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Diagnostic and Therapeutic Injections

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2019 Allina Health Spine Consensus Conference

Background

- Diagnosis depends on history and physical exam with testing to confirm the diagnosis.
- Selective injection in the spine is one of the most powerful diagnostic and therapeutic modalities available to the practitioner.
- Provides information about the structures generating pain less reliably obtained from PE, spinal imaging, or electrodiagnostic testing.
- Most useful in those patients with residual pain and restricted ROM and function, despite 4-6 weeks of aggressive rehabilitation.

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Pain Generators

- Nervous structures
- Facet joints
- Bone, ligaments, tendons
- Intervertebral discs
- Muscles & fascia

Bottom Line: Back pain is very complex and is often a *summation* of multiple, coincidental pain generators.

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Differential Diagnosis

- Myofascial pain (sprain/strain, fibromyalgia)
- Facet syndrome
- Degenerative disc disease
- Annular tear
- Disc bulge/herniation
- Spinal stenosis
- Segmental instability (spondylolisthesis)
- Arthritis
- Segmental dysfunction
- Sacroiliac dysfunction
- Hip fracture
- Hip DJD
- Hip bursitis/synovitis
- Knee DJD
- Rheumatologic (PMR, AS)
- Vertebral compression fracture
- Sacral insufficiency fracture
- Radiculitis/Radiculopathy
- Polyradiculoneuropathy
- Plexopathy
- Peripheral neuropathy
- Motor neuron disease (ALS)
- Myopathy
- AVM
- Malignancy/Paraneoplastic Syndrome
- Infection
- Herpes zoster
- Referred pain (viscerosomatic reflex)
- CNS mediated pain
- Psychogenic factors

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Example

- 65 y/o female with PMH chronic episodic LBP presented to the UMass Spine Center 9/06 with severe right buttock and lower extremity pain x 3-4 months.
- Pain began suddenly when getting out of bed.
- Consulted PCP, Lumbar MRI obtained.
- Findings significant for right L4-5 foraminal disc protrusion with moderate foraminal encroachment.

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Example

- PT ordered, patient attended 9 sessions (US, stretching, lumbar mechanical traction).
- Condition worsened.
- Transferred to another PT facility, PT included LE strengthening.
- Pain became significantly worse, patient required cane to ambulate.

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Example

- Physical Examination:
  - NAD/A&O
  - Stands in left lateral flexion
  - Antalgic gait, ambulates slowly with cane
  - Non-focal neuro exam
  - Right SLR reproduces right lower extremity pain
  - Lumbar ROM WFL
  - Palpation: Tender right upper gluteals/thigh
  - Positive right Stinchfield's and FABER's test
  - Active/passive right hip ROM painful in all planes

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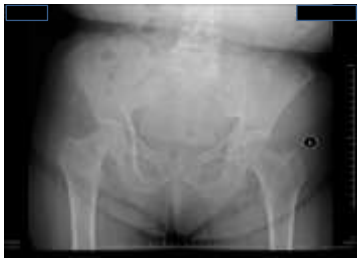
Example



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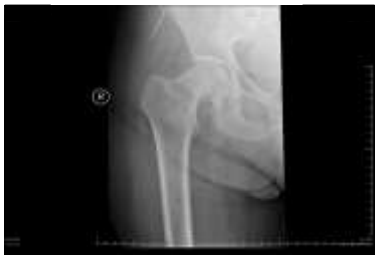
Example



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Example

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Techniques

- Facet injections
- Medial branch blocks
- Radiofrequency ablation
- Sacroiliac joint injection
- Epidural steroid injections:
  - Interlaminar
  - Caudal
  - Transforaminal

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Lidocaine

- Has been shown to have an anti-inflammatory effect on nucleus pulposis induced nerve injury
- Has been shown to increase intra-radicular blood flow in an animal compressed nerve root model
- May improve intra-neural metabolism and reduce inflammatory mediators
- May dilute epidural inflammatory mediators

Huston CW. Cervical epidural steroid injections in the management of cervical radiculitis: Interlaminar versus transforaminal. A review. Curr Rev Musculoskelet Med. 2009 Mar;2(1):30-42.

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Corticosteroids

- Mitigate nerve conduction slowing due to inflammation
- Block nocioceptor C-fiber conduction
- Inhibit prostaglandin synthesis
- Affect cell-mediated activity and cytokines which may be involved in the pathogenesis of radicular pain

Huston CW. Cervical epidural steroid injections in the management of cervical radiculitis: interlaminar versus transforaminal. A review. Curr Rev Musculoskelet Med. 2009 Mar;2(1):30-42.

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Corticosteroids

- Dexamethasone - Particles were 5-10 times smaller than red blood cells, contained few particles, and showed no aggregation.
- Triamcinolone - Particles varied greatly in size, were densely packed, and formed extensive aggregations.
- Betamethasone - Particles varied greatly in size, were densely packed, and formed extensive aggregations.
- Methylprednisolone - Particles were relatively uniform in size, smaller than red blood cells, densely packed, and did not form very many aggregations.

Derby R, Date ES, Lee C, et al. Size and aggregation of corticosteroids used for epidural injections. Pain Med 2008; 9(2)

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Corticosteroids

- Volunteer patients randomized to receive a single cervical transforaminal injection with either dexamethasone or triamcinolone.
- Ratings obtained by an independent unbiased assessor at 4 weeks via a telephone interview.
- VAS used preprocedurally and verbal integer scale used at 4 weeks to assess severity of radicular pain
- Both groups exhibited statistically and clinically significant improvements in pain at 4 weeks.
- Although the triamcinolone group exhibited a somewhat greater improvement, the difference between groups was not significant.

Dreyfuss P, Baker R, Bogduk N. Comparative effectiveness of cervical transforaminal injections with particulate and nonparticulate corticosteroid preparations for cervical radicular pain. Pain Med 2006;7:237-242.

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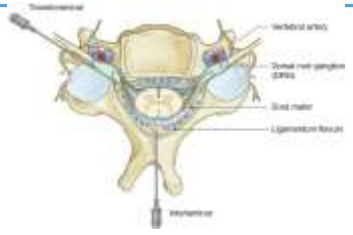
Technique



Van Zundert J, Huntoon M, Patijn J, Lataster A, Mekhail N, van Kleef M, Cervical RAdicular Pain. Pain Pract 2010 Jan-Feb; 10(1):1-17.

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Corticosteroids

Dexamethasone

Betamethasone

Derby R, Date ES, Lee C, et al. Size and aggregation of corticosteroids used for epidural injections. Pain Med 2008; 9(2)

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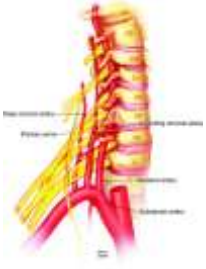
Spinal Anatomy



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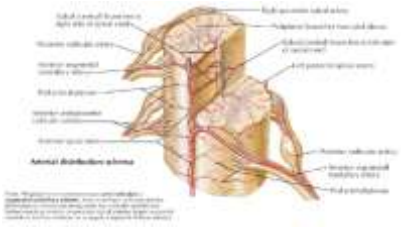
Spinal Cord Blood Supply



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Transforaminal intravascular uptake

- Cervical: 19.4%
- Lumbar: 8.1%
- S1: 23.1%

Furman MB, Giovanniello MT, O'Brien EM. Incidence of intravascular penetration in transforaminal cervical epidural steroid injections. Spine (Phila Pa 1976). 2003 Jan 1;28(1):21-5.

Furman MB, O'Brien EM, Zglesewski TM. Incidence of intravascular penetration in lumbosacral transforaminal cervical epidural steroid injections. Spine (Phila Pa 1976). 2000 Oct 15;25(20):2628-32.

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How Many Injections?

- Generally accepted that no further injections need to be performed in the same area if the first injection was not beneficial.
- The suggested frequency of interventional techniques is 2 months or longer between each injection, provided that at least >50% relief is obtained for 6 to 8 weeks.
- A maximum of 6 epidural injections per year (480 mg of Depo-Medrol) is generally reported.
- Potential side effects: insomnia/hyperactivity/anxiety/psychosis, facial flushing, "hot flashes", elevated blood glucose measurements in diabetics (125 mg/dL for1-2 days).

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Anticoagulation

- **Background.** Guidelines have been published that recommend discontinuing anticoagulants in patients undergoing interventional pain procedures. The safety and effectiveness of these guidelines have not been tested.
- **Objectives.** The present study was performed to determine if continuing or discontinuing anticoagulants for pain procedures is associated with a detectable risk of complications.
- **Methods.** An observational study was conducted in a private practice in which some partners continued anticoagulants while other partners routinely discontinued anticoagulants.
- **Results.** No complications attributable to anticoagulants were encountered in 4,766 procedures in which anticoagulants were continued. In 2,296 procedures in which anticoagulants were discontinued according to the guidelines, nine patients suffered serious morbidity, including two deaths.
- **Conclusions.** Lumbar transforaminal injections, lumbar medial branch blocks, trigger point injections, and sacroiliac joint blocks appear to be safe in patients who continue anticoagulants. In patients who discontinue anticoagulants, although low (0.2%) the risk of serious complications is not zero, and must be considered when deciding between continuing and discontinuing anticoagulants.

Endres S, Shufelt A, Boduk N. The risks of continuing or discontinuing anticoagulants for patients undergoing common interventional pain procedures. Pain Med 2016;18:403–9.

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Goodman B, House M, et al. Anticoagulant and Antiplatelet Management for Spinal Procedures: A Prospective, Descriptive Study and Interpretation of Guidelines. Pain Medicine 2017; 18: 1218–1224.

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Contraindications

- Absolute:
  - Patient refusal
  - Bacterial infection (systemic or localized)
  - Bleeding diathesis
  - Intracranial hypertension
- Relative:
  - Allergy to medications (< 1% incidence with non-ionic contrast)
  - Pregnancy
  - Medications which increase bleeding risk
  - Hyperglycemia
  - Adrenal suppression
  - Immune compromise
  - CHF
  - Altered epidural anatomy

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Complications and Side Effects

Minor
- Increased axial neck pain
- Headache
- Facial flushing
- Vasovagal episodes
- Nausea/vomiting
- Fever
- Hypotension
- Respiratory insufficiency
- Subjective weakness
- Insomnia
- Acne
- Muscle contractions
- Prevertebral abscess
- Superficial infection

Major
- Subdural complications
- Dural puncture
- Post dural puncture headache
- Neuropathic symptoms
- Intracranial hypotension
- Epidural granuloma
- Permanent spinal cord injury
- Intravascular uptake of injectate
- Pneumocephalus
- Venous air embolism
- Cervical epidural abscess
- Cushing's syndrome
- Retinal hemorrhage
- Death

Abbasi A, Malhotra G, Malanga G, Elovic EP, Kahn S. Complications of interlaminar cervical epidural steroid injections: a review of the literature. Spine. 2007 Sep 1;32(19):2144-51.

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Complications and Side Effects

- Tetraplegia has occurred after cord penetration of sedated patients following interlaminar CESI
- Needle penetration of the cord in alert patients can be without pain or paresthesias, but injection of contrast agent into the cord produces pain
- Excessive sedation may increase risk of intramedullary injection
- Injury thought due to cord ischemia

Huston CW. Cervical epidural steroid injections in the management of cervical radiculitis: Interlaminar versus transforaminal. A review. Curr Rev Musculoskelet Med. 2009 Mar;2(1):30-42.

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Case 1

- 52 y/o female with 1 month history of neck and left arm pain.
- History of C5-C7 ACDF 2008.
- 6/10 mid back; 4/10 neck and left arm.
- No neurologic deficit on examination.
- Positive Spurling's test.

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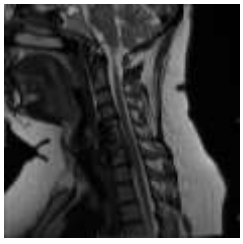
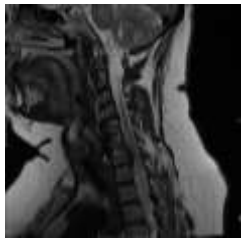
MRI





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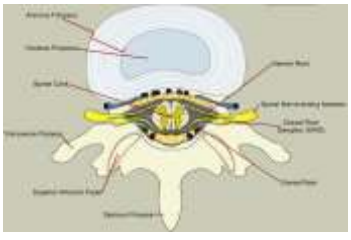
Anatomy



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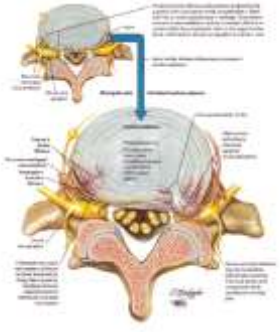

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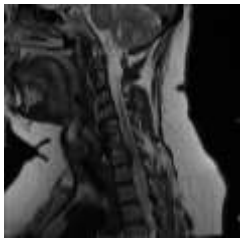
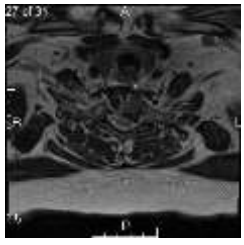
MRI





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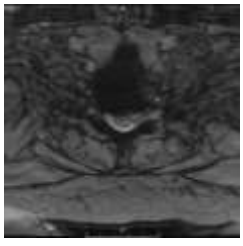
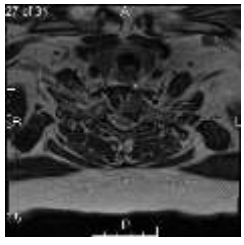
MRI





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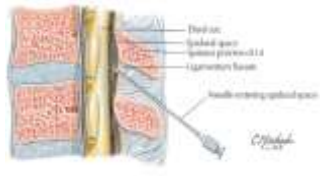
Interlaminar Epidural Steroid injection



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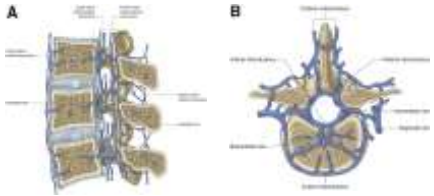
Anatomy



Kaplan MS, Cunniff J ,Cook J, Collins JG. Intravascular uptake during fluoroscopically guided cervical interlaminar steroid injection at C6-7: a case report. Arch Phys Med Rehabil 2008 Mar 89(3): 553-8.

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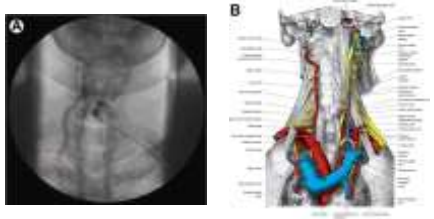
Anatomy



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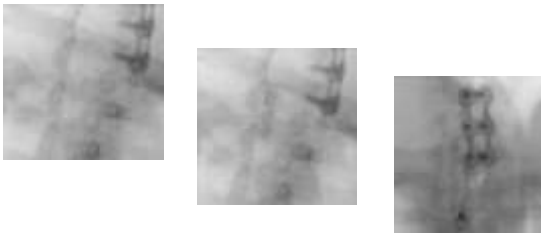
Interlaminar Epidural



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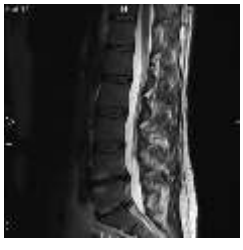
Case 1

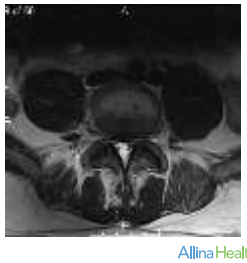
- C7-T1 interlaminar epidural steroid injection.
- Pain decreased temporarily from 8/10 to 0/10, then returned to baseline.
- Referred for surgical consultation.

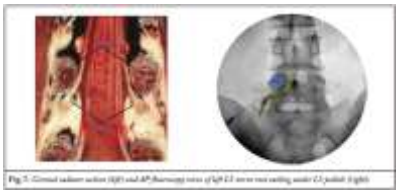
Case 2

- 47 y/o male with 20 year history of left low back and leg pain.
- Intermittent flare-ups, radiates to left buttock, calf and foot.
- Past medical treatment has included physical therapy, chiropractic manipulation, acupuncture and massage therapy.
- Exam: Repeated toe raises require greater effort on the left side, positive slump test.

MRI







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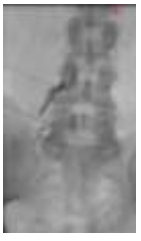
Transforaminal Epidural



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Case 2

- Pain immediately decreased from 5/10 to 2-3/10.
- On follow up low back and left leg pain had resolved.
- HOWEVER: New pain radiating into right calf as well as numbness extending into the dorsal lateral aspect of right foot.
- Sudden onset following a forceful sneeze.
- He also states that his right foot tends to "roll out on him" while walking.
- Pain is 5-6/10.

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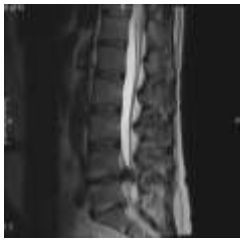
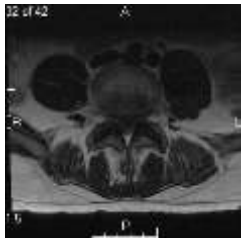
MRI 3 Weeks Later





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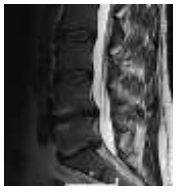
MRI

July



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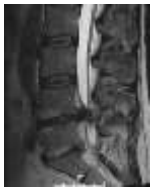

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Case 2

- Referred for surgical consultation.
- Underwent bilateral L4-L5 hemilaminotomy/discectomy.
- Pain 0.5/10, ODI 6 at follow up.

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Case 3

- 60 y/o female seen for chronic low back and bilateral buttock pain.
- History of frequent falls, numbness in legs.
- Pain is exacerbated by most physical activities including standing, sitting and walking.
- EXAM: Ambulates with wide based gait, decreased sensitivity to light touch in a stocking-like distribution extending proximally to the knees bilaterally, right greater than left. Decreased proprioception at the great toe bilaterally.

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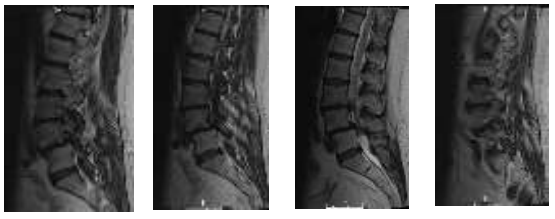
MRI: Right to Left



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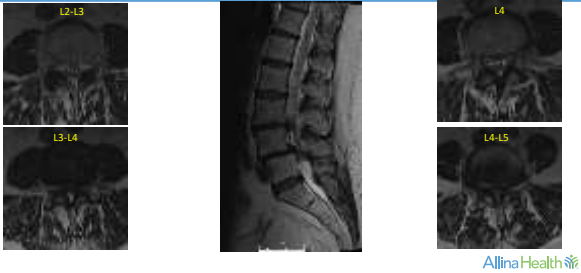
MRI



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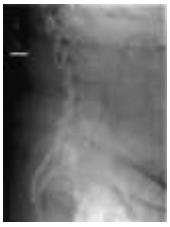
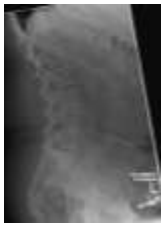
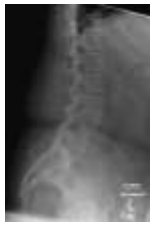
Plain Films

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EMG 8/2/19

- There is electrophysiologic evidence of sensorimotor peripheral neuropathy. There is no electrophysiologic evidence of lumbosacral plexopathy or radiculopathy.

Case 3

- Surgical consultation recommended but patient declined.
- Not interested in injections.
- Started on gabapentin.
- Referred for physical therapy.
- Completed several months of PT, pain worsened.
- Referred for surgical consultation.

Case 4

- 77 y/o male with chronic intermittent left calf pain.
- H/O L4-L5 decompression/TLIF performed 10/5/17.
- MVA 8/3/18: Developed pain in his low back and left calf.
- Dx: Acute midline low back pain with left-sided sciatica

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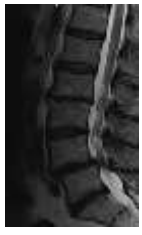
MRI: Right to Left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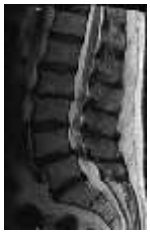
MRI

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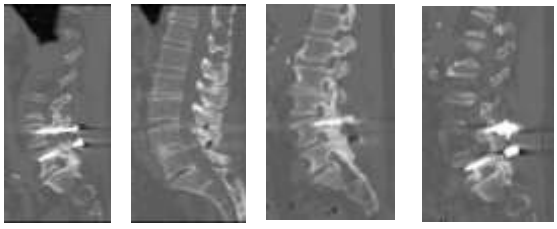
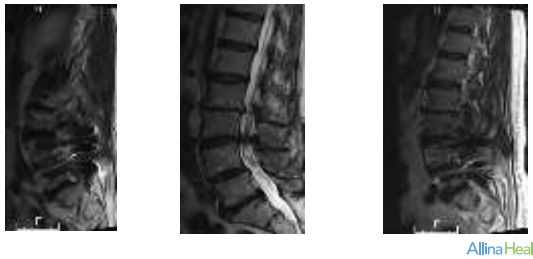
CT: Right to Left



55

Allina Health

MRI: Right to Left



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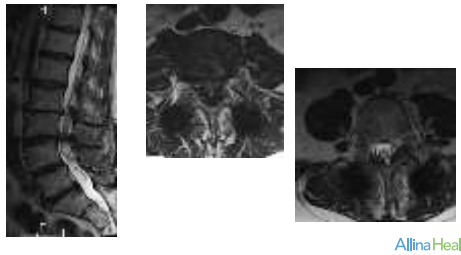
MRI



57

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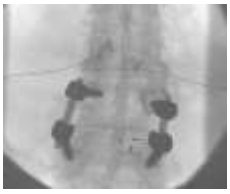
Epidural: January



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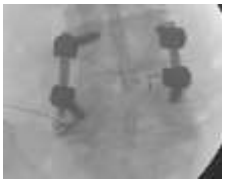
Epidural: April



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Case 4

- EXAM: 4/5 strength is noted in the left peroneus longus and EHL. All major muscle groups of the bilateral lower extremities including tibialis posterior otherwise demonstrate normal and symmetric muscle strength, bulk, tone and activation.

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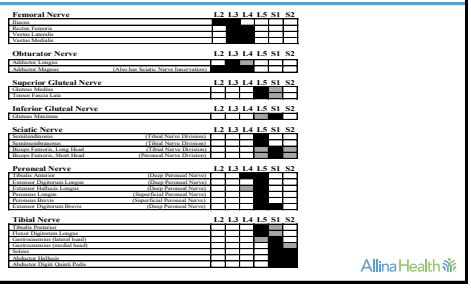

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52

Case 4

- Referred for PT.
- Decreased pain, improved gait after 5 visits.

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Case 5

- 31 y/o male with acute right buttock and leg pain.
- Sudden onset while bending at the waist.
- Unable to rise on right toes and reports numbness along the posterior lateral calf and foot.
- EXAM: Right calf strength is 3.5/5, right ankle jerk reflex is absent, decreased sensitivity to light touch along the dorsolateral right foot, slump test is positive on the right for radicular pain.

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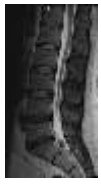
MRI: Right to Left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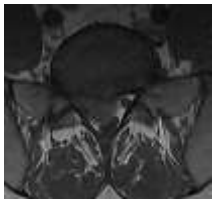
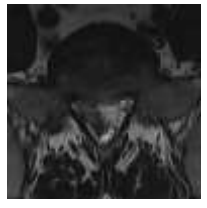
MRI

65

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Case 5

- Referred for surgical consultation.

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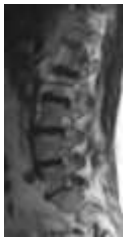
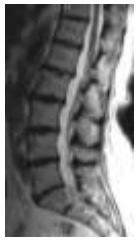
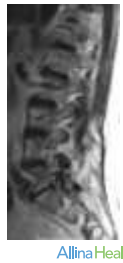
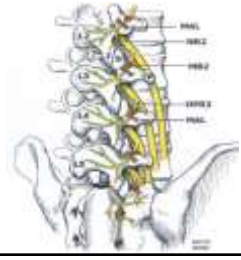
Case 6

- 68 y/o female with chronic LBP since 1994.
- H/O lumbar surgery x2.
- Failed PT, ESI's.
- EXAM: Lumbar quadrant loading is positive for right axial low back pain.

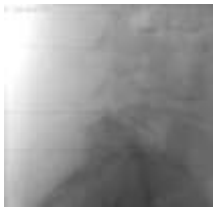
MRI: Right to Left

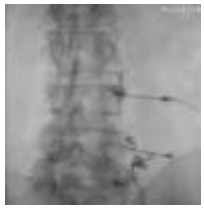




Lumbar Facet Innervation



Medial Branch Block





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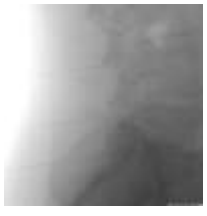
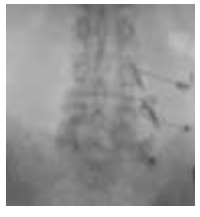
Medial Branch Block





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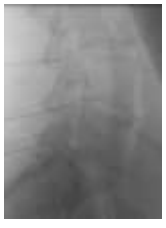
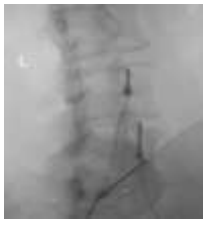
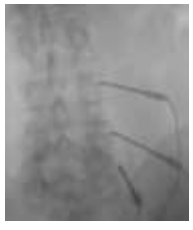
Radio Frequency Ablation







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Case 7

- 51 y/o female with abrupt onset of right-sided periscapular deltoid, axilla, and forearm pain.
- Associated numbness and tingling into the thumb, index, and middle finger.
- EXAM: 4/5 to the right triceps strength, absent right triceps reflex, decreased sensation right thumb, index, and middle finger

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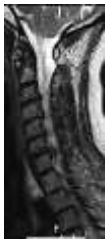
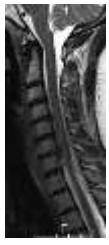
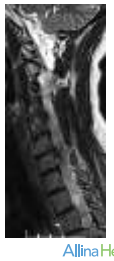
MRI: Right to Left

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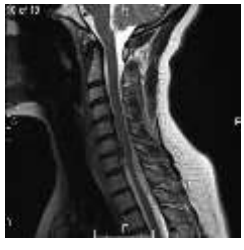
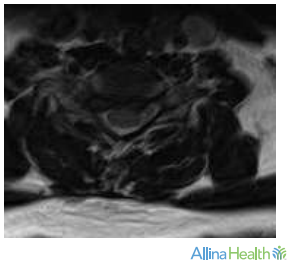
MRI

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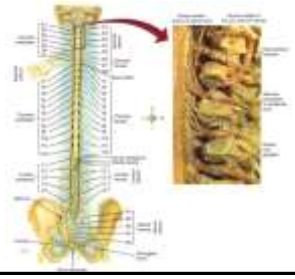
Spinal Anatomy



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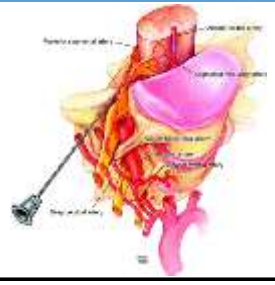
Spinal Anatomy



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Safety

- Mild conscious sedation
- Fluoroscopy with digital subtraction
- Multiplanar imaging
- Contrast with extension tubing
- 1 mL test dose preservative-free 2% lidocaine; wait 60-90 seconds
- Small volume of injectate (~3 mL)
- Dexamethasone (non-particulate)

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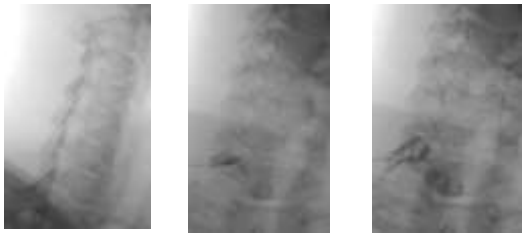
Transforaminal Epidural



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Case 7

- Pain decreased from 10/10 to 4/10, then returned to baseline.
- C6-C7 decompression, discectomy and fusion.
- On follow up weakness improving, no right upper extremity pain, slight residual paresthesias.

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Case 8

- 60 y/o female with low back and buttock pain x1 month.
- H/O multilevel lumbar fusion.
- Pain primarily exacerbated by sitting.
- EXAM: Pain on palpation of the upper gluteal muscles. Negative neuro exam.

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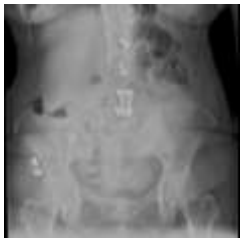
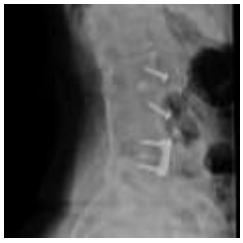
Plain Films





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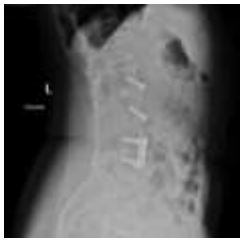
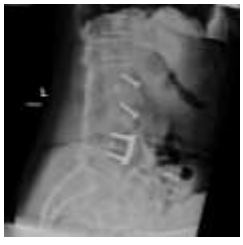
Plain Films 7/19





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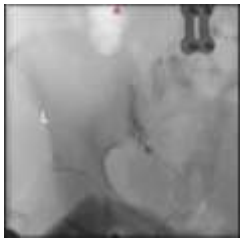
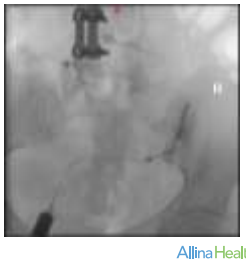
SI Joint Injections





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Case 8

- Pain decreased from 7/10 to 4/10.
- Referred for PT.

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Case 9

- 38 y/o female with chronic left-sided neck pain and headaches s/p MVA.
- Headache extends into the left hemicranium.
- Failed PT and chiropractic.
- EXAM: Normal neuro exam, marked tenderness on palpation of the soft tissues overlying the left C2-C3 facet joint.

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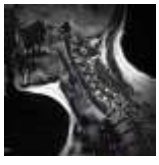
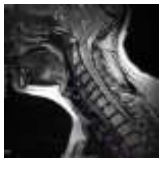
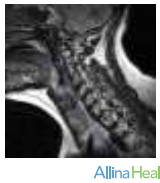
MRI: Right to Left

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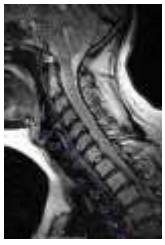
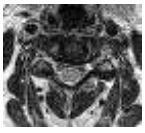
MRI





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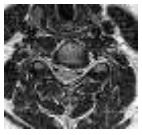

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Cervical Facet Innervation

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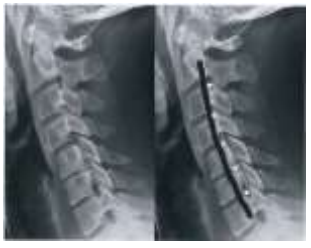

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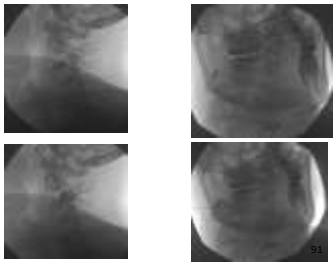
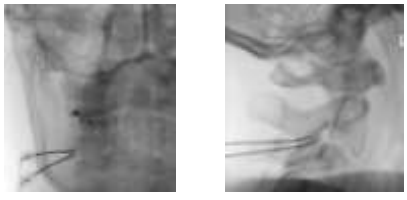
Third Occipital Nerve Block



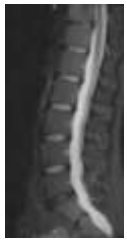
TON Radiofrequency Ablation



Case 10

- 30 y/o male with low back and bilateral leg pain x3 months.
- No improvement with PT 2x/week for 6 weeks.
- Meds not effective.
- Normal neuro exam.

MRI: Right to Left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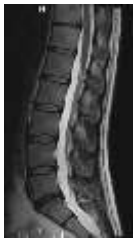
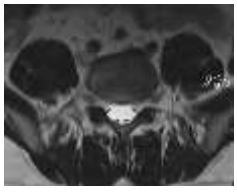
MRI 9/19

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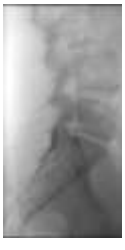
EPIDURAL 9/19

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Case 10

- Temporary improvement following ESI, then pain increased.
- Referred for PT with MedX, lower extremity EMG.

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Case 11

- 76 y/o male with chronic bilateral suboccipital pain, R>L.
- Pain is worse with rotation.
- Failed PT, chiropractic, ESI's, FJI's and MBB's.
- EXAM: ROM decreased/painful in extension and bilateral rotation.

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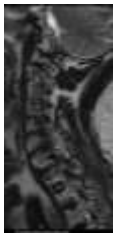
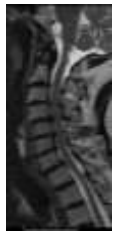
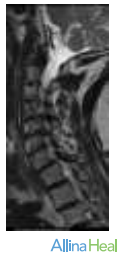
MRI: Right to Left

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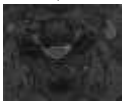
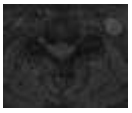
MRI





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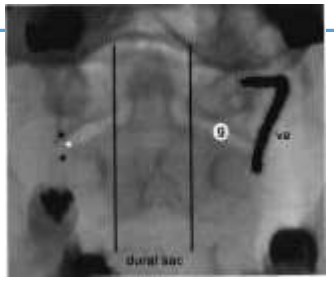

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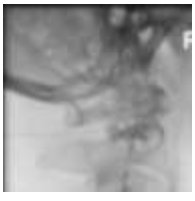
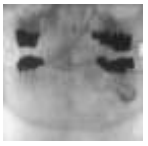
Right C1/C2 Facet Injection





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Case 12

- 55 y/o female with chronic intermittent LBP.
- Primarily midline with some radiation into lateral pelvis, lower extremities.
- Unremarkable exam.

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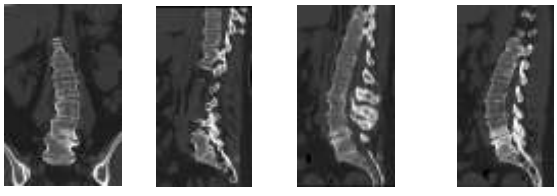
CT: Right to Left



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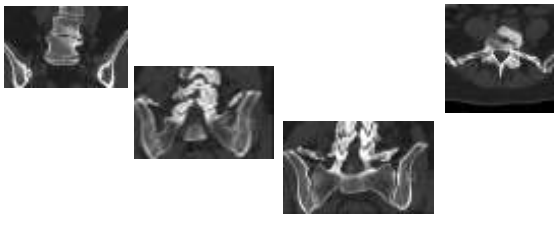
CT: Iliolumbar Ligament Calcification



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CT

L4/L5

L3/L4

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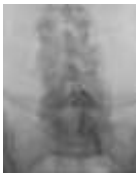
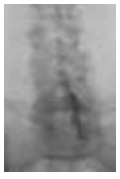
Epidural





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Case 12

- Pain decreased from 3/10 to 0/10.

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Case 13

- 35 y/o male with chronic low back pain.
- H/O L4-L5 discectomy 9/18.
- Pain slightly worse following surgery.

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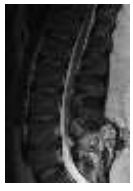
MRI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MRI




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MRI

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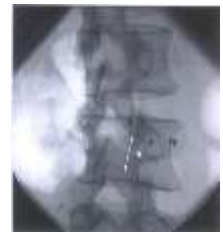
Facet Injections

- Fluoroscopic localization is required.
- Use of contrast confirms intraarticular needle placement but not required.
- Volume of joint 1.5 mL
- Most common levels L4-L5, L5-S1.
- Single, uncontrolled diagnostic injections may be unreliable.
- Sometime involve sequential controlled or comparative injections.
- Injectate includes anesthetic and steroid.



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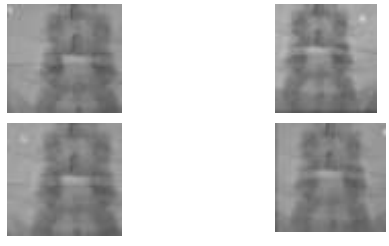
Facet Injections



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Case 13

- Pain decreased from a 4-5/10 to a 2-3/10.
- Significant pain relief for approximately 7-8 days.
- Start physical therapy using the MedX protocol.
- Prescription for a TENS unit was provided.
- Bilateral L3 and L4 medial branch blocks scheduled.

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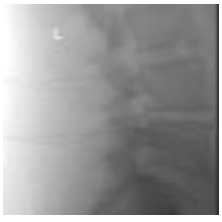
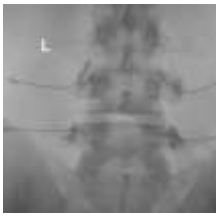
Medial Branch Blocks

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Case 13

- Pain decreased from a 3/10 to 1/10.

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Questions?

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References

- Huston CW. Cervical epidural steroid injections in the management of cervical radiculitis: Interlaminar versus transforaminal. A review. Curr Rev Musculoskelet Med. 2009 Mar;2(1):30-42.
- Derby R, Date ES, Lee C, et al. Size and aggregation of corticosteroids used for epidural injections. Pain Med 2008; 9(2).
- Huntoon MA. Anatomy of the cervical intervertebral foramina: vulnerable arteries and ischemic neurologic injuries after transforaminal epidural injections. *Pain* 2005;117:104–11.
- Dreyfuss P, Baker R, Bogduk N. Comparative effectiveness of cervical transforaminal injections with particulate and nonparticulate corticosteroid preparations for cervical radicular pain. Pain Med 2006;7:237-242.
- Furman MB, Giovanniello MT, O'Brien EM. Incidence of intravascular penetration in transforaminal cervical epidural steroid injections. Spine (Phila Pa 1976). 2003 Jan 1;28(1):21-5.
- Furman MB, O'Brien EM, Zgleszewski TM. Incidence of intravascular penetration in lumbosacral transforaminal cervical epidural steroid injections. Spine (Phila Pa 1976). 2000 Oct 15;25(20):2628-32.
- Kaplan MS, Cunniff J ,Cook J, Collins JG. Intravascular uptake during fluoroscopically guided cervical interlaminar steroid injection at C6-7: a case report. Arch Phys Med Rehabil 2008 Mar 89(3): 553-8.
- Endres S, Shufelt A, Bodu k N. The risks of continuing or discontinuing anticoagulants for patients undergoing common interventional pain procedures. Pain Med 2016;18:403–9.
- Goodman B, House M, et al. Anticoagulant and Antiplatelet Management for Spinal Procedures: A Prospective, Descriptive Study and Interpretation of Guidelines. Pain Medicine 2017; 18: 1218–1224.
- Van Zundert J, Huntoon M, Patijn J, Lataster A, Mekhail N, van Kleef M; Cervival RAdicular Pain. Pain Pract 2010 Jan-Feb; 10(1):1-17.
- Abbasi A, Malhotra G, Malanga G, Elovic EP, Kahn S. Complications of interlaminar cervical epidural steroid injections: a review of the literature. Spine. 2007 Sep 1;32(19):2144-51.
- Manchikanti L, Singh V. Interventional Techniques in Chronic Spinal Pain (Volume 1). ASIPP Publishing (2007).
- Fenton DS, Czervionke LF. Image-Guided Spinal Intervention (1st Edition). Saunders. November 19, 2002.
- Spine Intervention Society. Practice Guidelines for Spinal Diagnostic and Treatment Procedures (Second Edition).

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