



Noncancer Pain: Radiculopathy and Epidural Steroid Injections

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Introduction

- Radiculopathy is a common source of chronic back and neck pain and may be accompanied by **signs of nerve root damage** including loss of sensory and/or motor function, which may present as numbness, paresthesia, weakness, atrophy or loss of reflexes [1].
- Radiculopathy refers to a disease process that affects the function of one or more **nerve roots**.
- The most common causes of radiculopathy due to nerve compression include **disc herniation** or **foraminal stenosis**, which is most often a result a narrowing of the spinal canal due to degenerative changes affecting the spine.
- Non-mechanical causes include chemically mediated non-cellular inflammatory reactions, including infection, neoplasm, and vascular injury.
- All lumbar and sacral nerve roots originate at the T10 to L1 vertebral level. A dorsal and a ventral nerve root join in the spinal canal to form the dorsal root ganglion. The roots exit at their respective neural (intervertebral) foramina. In thoracic and lumbar regions, they exit **below the vertebral body**. For example L4 nerve roots exit **below the L4 vertebra**. In the cervical spine, the nerve roots exit above the corresponding vertebral body. For example, the C4 nerve roots exit **below the C3 vertebra** and above the C4 vertebra. **The exception is C8**, which exits between C7 and T1.
- Nerve roots may be injured at their exit from neural foramina or central disc herniation. For example, the L5 root can be compressed by a *central* disc protrusion at the **L2–3** or **L3–4** level or a *paracentral* disc herniation at the **L4–5 level** or at the **L5–S1 foramen**.
- Classic radiating pain from spinal nerve root injury follows a specific lumbosacral dermatome (see Fig. 45.1; **high yield**)
- Radiculopathy can be present without an obvious compression in MRI e.g. chemical radiculitis due to the rupture of the **intervertebral** disc and release of chemical mediators. EMG can be useful for diagnosis in the cases.

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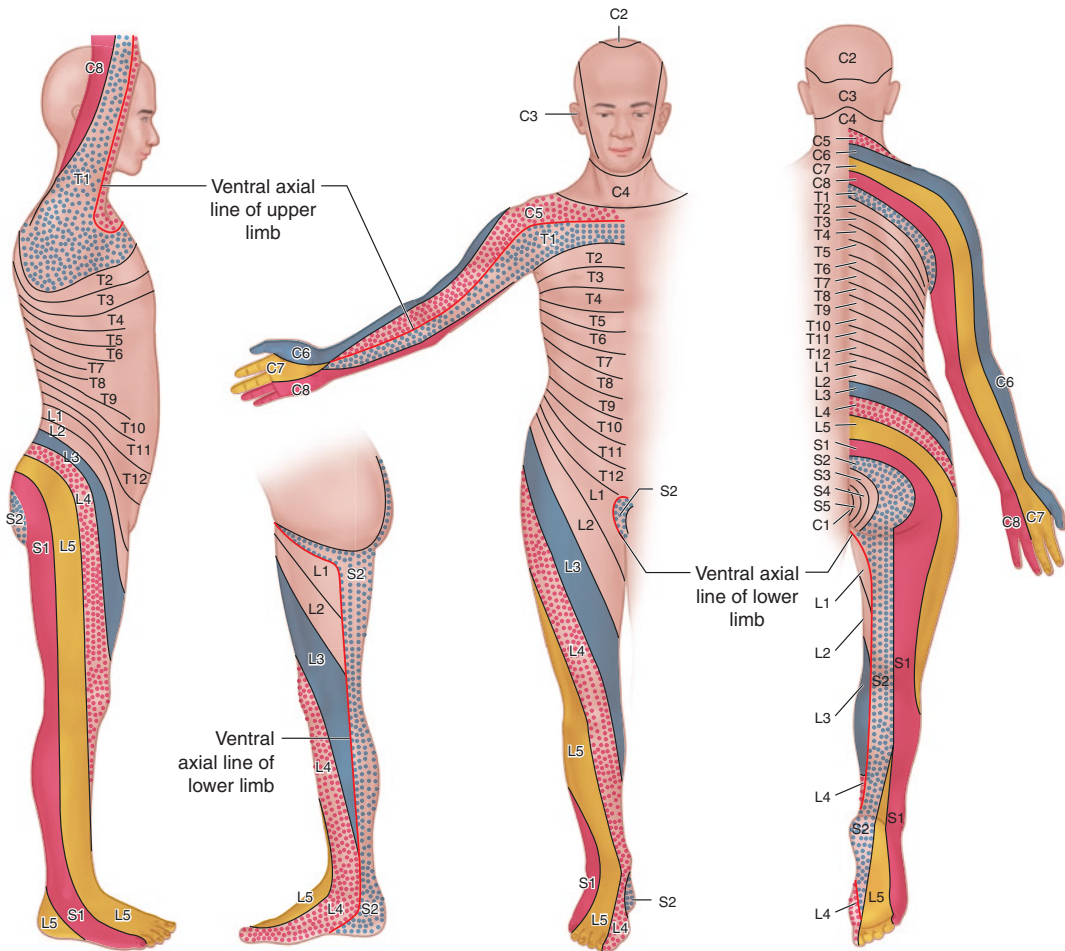


Fig. 45.1 The area of the skin supplied by a spinal sensory nerve root named as dermatome

Clinical Presentation of Radiculopathy Pain

Lumbar

L1 radiculopathy: Symptoms include pain, paresthesia, sensory loss in the inguinal region, and rarely mild weakness with hip flexion.

L2 radiculopathy: Symptoms include pain, paresthesia, and sensory loss in the anterior mid-thigh, and weakness with **hip flexion**.

L3 radiculopathy: Symptoms include pain, paresthesia, sensory loss in the distal anterior thigh, and weakness with **hip flexion and knee extension**. There may also be a diminished patellar reflex.

L4 radiculopathy: Symptoms include pain, paresthesia, sensory loss in the medial lower leg and foot, and weakness with knee extension and **ankle dorsiflexion**. There may also be a diminished patellar reflex.

L5 radiculopathy: The **most common** form of radiculopathy. Presents with back pain that radiates down the **lateral** aspect of the leg into the foot (Figs. 45.1 and 45.2), and weakness with dorsiflexion, toe extension, foot inversion, and foot eversion.

S1 radiculopathy: Symptoms include pain radiates down the **posterior** aspect of the leg into the foot from the back. **Weakness of plantar flexion**, leg extension, knee flexion and loss of ankle reflex may be present.

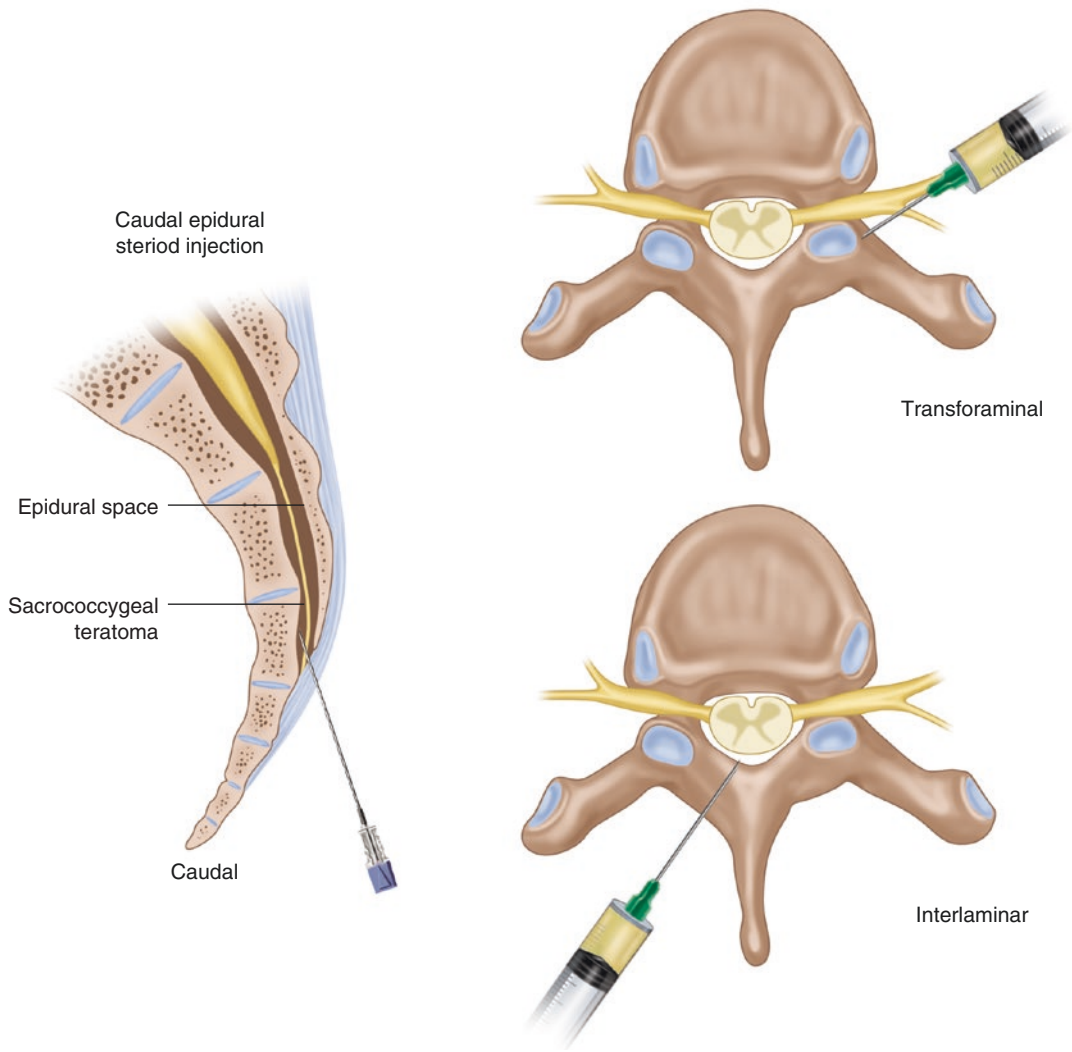


Fig. 45.2 Epidural injections are performed utilizing three approaches in the lumbar spine: caudal, interlaminar, and transforaminal and two approaches (transforaminal and interlaminar) in the thoracic and cervical spine

Cervical

C5 radiculopathy: pain in the neck and **shoulder** which may radiate to lateral arm along the axillary nerve.

C6 radiculopathy: pain in the neck and shoulder, which may radiate to lateral arm, lateral forearm, lateral hand (**thumb** and index finger).

C7 radiculopathy: pain in the neck, shoulder, and **middle finger**.

C8 radiculopathy: pain in the neck, shoulder, medial forearm, **fourth and fifth digits**, medial hand.

Diagnosis

- Acute onset of symptoms with bending, lifting, or trauma.
- Symptoms consistent with radiculopathy including pain, paresthesia, sensory loss, weakness.
- Positive straight leg raise, reverse straight leg raise, contra lateral straight leg test, Patrick test.
- For cervical radiculopathy, positive **Spurling test** (extension and rotation of neck to the side of the pain, followed by applying downward pressure on the head → paresthesia)

- **Lhermitte phenomenon:** a shock-like symptoms with neck flexion if there is compression of the cervical cord by a disc herniation
- MRI imaging if patient presents with radiculopathy, myelopathy symptoms or other alarm symptoms such as urinary retention or bowel/bladder incontinence. If MRI is contraindicated then consider performing a CT myelogram.
- Electromyography (EMG) with nerve conduction study (NCS) may help differentiate radiculopathy from other causes if MRI is negative. Note that it takes **2–3 months** after the injury to see EMG changes.

Treatment

- The mainstay of treatment for chronic back and neck pain are primarily symptom management and include the use of non-opioid analgesics, activity modification, and formal physical therapy. If conservative therapy fails, further treatment is indicated and includes a range of therapies from short-term opioid therapy, surgery, and systemic or epidural steroid injections. Of note, epidural steroid injections are **not effective** for chronic back and neck pain **without a radicular component** [2]. Indications are listed in Table 45.1.
- Acute radiculopathy with **myelopathy** due to sudden disc herniation will require **immediate** intervention.
- Epidural steroid injections may be performed using three different approaches: the translaminar approach, transforaminal approach, and caudal approach. These typically are beneficial in the short-term (less than 3 months) [2].

Indications [2]

Table 45.1 Indications for Epidural Steroid Injections

Intervertebral disc herniation
Spinal stenosis
Synovial cysts
Radicular pain

Contraindications [1]

- Relative contraindications to epidural steroid injections include uncontrolled diabetes, congestive heart failure, and states in which fluoroscopy is not advised such as pregnancy.
- Absolute contraindications include a local infection **at the site of injection** or systemic infection, a fully anticoagulated state, a significant allergy to contrast or corticosteroid without prophylaxis, acute spinal cord compression, inability to obtain informed consent, or patient refusal.
- The clinician should carefully weigh the risks and benefits of **holding anticoagulation** for an elective procedure such as an epidural steroid injection.

Technique

- The interlaminar approach is performed by placing the patient in the prone position. Under fluoroscopic guidance, the interlaminar space of interest is identified and marked in the anterior-posterior view. After sterile preparation, a skin wheal is raised using local anesthetic. An epidural needle, typically Tuohy or Hustead, is directed between the lamina of the upper and lower vertebra and advanced via coaxial fluoroscopic technique. The epidural space is identified by loss of resistance to air and/or saline. Contrast dye approved for epidural use is injected to confirm the placement of the needle by fluoroscopy. The corticosteroid preparation is then injected into the epidural space. The needle is removed and gentle pressure is applied to the insertion site.
 - A pillow under the abdomen can help to flatten the lumbar lordosis and increase the opening of the interlaminar space
 - Often for cervical sources of radicular pain, an interlaminar approach may be used in the upper thoracic region such as between T1 and T2. A catheter is then threaded up to the level of interest and contrast spread is confirmed with fluoroscopy after the desired level is reached.

- The transforaminal approach is performed by placing the patient prone. An ipsilateral oblique view is obtained with the superior articular process (SAP) at the desired level. The target is approximately at the 6 o'clock position of the pedicle at the same level in the anterior-posterior view (the lateral surface of the SAP is marked along a line that bisects the sagittal plane of the pedicle). The skin is prepared and a skin wheal is raised with local anesthetic. Under fluoroscopic guidance, the needle is advanced coaxially in the oblique view until it reaches this 6 o'clock position. Needle placement is confirmed by injecting non-ionic contrast, typically under digital subtraction angiography, followed by injection of the corticosteroid preparation.
 - The caudal approach is performed by placing the patient in the prone position. A lateral fluoroscopic image is obtained and the sacral hiatus is identified as an opening at the end of the S4 lamina. A needle is advanced under fluoroscopic guidance towards the sacral hiatus. A subjective "give" may be experienced when the needle pierces the sacrococcygeal ligament. Contrast medium may be injected to verify placement of the needle within the epidural space and to confirm there is no intravascular uptake.
- Post dural puncture headache may occur if inadvertent dural disruption occurs and has an incidence far less than 1%.
 - The patient may also complain of transient back pain after the procedure.
 - Infections such as **epidural abscess** and meningitis are very rare.
- Drug-related complications may also cause injury. For example, stroke and spinal cord injury can occur due to **embolized particulate steroid** and is more common with cervical TFESI given the proximity of the ascending cervical and vertebral arteries [4]. Repeated ESI have a number of long-term complications associated with their repeated use including osteoporosis and osteopenia, avascular necrosis, steroid induced myopathy, and cushingoid signs and symptoms.

Clinical Pearls

- In thoracic and lumbar regions, nerve roots exit **below the vertebral body**. For example L4 nerve roots exit **below the L4 vertebra**. In the cervical spine, the nerve roots exit above the corresponding vertebral body. For example, the C4 nerve roots exit **below the C3 vertebra** and above the C4 vertebra. **The exception is C8**, which exits between C7 and T1.
- L5 root can be compressed by a **central disc protrusion at the L2–3 or L3–4 level** or a **paracentral disc herniation at the L4–5 level**.
- Epidural steroid injections are commonly performed for radiculopathy pain after conservative measures have been attempted.
- Epidural injections are typically **not beneficial** for idiopathic chronic back or neck pain **without** radiculopathy.
- Non-particulate steroids are favored over particulate steroids.

Complications [3]

- Procedural complications include direct tissue injury due to disruption of the tissue by the needle tip including vascular injury, dural injury, and direct neural injury.
 - Bleeding associated with these procedures is typically minor, but care must be taken to avoid the development of an **epidural hematoma**, a potentially catastrophic complication.
 - Anterior spinal artery syndrome may occur while performing TFESIs. This is believed to occur due to injury to segmental medullary arteries that supply the anterior spinal artery.

Multiple Choice Questions

1. Epidural steroid injections are typically NOT indicated in which of the following:

- A. Lumbar spinal stenosis
 - B. Discogenic pain
 - C. Chronic low back pain
 - D. Lumbar radicular pain
2. Particulate steroid formulations in epidural steroid injections have been associated with
 - A. Stroke and spinal cord injury due to arterial embolization
 - B. Increased long-term effectiveness compared to non-particulate steroids
 - C. Increased pain due to chemical irritation
 - D. Nerve damage due to osmotic effects
 3. The typical initial fluoroscopic approach for a transforaminal epidural steroid injection is
 - A. Anterior-posterior view
 - B. Lateral view
 - C. Contralateral oblique view
 - D. Ipsilateral oblique view
 4. A standard interlaminar epidural technique includes
 - A. Non-ionic contrast dye
 - B. IV sedation
 - C. A particulate steroid preparation
 - D. Lateral fluoroscopic approach
 5. An absolute contraindication to epidural steroid injection includes
 - A. Pregnancy
 - B. Local infection at the site of injection
 - C. Diabetes
 - D. Immunocompromised status
 6. A patient complains of pain and paresthesia in the lateral leg and foot, and weakness with dorsi flexion. The most likely diagnosis is
 - A. A, L3 radiculopathy
 - B. L4 radiculopathy
 - C. L5 radiculopathy
 - D. S1 radiculopathy
 7. A 43-year-old patient mentions that his right thumb tingles and then becomes numb if he extends his head. This symptom most likely represents

- A. C7 radiculitis
- B. C6 nerve root irritation
- C. Carpal tunnel syndrome
- D. C8 radiculopathy

Answers

1. C, 2. A, 3. D, 4. A, 5. B, 6. C, 7. B

References

1. Friedrich JM, Harrast MA. Lumbar epidural steroid injections: indications, contraindications, risks, and benefits. *Curr Sports Med Rep.* 2010;9(1):43–9.
2. Manchikanti L, Abdi S, Atluri S, Benyamin RM, Boswell MV, Buenaventura RM, et al. An update of comprehensive evidence-based guidelines for interventional techniques in chronic spinal pain. Part II: guidance and recommendations. *Pain Physician.* 2013;16(2 Suppl):S49–283.
3. Epstein NE. The risks of epidural and transforaminal steroid injections in the spine: commentary and a comprehensive review of the literature. *Surg Neurol Int.* 2013;4(Suppl 2):S74–93.
4. Tiso RL, Cutler T, Catania JA, Whalen K. Adverse central nervous system sequelae after selective transforaminal block: the role of corticosteroids. *Spine J.* 2004;4(4):468–74.

Suggested Further Reading

- Manchikanti L, Abdi S, Atluri S, et al. An update of comprehensive evidence-based guidelines for interventional techniques in chronic spinal pain. Part II: guidance and recommendations. *Pain Physician.* 2013;16(2 Suppl):S49–283.