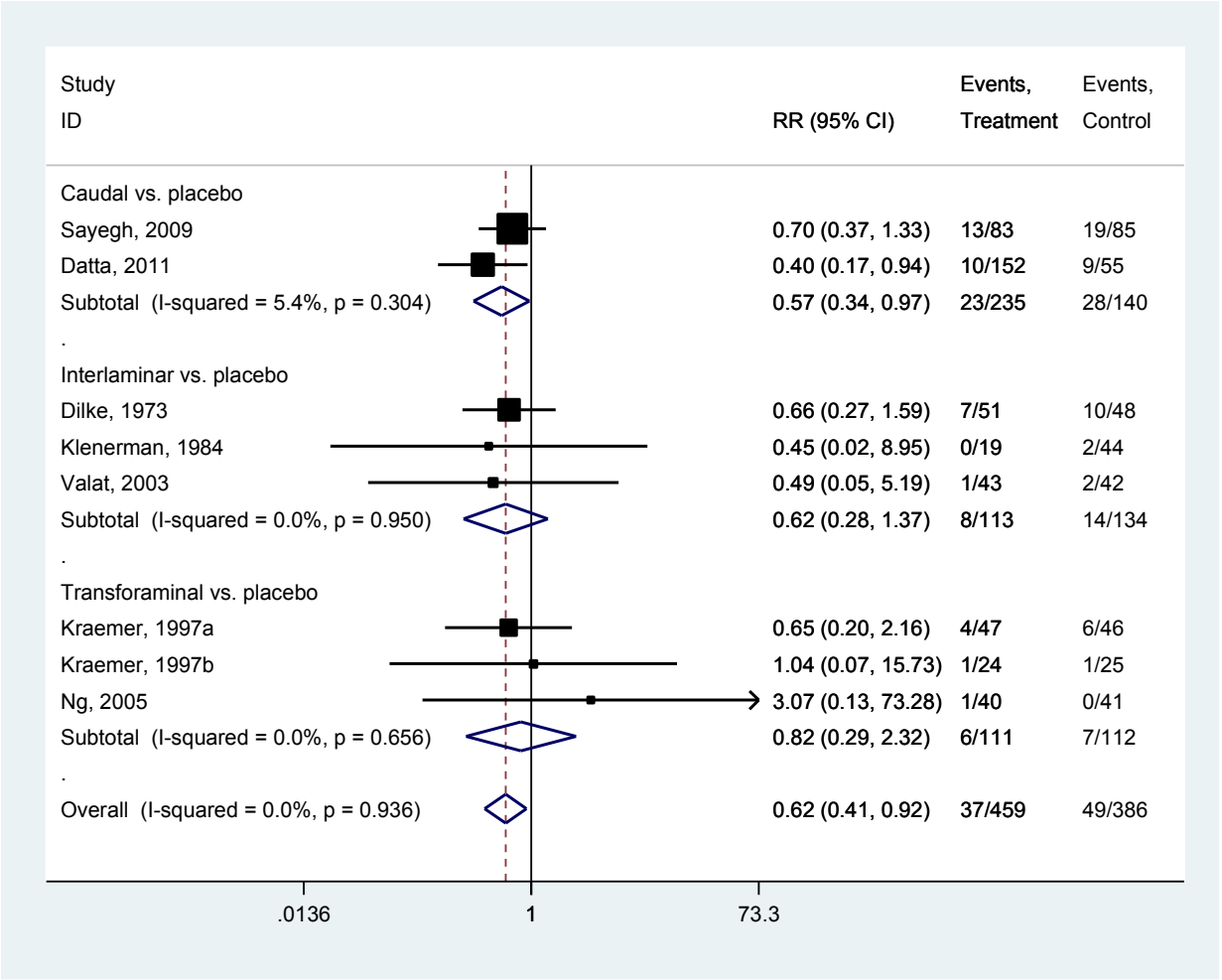


Figure 18. Meta-analysis of epidural corticosteroid injections versus placebo interventions for radiculopathy: Long-term risk of surgery

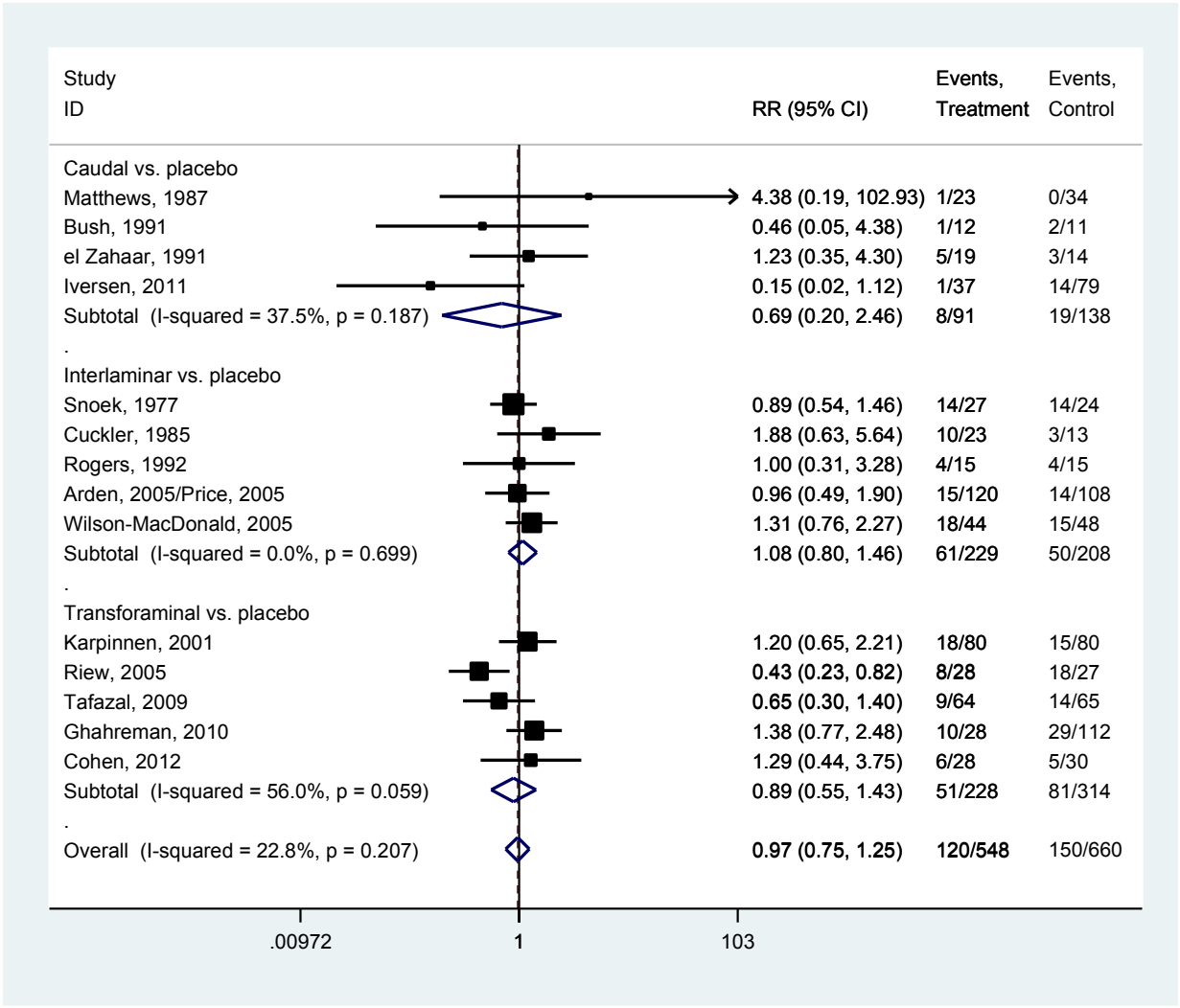


Figure 19. Meta-analysis of epidural corticosteroid injections versus placebo interventions for radiculopathy: Successful immediate-term outcome

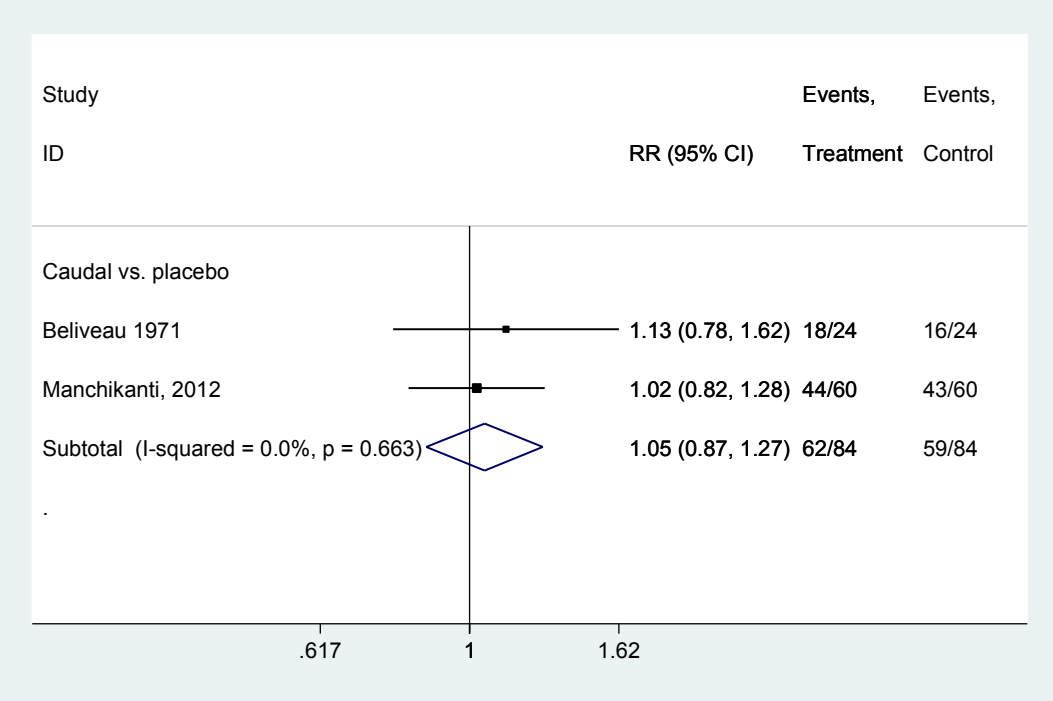


Figure 20. Meta-analysis of epidural corticosteroid injections versus placebo interventions for radiculopathy: Successful short-term outcome

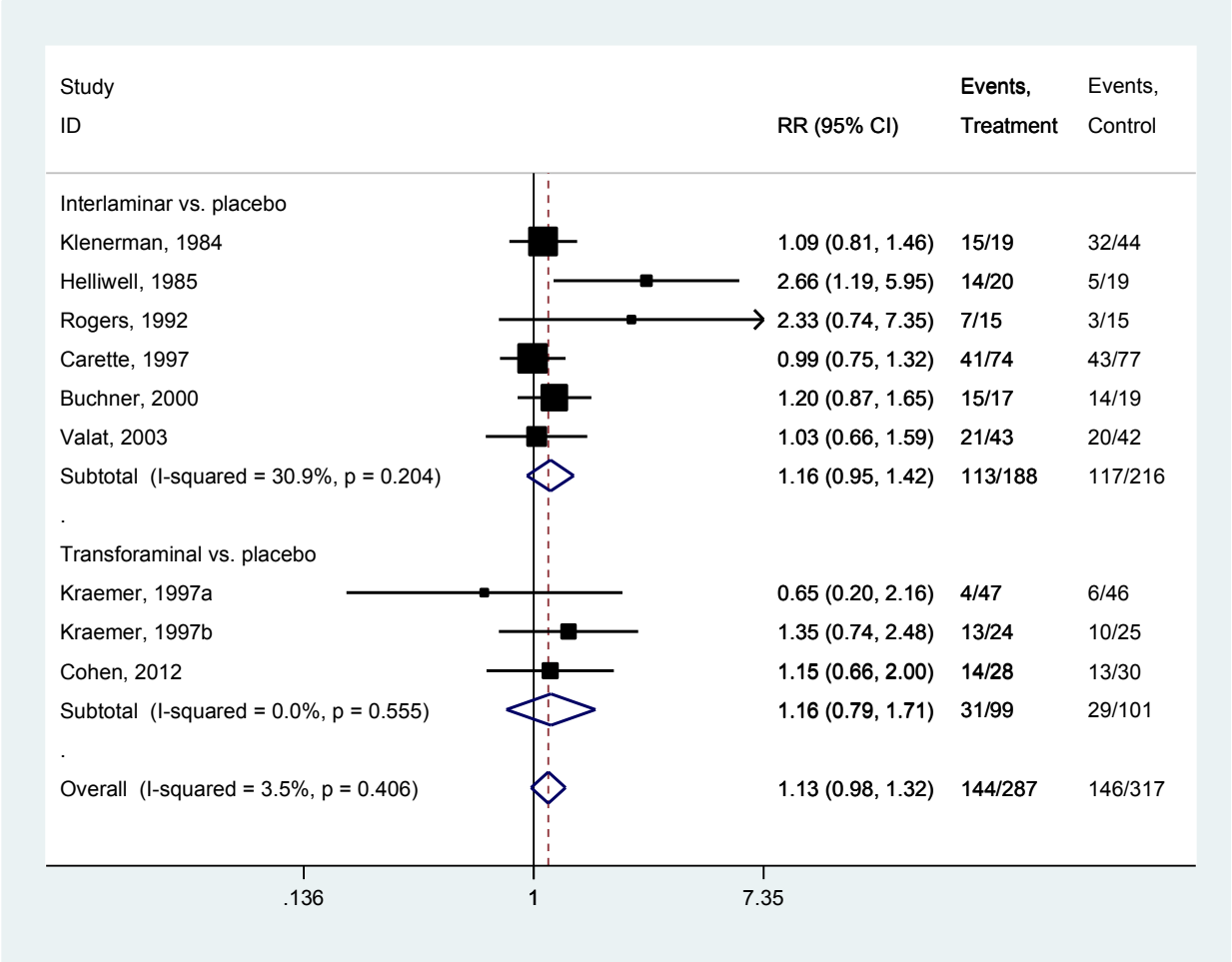


Figure 21. Meta-analysis of epidural corticosteroid injections versus placebo interventions for radiculopathy: Successful long-term outcome

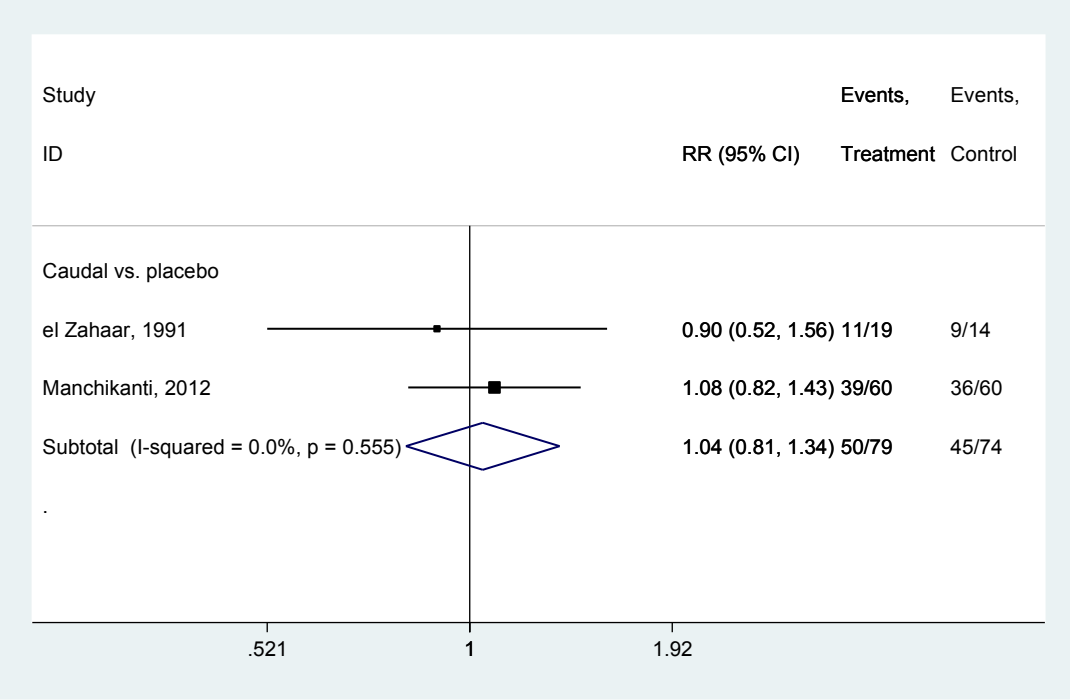


Figure 22. Funnel plot of epidural corticosteroid injections versus placebo interventions: Mean short-term improvement in pain

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Egger's test for small-study effects: p=0.09
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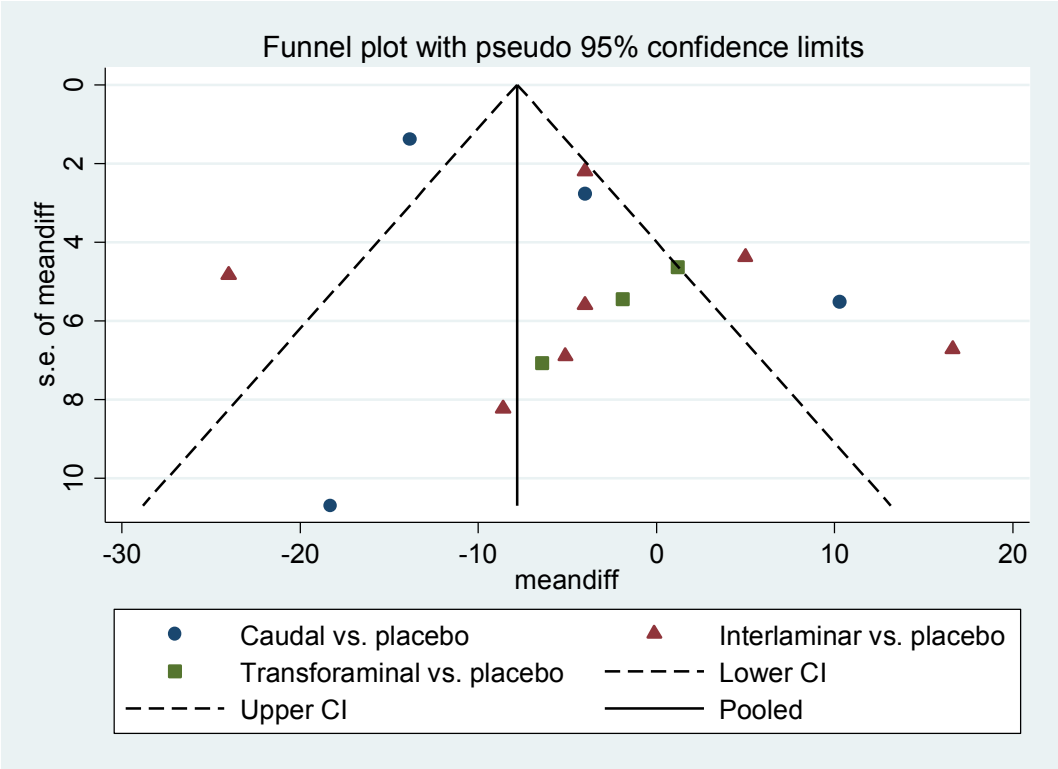

Figure 23. Funnel plot of epidural corticosteroid injections versus placebo interventions: Mean short-term improvement in function

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Egger's test for small-study effects: p=0.81
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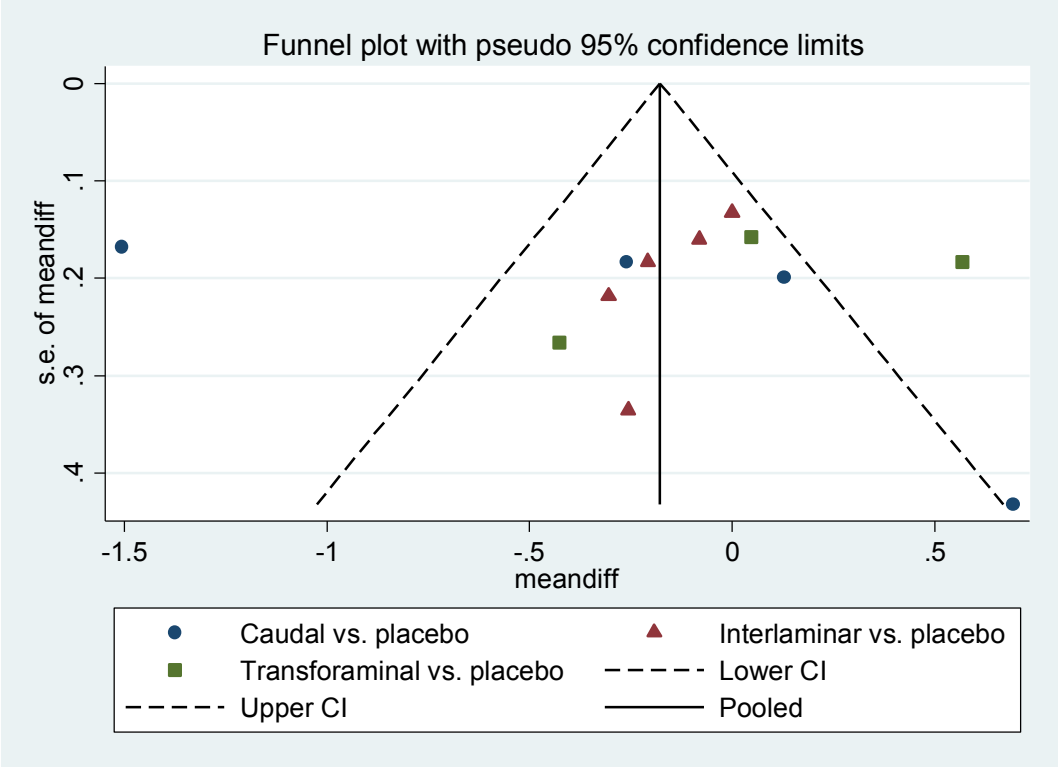

Figure 24. Funnel plot of epidural corticosteroid injections versus placebo interventions: Likelihood of surgery at long-term

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Egger's test for small-study effects: p=0.81
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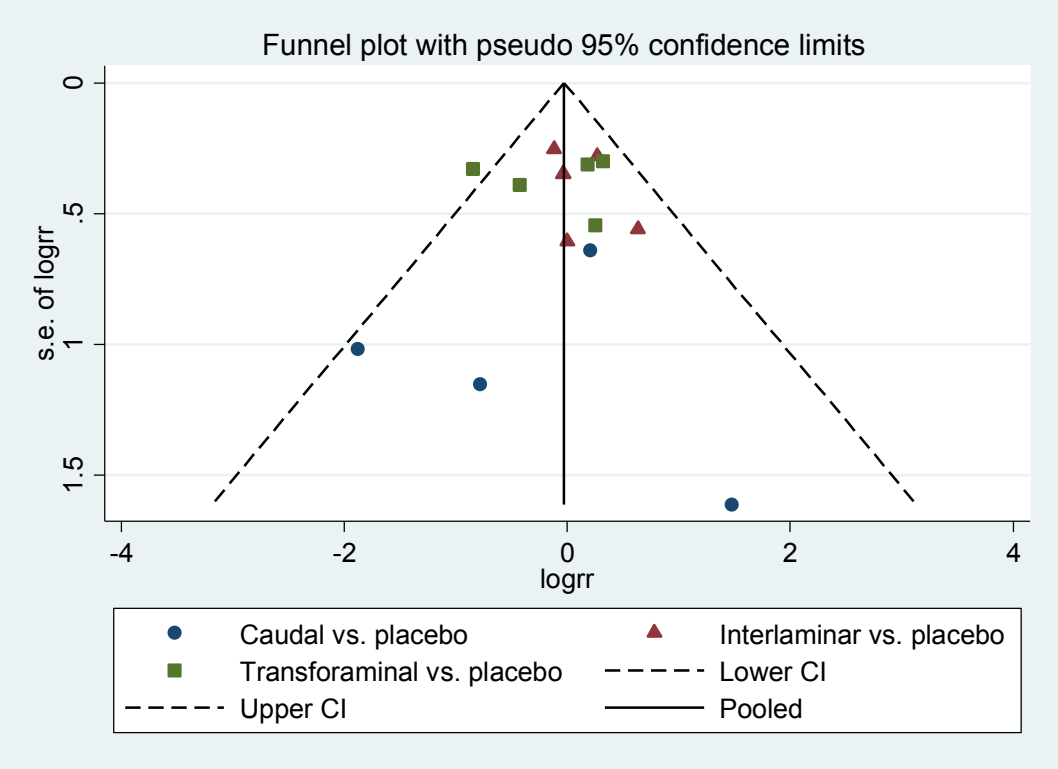


Figure 25. Meta-analysis of epidural corticosteroid injections versus placebo interventions for spinal stenosis: Short-term improvement in pain

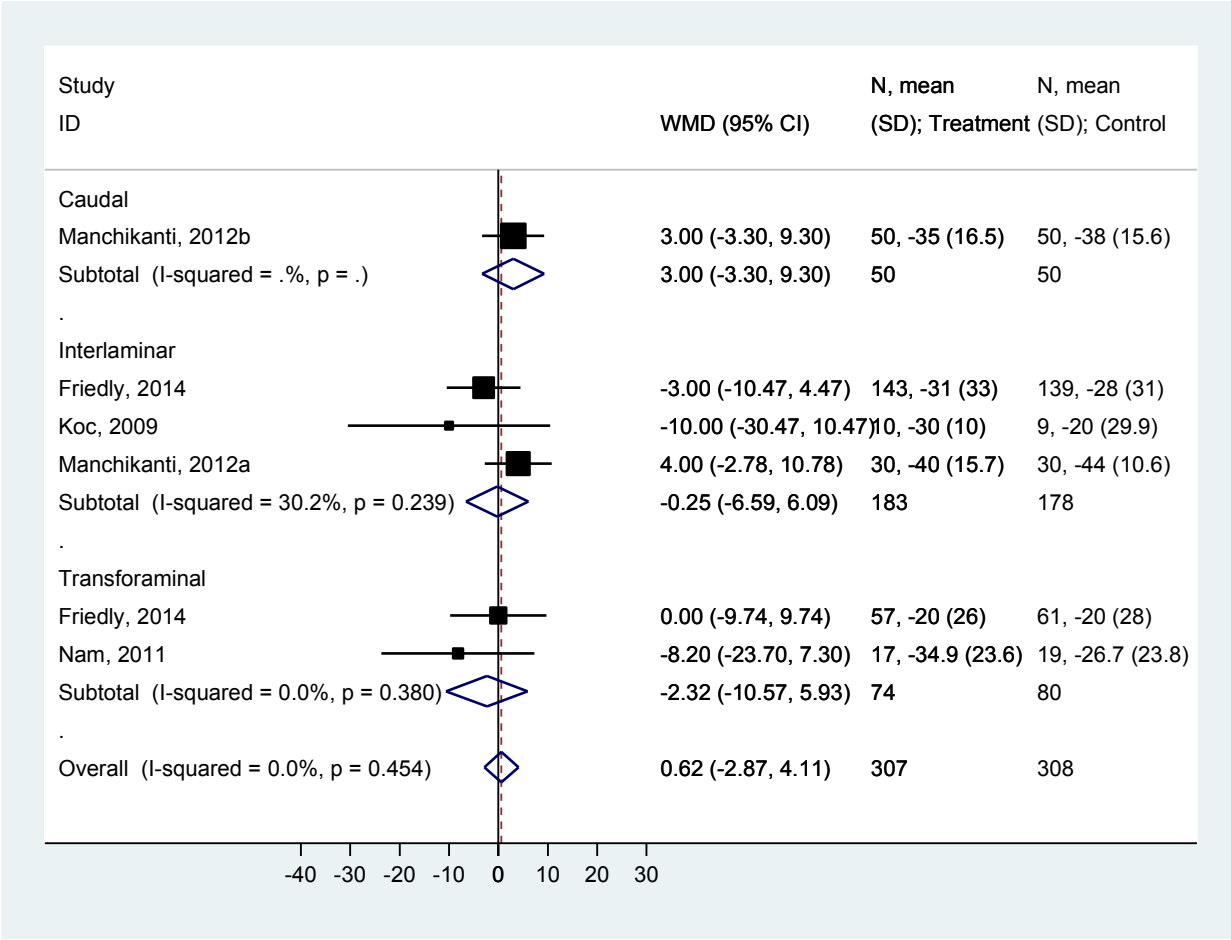


Figure 26. Meta-analysis of epidural corticosteroid injections versus placebo interventions for spinal stenosis: Intermediate-term improvement in pain

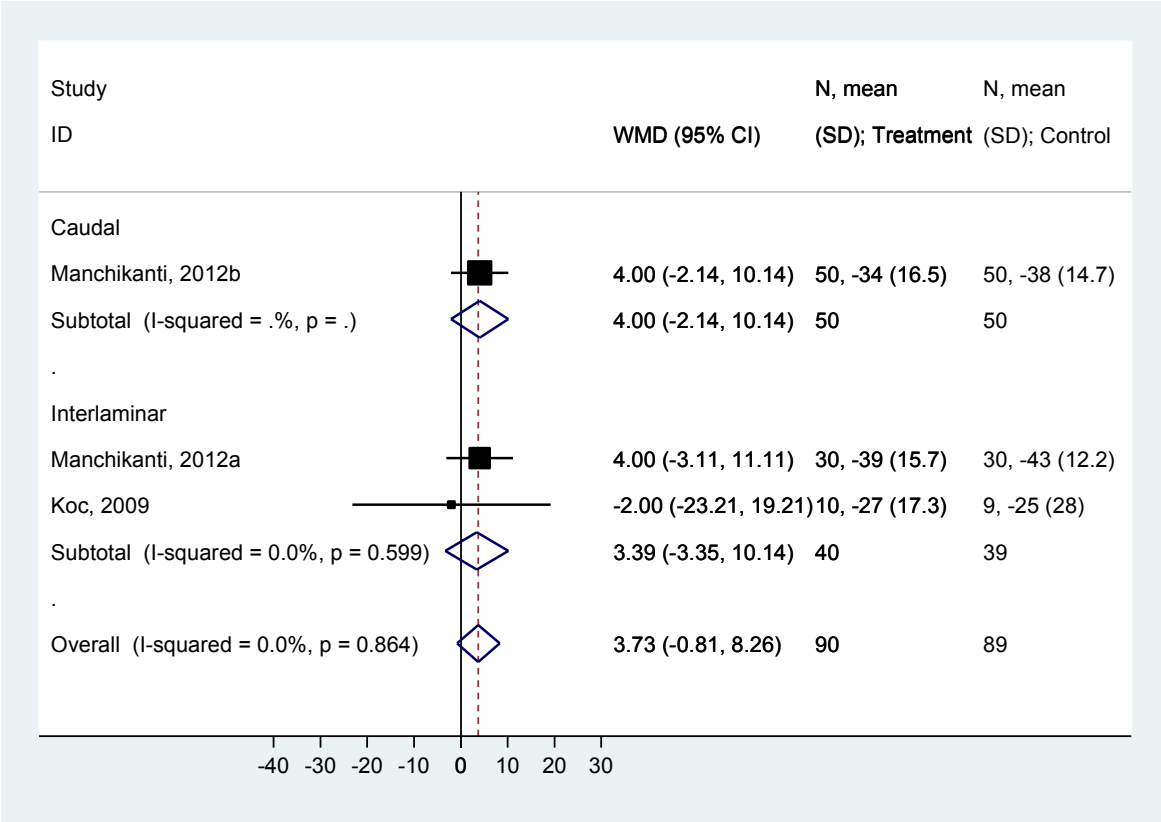


Figure 27. Meta-analysis, epidural corticosteroid injections versus placebo interventions for spinal stenosis: Successful short-term pain outcome

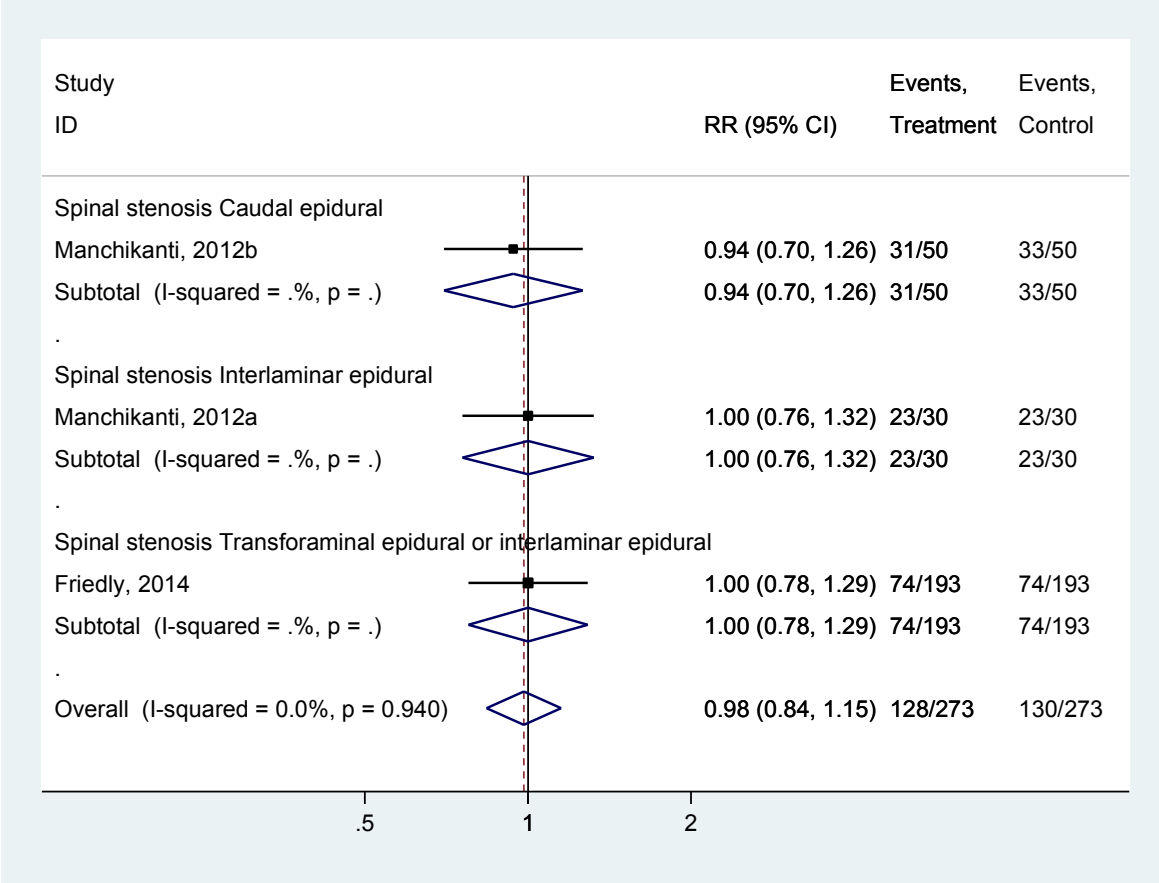


Figure 28. Meta-analysis of epidural corticosteroid injections versus placebo interventions for spinal stenosis: successful intermediate-term pain outcome

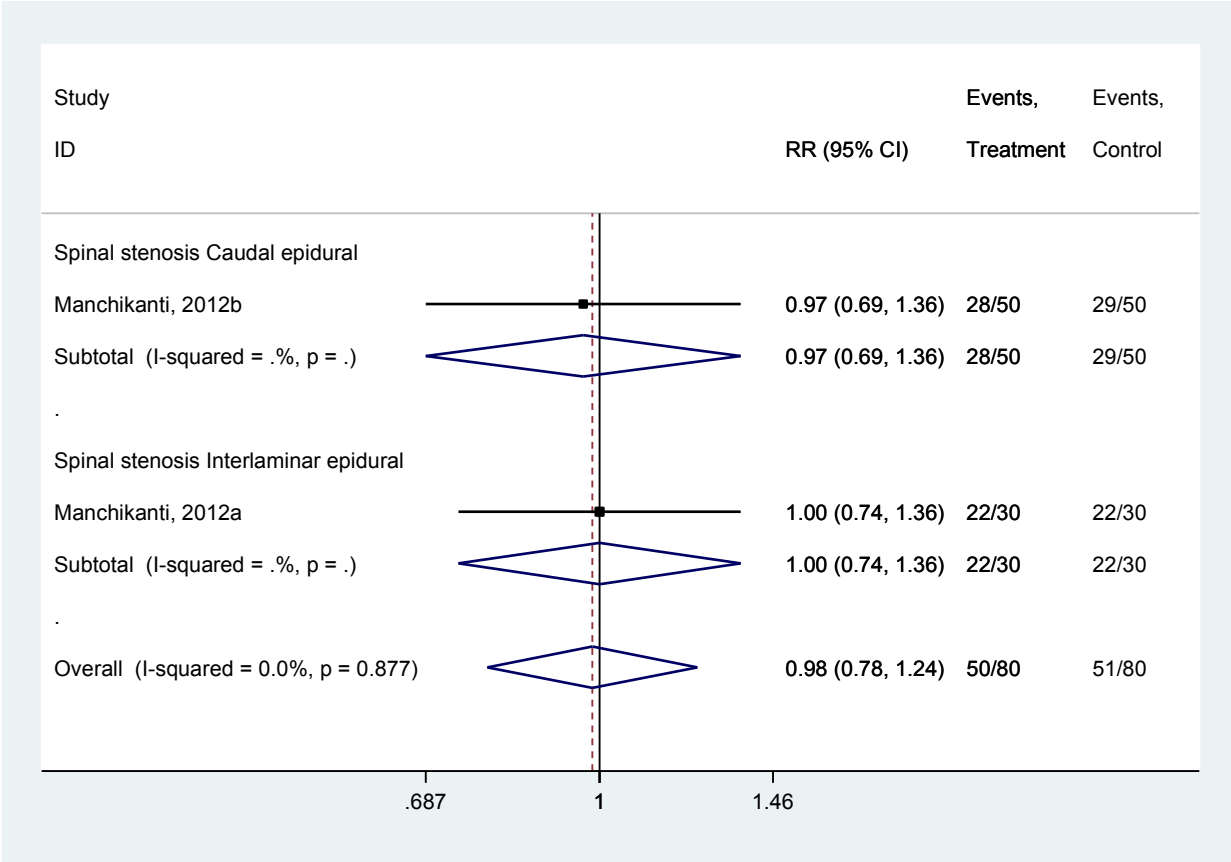


Figure 29. Meta-analysis of epidural corticosteroid injections versus placebo interventions for spinal stenosis: successful long-term pain outcome

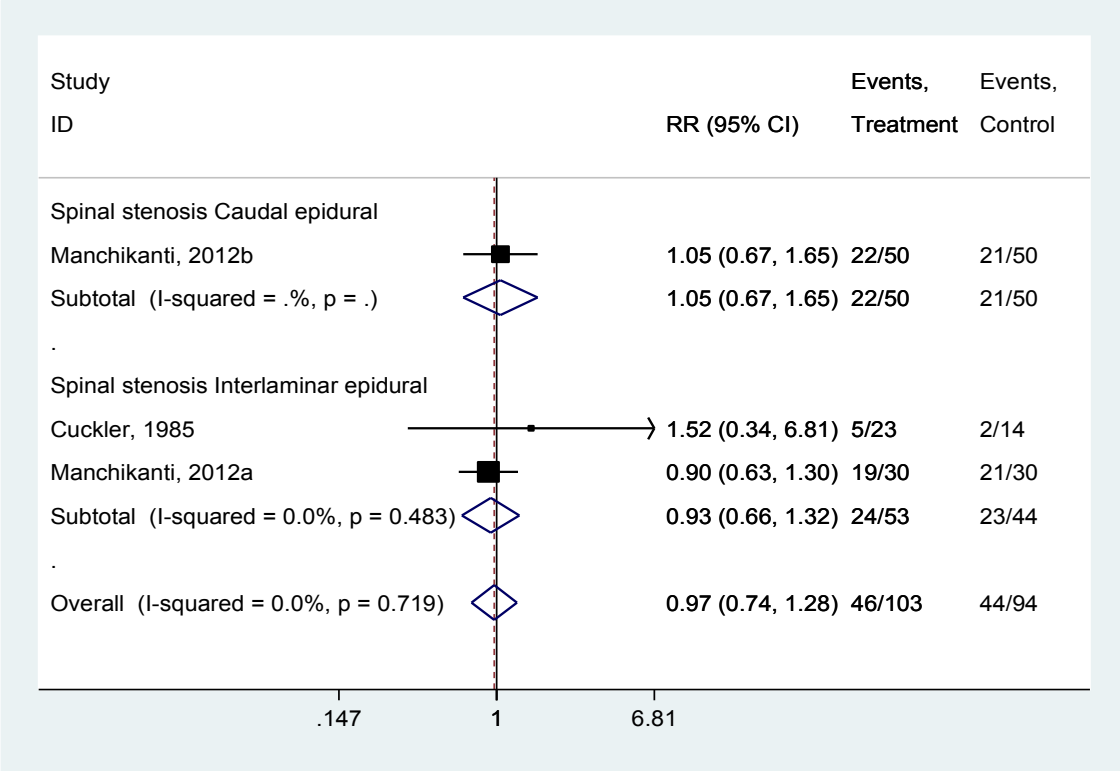


Figure 30. Meta-analysis of epidural corticosteroid injections versus placebo interventions for spinal stenosis: Immediate-term improvement in function

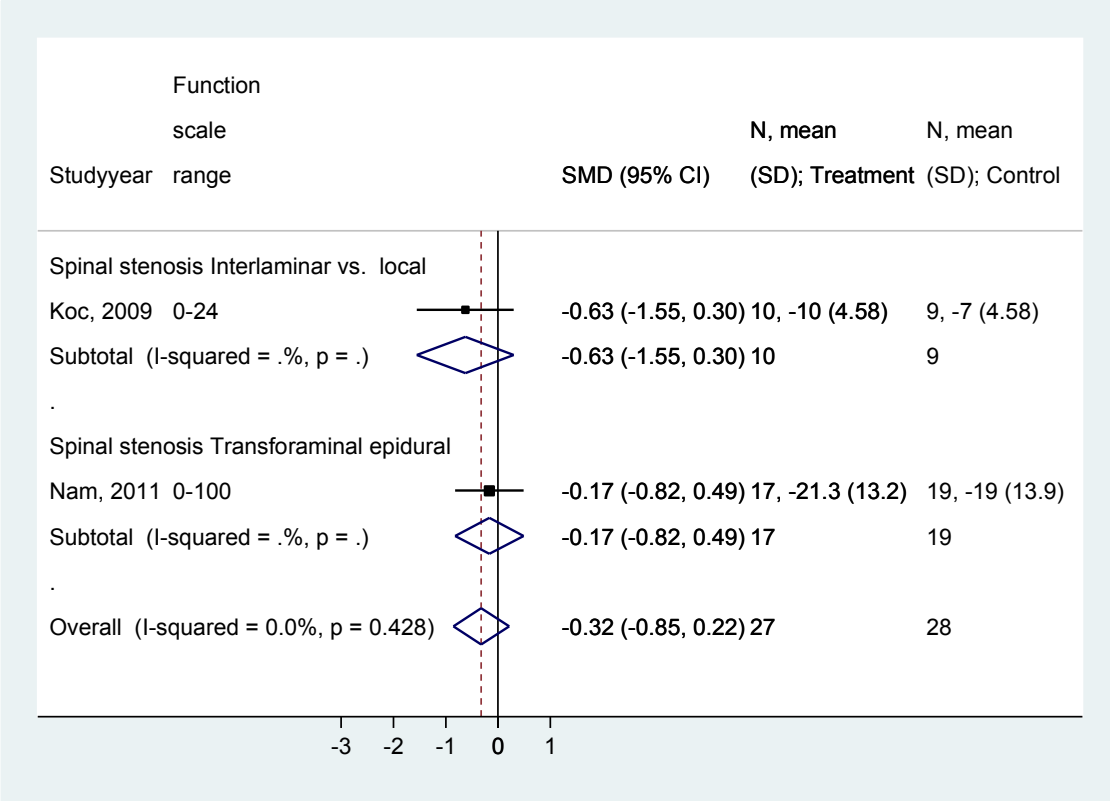


Figure 31. Meta-analysis of epidural corticosteroid injections versus placebo interventions for spinal stenosis: Short-term improvement in function

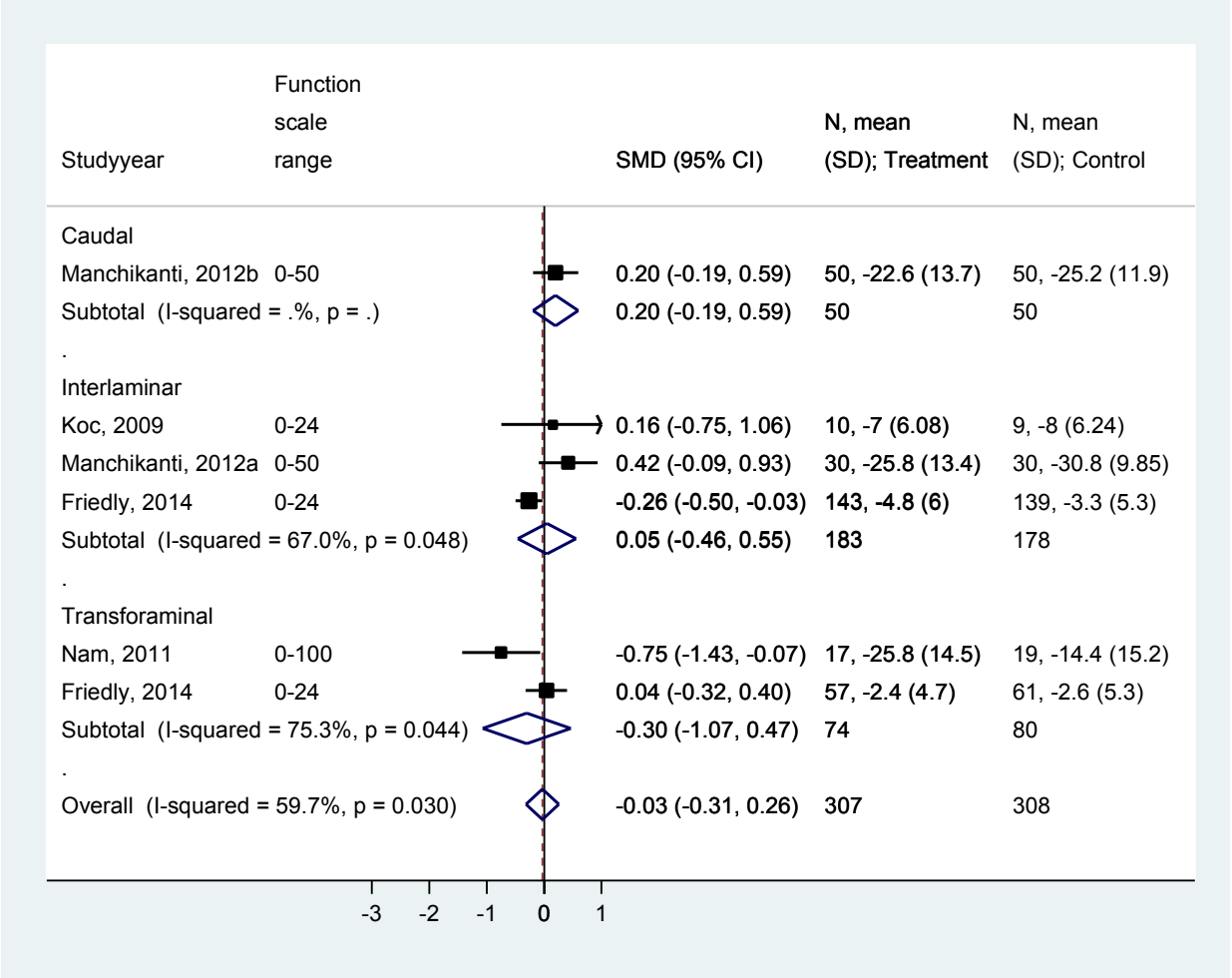


Figure 32. Meta-analysis of epidural corticosteroid injections versus placebo interventions for spinal stenosis: Intermediate-term improvement in function

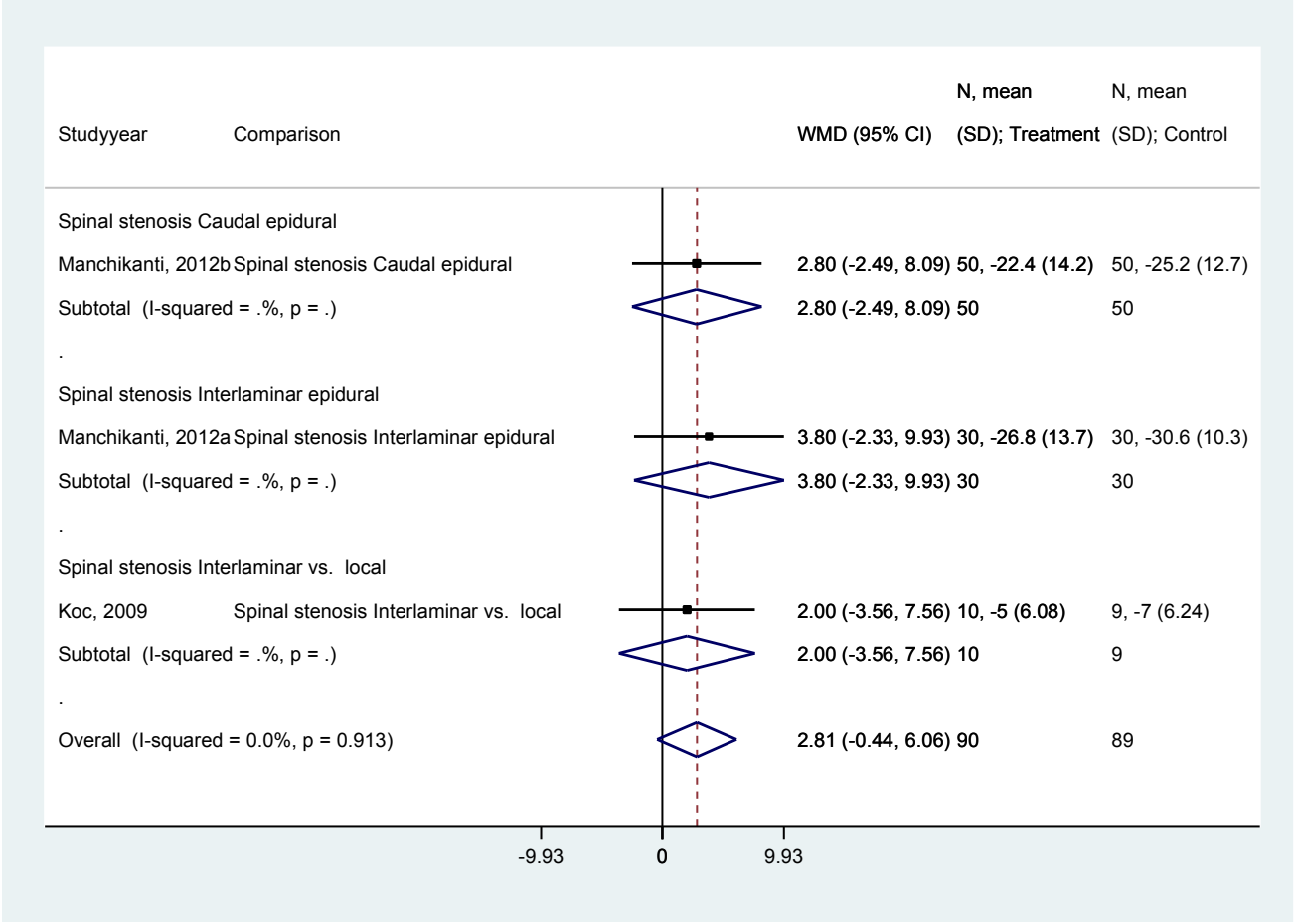


Figure 33. Meta-analysis of epidural corticosteroid injections versus placebo interventions for spinal stenosis: Long-term improvement in function

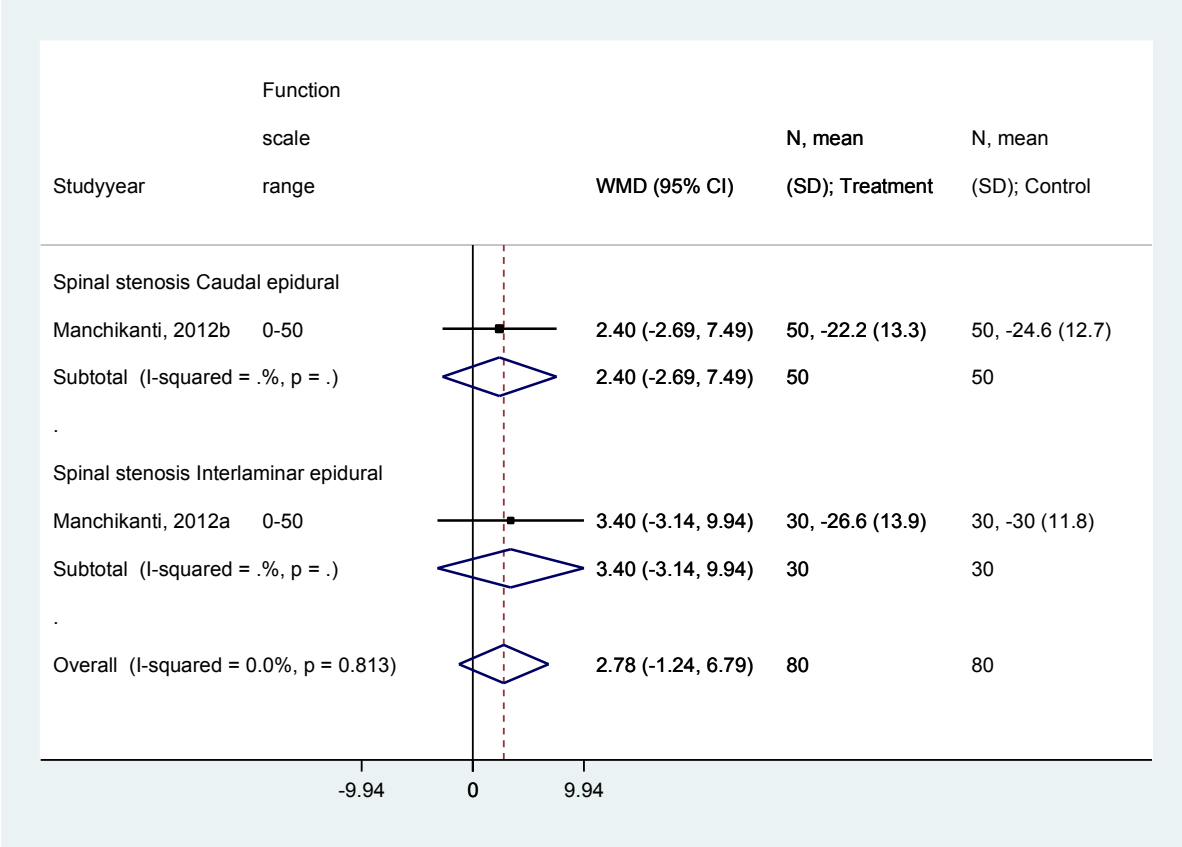


Figure 34. Meta-analysis of epidural corticosteroid injections versus placebo interventions for spinal stenosis: Successful short-term functional outcome

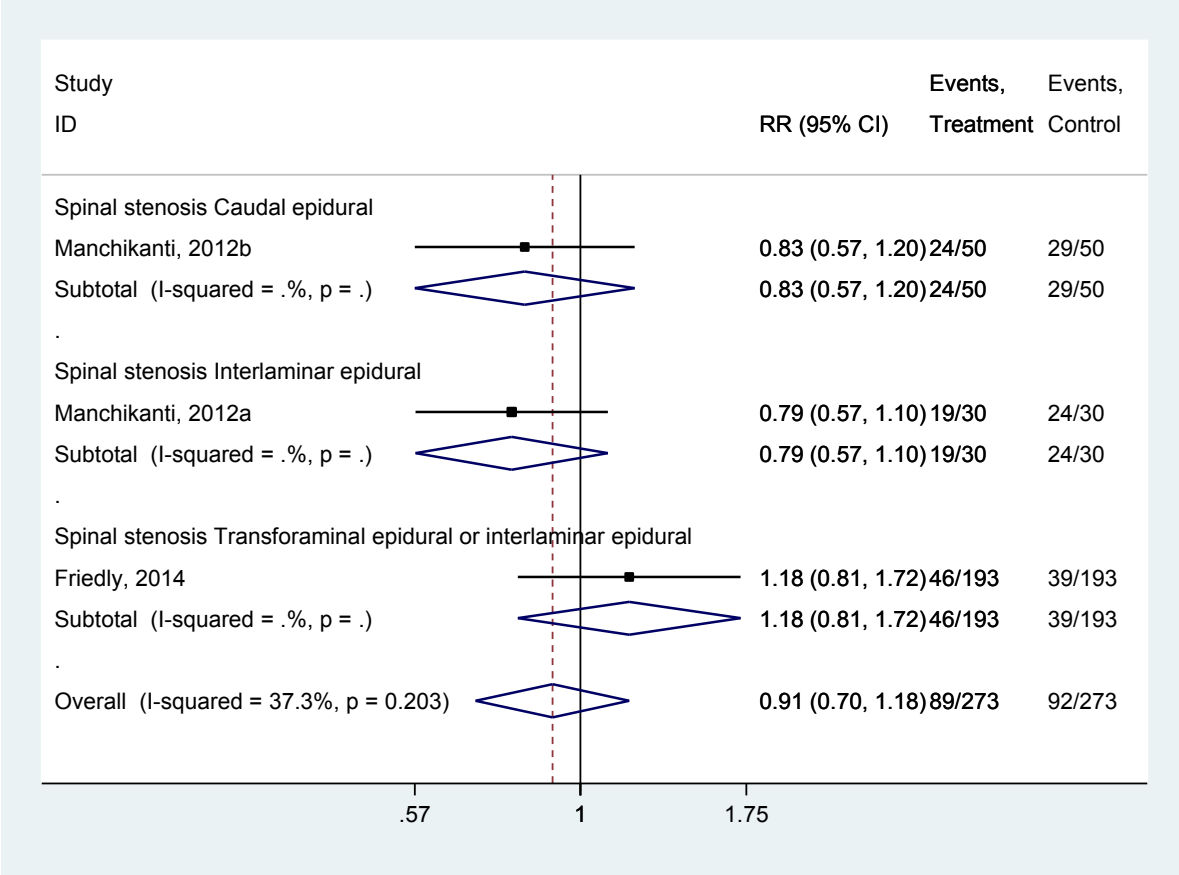


Figure 35. Meta-analysis of epidural corticosteroid injections versus placebo interventions for spinal stenosis: Successful intermediate-term functional outcome

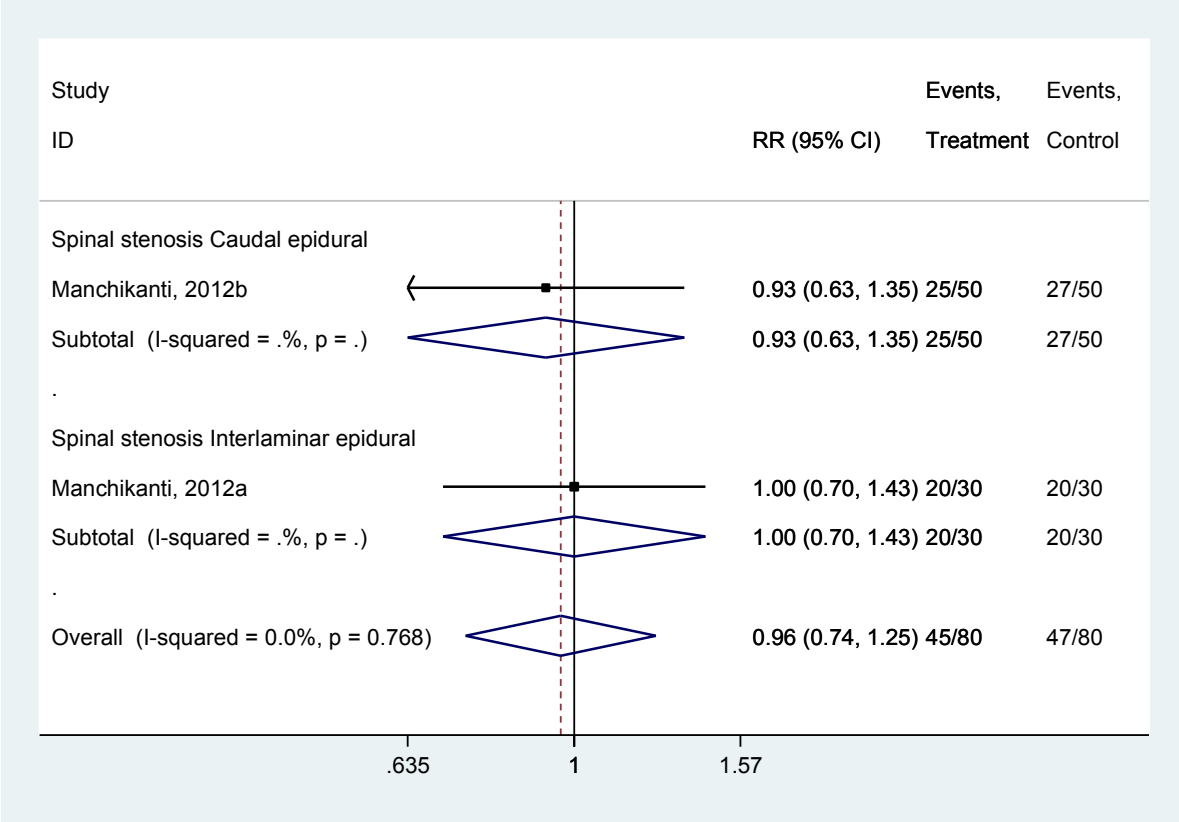


Figure 36. Meta-analysis of epidural corticosteroid injections versus placebo interventions for spinal stenosis: Successful long-term functional outcome

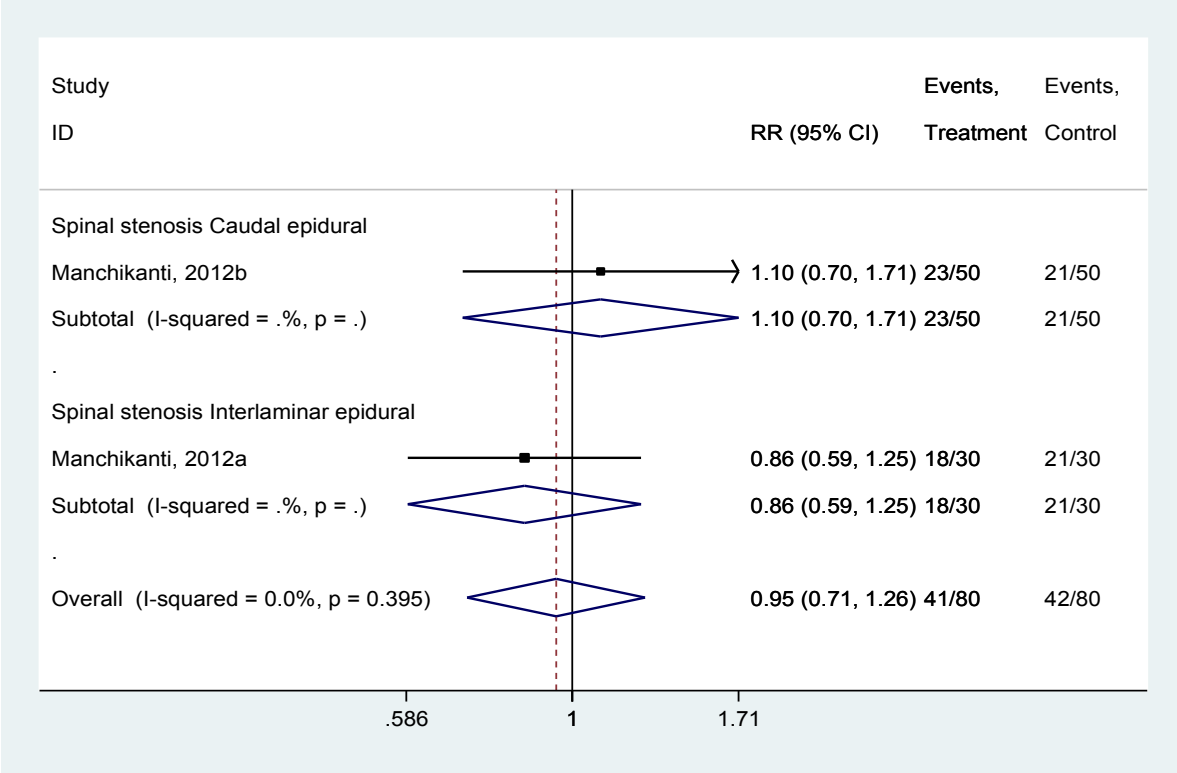


Figure 37. Meta-analysis of epidural corticosteroid injections versus placebo interventions for spinal stenosis: Successful short-term outcome

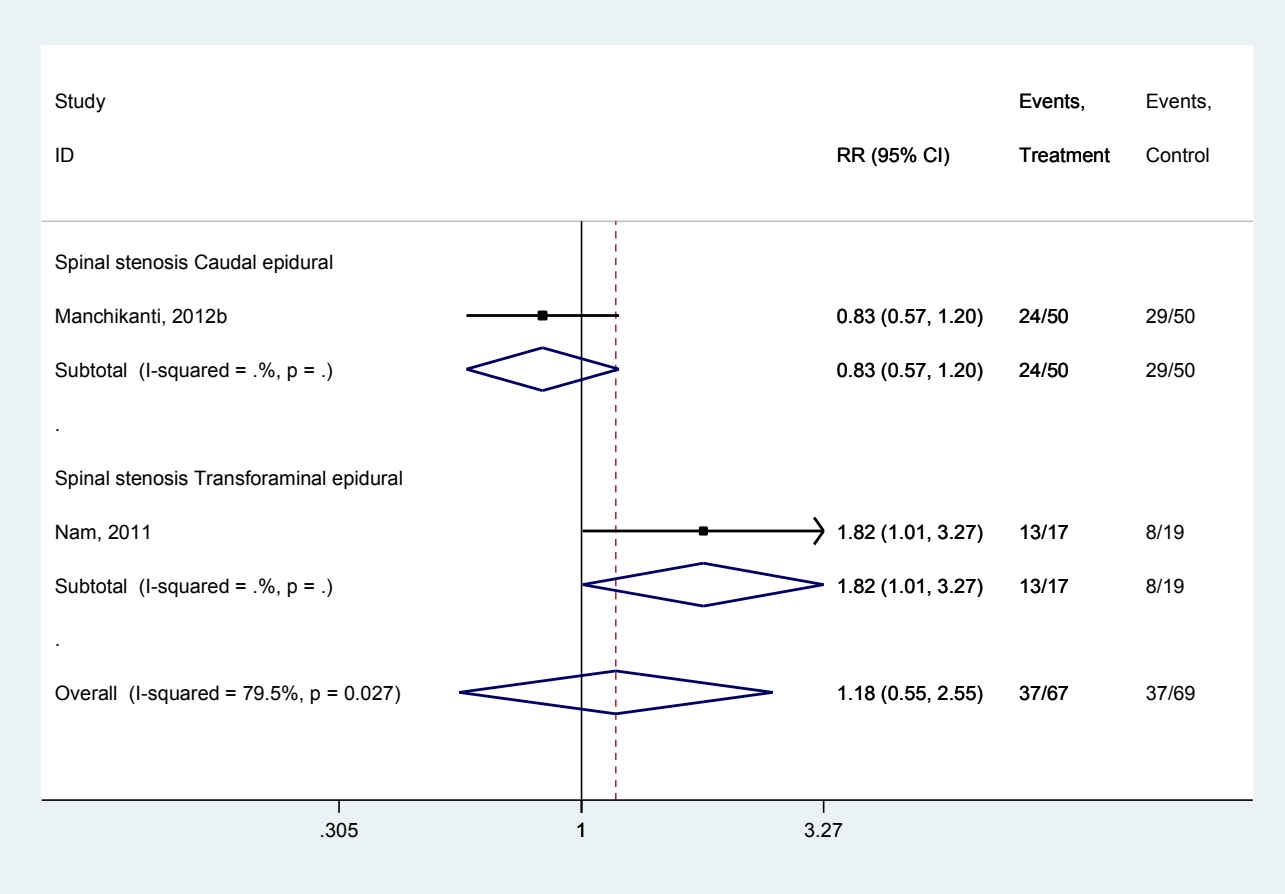


Figure 38. Meta-analysis of epidural corticosteroid injections versus placebo interventions for spinal stenosis: Successful long-term outcome

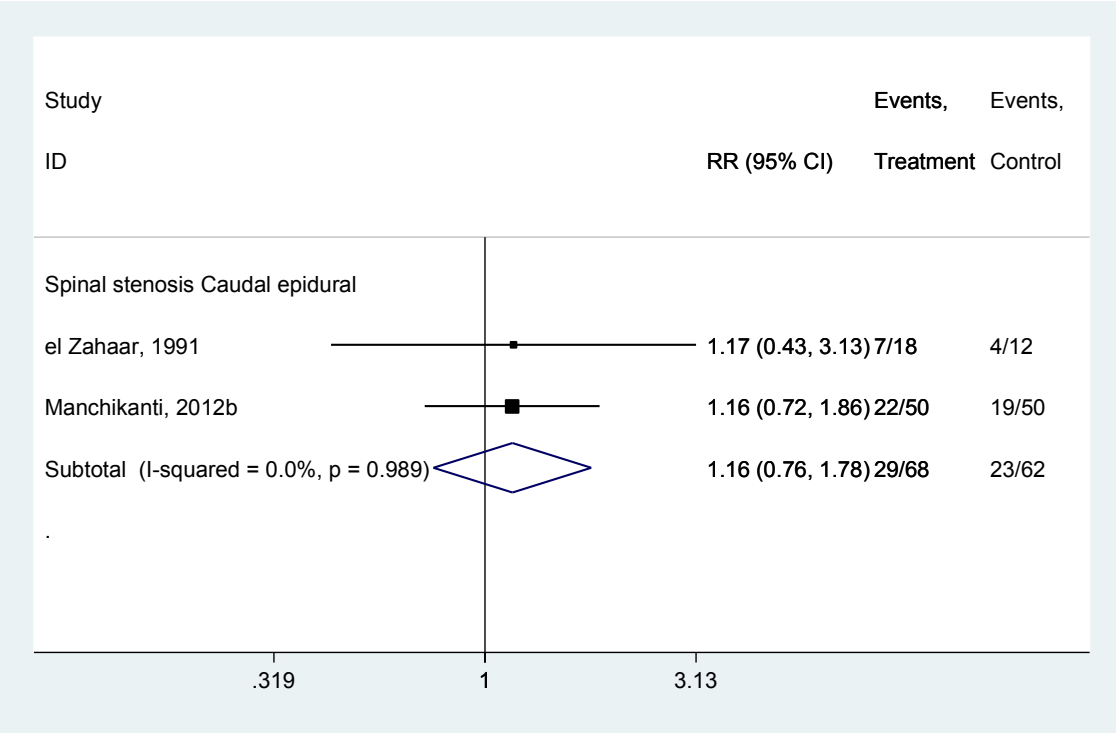


Figure 39. Meta-analysis of tranforaminal versus interlaminar epidural corticosteroid injections for radiculopathy: Immediate-term improvement in pain

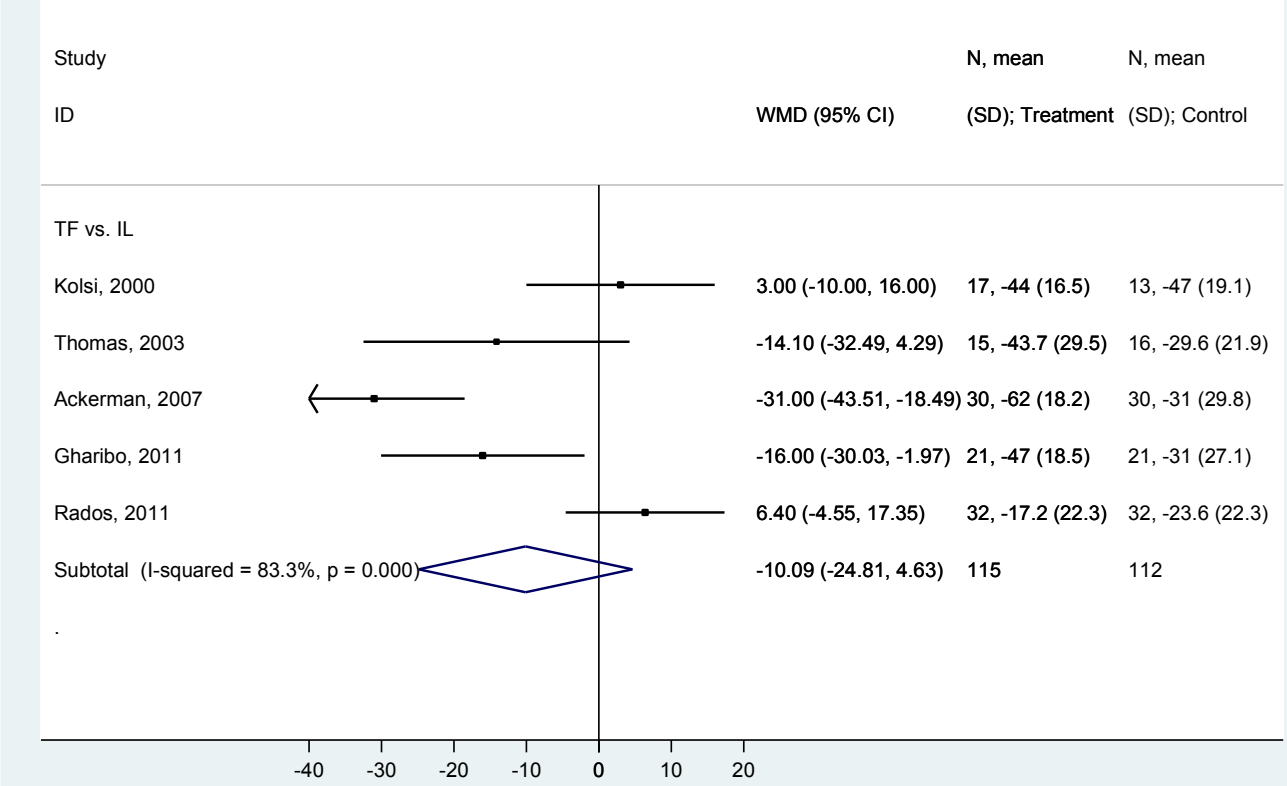


Figure 40. Meta-analysis of transforaminal versus interlaminar epidural corticosteroid injections for radiculopathy: Short-term improvement in pain

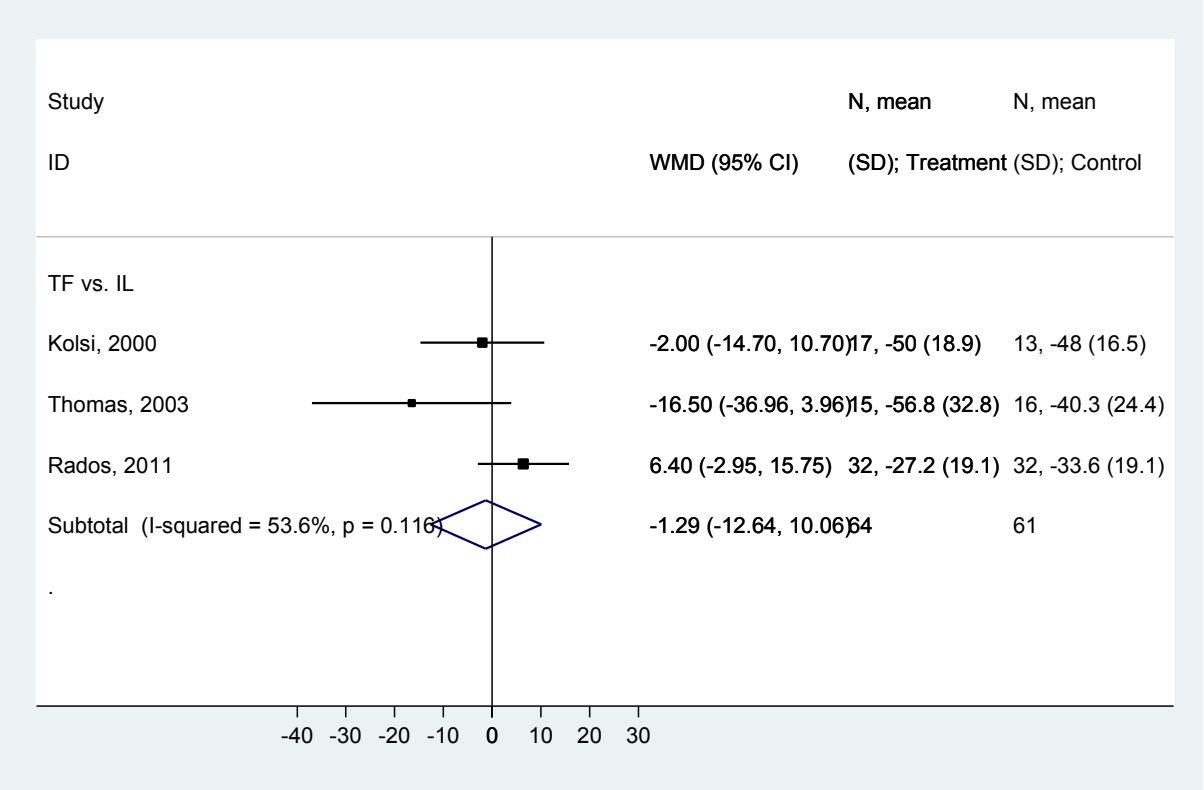


Figure 41. Meta-analysis of transforaminal versus interlaminar epidural corticosteroid injections for radiculopathy: Intermediate-term improvement in pain

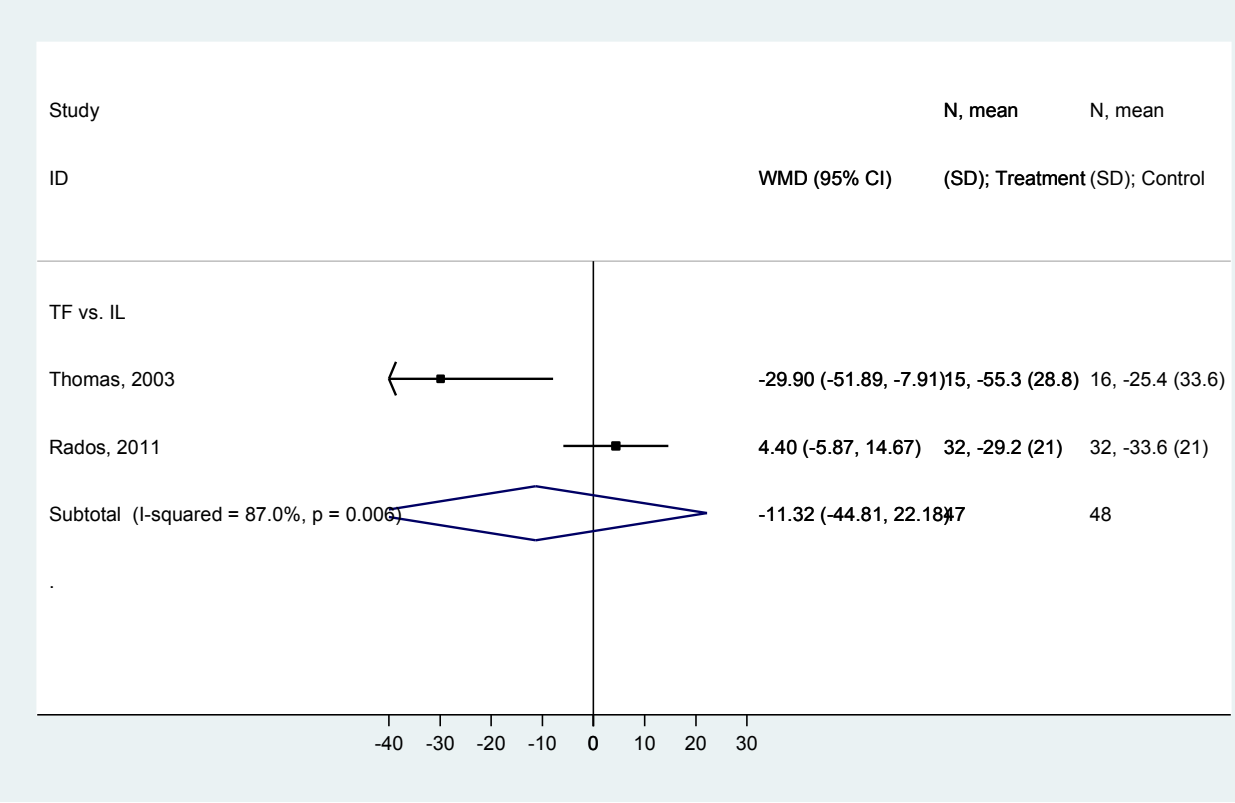


Figure 42. Meta-analysis of transforaminal versus interlaminar epidural corticosteroid injections for radiculopathy: Immediate-term improvement in function

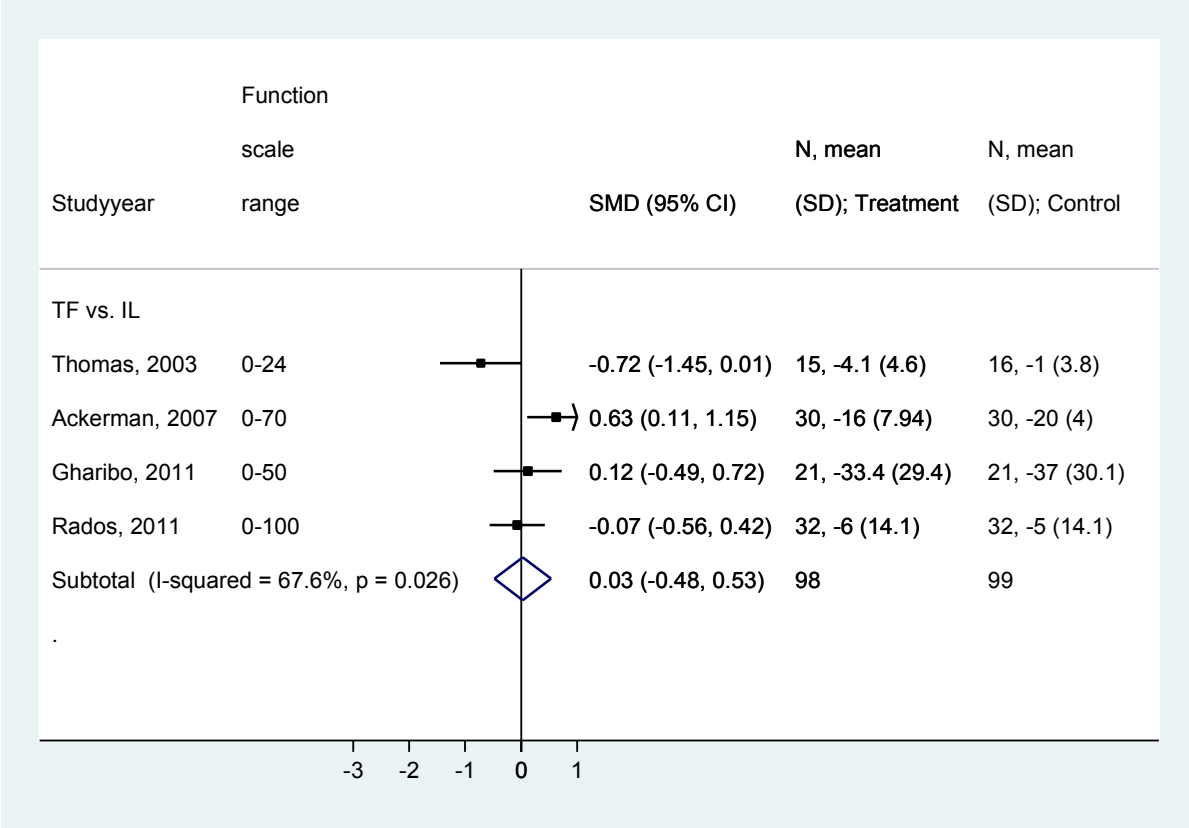


Figure 43. Meta-analysis of transforaminal versus interlaminar epidural corticosteroid injections for radiculopathy: Short-term improvement in function

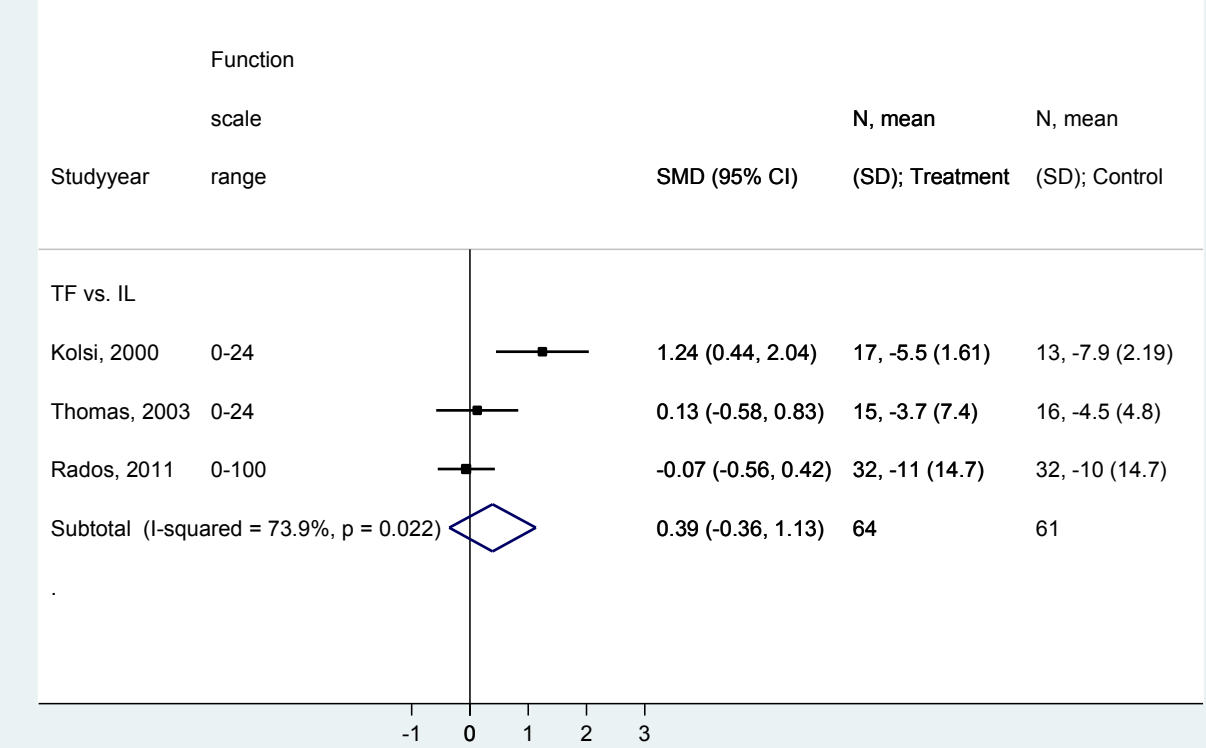
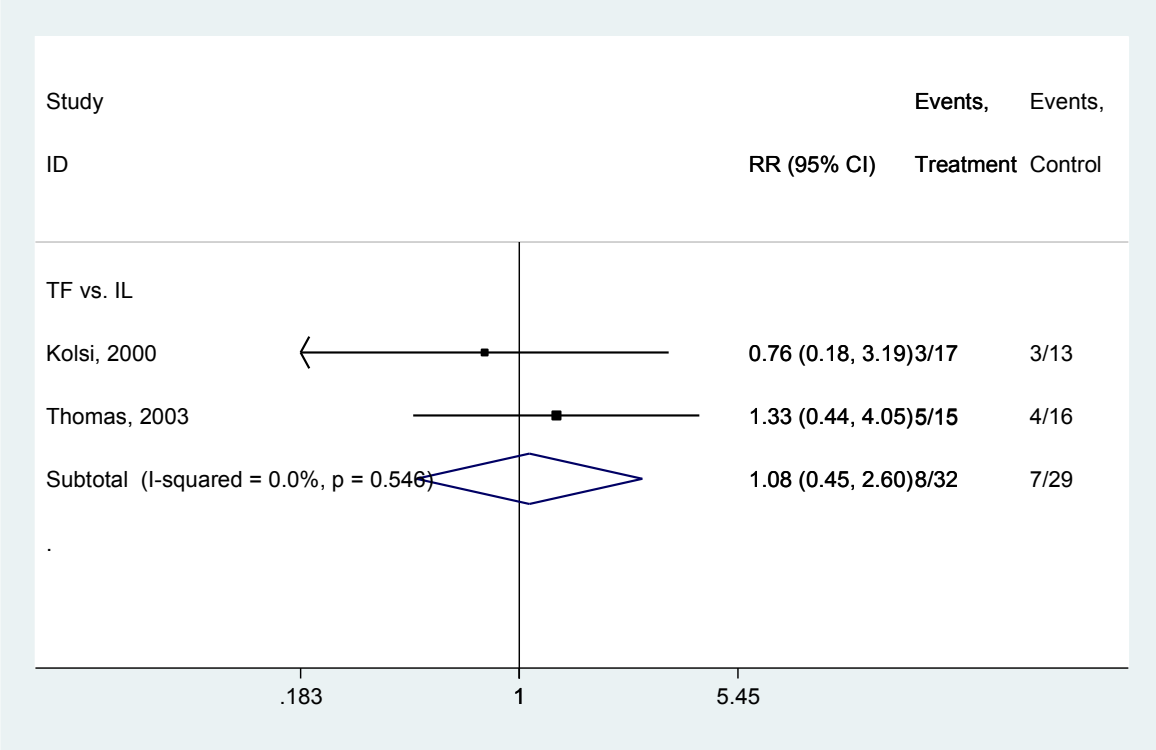


Figure 44. Meta-analysis of transforaminal versus interlaminar epidural corticosteroid injections for radiculopathy: Intermediate-term risk of surgery



Abbreviations

Abbreviation	Definition
AAOS	American Academy of Orthopedic Surgeons Scale
AHRQ	Agency for Healthcare Research and Quality
ANCOVA	Analysis of covariance
APS	American Pain Society
CI	Confidence interval
CMS	Centers for Medicare and Medicaid Services
CT	Computerized tomography
EPC	Evidence-based Practice Center
I^2	Heterogeneity estimate
L5-S1	The lumbosacral joint and the L5-S1 spine segment
MCMI-II	Millon Clinical Multiaxial Inventory-II
MED	Medical
MILD	Minimally invasive lumbar decompression
MRI	Magnetic resonance imaging
NASS	North American Spine Society
NRS	Numeric rating scale
ODI	Oswestry Disability Index
OR	Odds ratio
PICOTS	Populations, Interventions, Comparators, Outcomes, Timing and Setting
RDQ	Roland Morris Disability Questionnaire
RR	Relative risk
S1	Lumbosacral joint severe back pain
SF-36	Short Form- 36 (Medical Outcomes Study)
SIP	Scientific information packet
SMD	Standardized mean difference
SOE	Strength of evidence
SPECT	Single photon electronic computed tomography
TENS	Transcutaneous electrical nerve stimulation
TEP	Technical Expert Panel
USPSTF	United States Preventive Services Task Force
VAS	Visual Analog Scale
WMD	Weighted mean difference

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