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ORIGINAL ARTICLE

# Factors Associated With Pain Reduction After Transforaminal Epidural Steroid Injection for Lumbosacral Radicular Pain

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**Abstract**

**Objective:** To identify demographic and clinical factors associated with pain improvement after a lumbosacral transforaminal epidural steroid injection (TFESI) for the treatment of radicular pain.

**Design:** Retrospective cohort study.

**Setting:** Outpatient center.

**Participants:** Adults (N=188) who underwent a fluoroscopically guided TFESI for lumbosacral radicular pain.

**Interventions:** Not applicable.

**Main Outcome Measures:** Pain reduction from preinjection to 2-week follow-up was measured by visual analog scale (VAS). Patients were grouped by those who experienced no pain relief or worsened pain (≤0%), pain relief but <50% relief (>0%−<50%), or significant pain relief (≥50%) on the VAS.

**Results:** The mean duration of pain prior to injection was 45.8±81 weeks. The mean time to follow-up after TFESI was 20±14.2 days. Significantly more patients who experienced ≥50% pain relief at follow-up reported higher preinjection pain on the VAS ($P=.0001$) and McGill Pain Inventory Questionnaire ($P=.0358$), reported no worsening of their pain with walking ($P=.0161$), or had a positive femoral stretch test ($P=.0477$). No significant differences were found between VAS pain reduction and all other demographic and clinical factors, including a radiologic diagnosis of disk herniation versus stenosis or other neural tension signs on physical examination.

**Conclusions:** Greater baseline pain on the VAS and McGill Pain Inventory, a history of a lack of worsening pain with walking, and a positive femoral stretch test predict a greater likelihood of pain reduction after TFESI for lumbosacral radicular pain at short-term follow-up. Greater baseline pain on the McGill Pain Inventory and a lack of worsening pain with walking predict a magnitude of >50% pain reduction.

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A growing body of evidence exists regarding the efficacy of transforaminal epidural steroid injection (TFESI) for the treatment of lumbosacral radicular pain[1-3] and prevention of spinal surgery.[4] In a population of individuals with lumbosacral radicular pain related to a herniated nucleus pulposus, TFESI has been shown to provide a clinically significant magnitude of improvement in pain at short to medium durations of follow-up.[5-8]

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Aside from disk herniation, few factors have been identified that predict pain relief after TFESI. Electromyographic findings consistent with lumbosacral radiculopathy predict improvements in pain and function.[9,10] Individuals with radicular pain who have an increase in cold sensation thresholds or a decrease in light touch and vibration thresholds in the affected dermatome by quantitative sensory testing experience greater pain relief from TFESI compared with those without this finding.[11] Biomarkers that might predict a positive outcome from TFESI have been investigated.[12,13] Golish et al[12] found that the presence of a

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fibronectin-aggrecan complex in the epidural space is associated with significantly greater improvement in Medical Outcomes Study 36-Item Short-Form Health Survey physical component summary scores after TFESI. Magnetic resonance imaging studies have demonstrated that disk herniations in the central[14] or foraminal-extraforaminal zones[15] and low grade (grade 1) nerve root compression[14,16] are associated with improvement in pain after TFESI.

Investigators have also attempted to identify historical and physical examination findings that predict the outcome after epidural steroid injection. In a retrospective study of 56 patients, Lee et al[17] found that duration of radicular symptoms for <6 months and age <70 years were associated with greater improvement in pain after epidural steroid injection, but they found that this finding was not significant on multiple regression analysis. Lee,[17] Inman,[18] and colleagues found that sex does not predict the outcome of TFESI. In a secondary analysis of a randomized controlled trial of 71 subjects, Ghahreman and Bogduk[16] found that duration of symptoms, presence of sensory changes, and presence of neurologic signs were not associated with the outcome after TFESI.

Unfortunately, these few studies are limited by relatively small sample sizes. The goal of the current study was to identify clinical history, physical examination, and radiologic factors that predict reduction in pain after TFESI in a larger sample of individuals with lumbosacral radicular pain.

## Methods

This retrospective cohort study was approved by the Northwestern University Institutional Review Board. Subjects were seen at an urban, academic, physical medicine and rehabilitation outpatient interventional musculoskeletal and spine center. Clinical data were entered into a discrete structured clinical database (Rehabilitation Institute of Chicago Physiatric Log & Analysis System) as a routine method of generating clinical documentation to be placed in the hospital medical record. The treating physician entered all data using preset drop-down menu choices to facilitate standardized reporting. Deidentified data were extracted from the clinical database (Rehabilitation Institute of Chicago Physiatric Log & Analysis System) using queries constructed in Microsoft SQL Server 2000[a] and Microsoft Access 2007.[a] The study included individuals ≥18 years old who underwent a first-time TFESI in at this facility during the study time frame. Consecutive subjects from November 2004 through December 2008 were included unless they had missing subjective pain rating scores on the visual analog scale (VAS) either before or after the TFESI. Imaging findings at the level of clinical pathology were grouped as diskogenic pathology, central stenosis, foraminal stenosis, spondylolisthesis, or other. Diskogenic pathology was defined as a disk protrusion, extrusion, sequestration, or a disk bulge with an annual tear considered significant enough to potentially cause radicular pain by a consensus between radiology report and interpretation by senior board-certified physical medicine and rehabilitation physicians, with additional board certification in either pain medicine or sports medicine. Grading of nerve root compression described by Ghahreman and Bogduk[16] was not performed because data collection predated this publication. All injections were also ordered and performed by board-certified physical medicine and rehabilitation physicians, with additional board certification in either pain medicine or sports medicine. The general indication for an epidural injection among this cohort was radicular pain that had failed to respond to conservative treatment and still resulted in functional limitations.

The procedures were performed with a subpedicular transforaminal technique.[19] The patient was in a prone position, and skin was prepped with a sterile technique. The fluoroscope was positioned to provide an oblique view to identify the subpedicular space. One percent lidocaine (preservative-free) was used for skin and soft tissue analgesia. A sterile 22-gauge 3.5-, 5-, or 7-in spinal needle was then positioned at the superior aspect of the foramen above the exiting spinal nerve. Precise needle placement was confirmed by anterior-posterior, oblique, and lateral fluoroscopy. Between 0.2 and 0.5mL of iopamidol contrast dye was injected through microbore tubing under live fluoroscopy. If there was intravenous uptake, the needle was repositioned until no intravenous uptake was evident and until an epidural flow pattern was observed. Then, 1.5 to 2mL of 1% lidocaine was injected as an anesthetic test dose. After waiting 1 to 2 minutes and ensuring that there were no complications, 1 to 2mL of steroids (betamethasone [6mg/mL] or triamcinolone [40mg/mL]) were then injected through microbore tubing. Volumes varied depending on the number of sites injected. For unilateral single-level procedures, 2mL of 1% lidocaine and 2mL of steroids were used, whereas 1.5mL of lidocaine and 1mL of steroids at each injection site were used for unilateral 2-level procedures or bilateral unilevel procedures. Bilateral procedures were chosen for patients with bilateral symptoms. Two-level unilateral procedures were chosen for patients with multilevel disease. All patients in this cohort received the same total steroid dose, regardless of the injection being performed at 1 site or 2. No patients in this cohort received injections targeting >2 sites.

### Data analysis

To illustrate the demographic, radiologic, and procedural characteristics of the study sample, we calculated means and SDs for continuous variables and percentages for categorical variables. Demographic, history, physical examination, and radiologic findings that were hypothesized to either positively or negatively influence the outcome of an epidural injection were chosen for analysis. Patients were grouped by those who experienced no pain relief or worsened pain (≤0%), pain relief but <50% relief (>0%−<50%), or significant pain relief (≥50%) on the VAS. Differences between demographic, historical, physical examination, and radiologic findings were compared among these groups. Categorical analysis of VAS outcome was our primary measure because previous studies of epidural steroid injections have shown that there are often responders and nonresponders, such that when using group means, significant pain reduction in a subset of the study group can be masked.[6] In a secondary numerical analysis we used follow-up VAS scores as the outcome and preprocedure VAS scores as the covariate.

Data were first checked for distributional form and outliers using summary statistics and graphical displays. Chi-square tests were used to compare outcome groups on categorical variables, and Kruskal-Wallis tests were used to compare groups on numerical variables. Data were analyzed using SAS version 9.3.[b]

***List of abbreviations:***

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| **CI** | **confidence interval** |
| **TFESI** | **transforaminal epidural steroid injection** |
| **VAS** | **visual analog scale** |