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Abbreviations

A-P	Anteroposterior
CT	Computed tomography
G	Gauge
iv	Intravenous
mm	Millimetres
RF	Radiofrequency

17.1 Discography

Indication

- Determine symptomatic levels in patients with discogenic pain.
- Evaluation of symptomatic patients with minimum or no imaging findings.
- Evaluation of discogenic pain that directly correlates the internal morphology of the disc (with or without derangement) to the patient's usual painful symptom.

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Contraindication:

- Coagulation pathology
- Local or systemic infection
- Pregnancy due to ionizing radiation's teratogenic effects
- Patient unwilling to consent to the procedure

Pre- and post-procedural medications:

- Prophylactic single iv dose of antibiotics (according to the instructions of your hospital's infectious department) 30–60 min prior to the session
- Oral analgesics for 24–48 h post the session (optional use depending on patient)

Equipment:

- Fluoroscopy (X-ray fluoroscopic equipment with small focus and collimation, C-arm equipment, angiography suite with or without cone beam option)
- Computed tomography (CT) suite
- Disc monitor for evaluation of intradiscal pressure under injection with continuous and steady rate (optional)

Syringe and needle:

- 10–20 mL Luer-lock syringe for local anaesthetic
- 10–20 mL Luer-lock syringe for iodinated contrast medium
- 22 G, 90–170 mm spinal needle with Quincke type point
- Extension set with three cocks connecting of the needle and syringes

Injection drugs:

- 10–20 mL local anaesthetic (lidocaine hydrochloride 2% or bupivacaine hydrochloride 0.25–0.5%)
- 10–20 mL iodinated contrast; non-ionic iodinated myelographic contrast medium

Anatomy of the region:

- Intervertebral discs are located between the vertebral bodies.
- They consist of a peripheral part (annulus fibrosus) which surrounds the disc's centre (nucleus pulposus).
- Nucleus pulposus is a gel-like structure consisting of embryonic spinal cord remnants and few cells containing an amorphous matrix with high concentration of mucopolysaccharides binded to water.
- Annulus fibrosus is a lamellar structure of collagen and fibrous cartilage layers which are under tension.
- Intervertebral discs are thicker in craniocaudal direction and higher anteriorly in cervical and lumbar spine and posteriorly in thoracic spine.

Patient positioning:

- Patient lying in supine position for discography in the cervical spine
- Patient lying in prone position for discography in the thoracic and lumbar spine

Technique:

- Prepare sterile field of the region of interest, and apply strict sterility measures throughout the whole session (use scrubs, sterile drapes and coverings, gloves, etc.).

Cervical spine:

- Patient in supine position.
- In A-P fluoroscopy view, the selected intervertebral disc is recognized, and the vertebral end plates are superimposed.
- A skin projection is marked and needle is advanced under an anterolateral approach.
- Apply pressure pushing the vessels laterally, and advance the needle under continuous fluoroscopy between the larynx and jugular-carotid vessels, till the level of the anterior longitudinal ligament.
- Needle is placed centrally in the disc, verified on lateral and A-P fluoroscopy views.

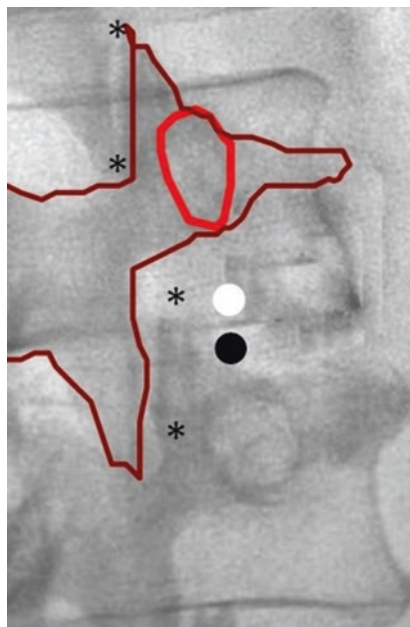
Thoracic spine:

- Patient in prone position.
- The disc space at the thoracic level is defined using a lateral oblique projection; the selected intervertebral disc is recognized, and the vertebral end plates are superimposed.
- A skin projection is marked and needle is advanced under a posterolateral approach.
- The entry point is situated laterally to the superior articulation of the lower vertebral body and medially to the head of the ipsilateral rib.
- Needle is placed centrally in the disc, verified on lateral and P-A fluoroscopy views.

Lumbar spine:

- Patient in prone position.
- The disc space at the lumbar level is defined using a lateral oblique projection (Scottie dog projection); the selected intervertebral disc is recognized, and the vertebral end plates are superimposed.
- A skin projection is marked and needle is advanced under a posterolateral approach.
- The entry point is situated just ventrolateral to the superior articular process (Fig. 17.1).
- Needle is placed centrally in the disc, verified on lateral and P-A fluoroscopy views.

Fig. 17.1 Oblique fluoroscopy view (Scottie dog projection): you can see drawn the Scottie dog; notice the target points for facet joint infiltration (*asterisks*), for discography or disc decompression techniques (*black dot*) and for transforaminal infiltration (*white dot*)



Tips and tricks:

- Access to the L5-S1 level requires significant caudal angulation in order to visualize the correct needle route.
- Performing injection at constant rate by means of a disc monitor or any other similar device seems to be less painful—process stops at a maximum injected volume of 4 cm³ or when intradiscal pressure rises over 100 psi.
- Provocative discography is positive when there is pain increase of 2 NVS units.
- Measurement of disc pressure seems to be a predictor for the treatment's outcome.

Aftercare:

- Adhesive tape at the puncture site.
- Patient should be observed for 2–3 h.
- Patients exit the hospital with an accompanying person; they are instructed to avoid driving for several hours post discography because they might experience temporary weakness or delayed reflexes due to the local anaesthetic.

Procedure-related symptoms and treatment:

- Pain at the puncture site could be treated with cold compression.
- Temporary pain exacerbation could be treated with oral analgesics.

- Discitis is the most fearsome complication (<0.5%).
- Postinjection disc morphology is evaluated according to the modified Dallas discogram scale.

17.2 Intervertebral Disc Decompression Techniques

Indication:

- Adult patients capable of providing consent with symptomatic small- to medium-sized intervertebral disc herniation (hernia size should occupy <1/3–1/2 of the spinal canal's diameter)
- MRI verifying the hernia
- leg pain ± back pain; leg pain >>>> back pain in case of co-existence

Contraindication:

- Asymptomatic herniation
- Sequestration
- Neurologic deficit
- Coagulation pathology
- Local or systemic infection
- Pregnancy due to ionizing radiation's teratogenic effects
- Patient unwilling to consent to the procedure

Pre- and post-procedural medications:

- Prophylactic single iv dose of antibiotics (according to the instructions of your hospital's infectious department) 30–60 min prior to the session
- Oral analgesics for 24–48 h post the session (optional use depending on patient)

Equipment:

- Fluoroscopy (C-arm equipment, angiography suite with or without cone beam option)
- CT suite
- Decompressor device (mechanical, thermal, chemical)

Syringe and needle:

- 20 mL Luer-lock syringe for local anaesthetic
- 22 G, 90–170 mm spinal needle with Quincke type point
- 17 G, 120–170 mm bevelled tip trocar
- Extension set with three cocks connecting of the needle and syringes

Injection drugs:

- In case of chemical decompression, one can use intradiscal alcohol gel or ozone according to the manufacturer's guidelines.

Anatomy of the region:

- Intervertebral discs are located between the vertebral bodies.
- They consist of a peripheral part (annulus fibrosus) which surrounds the disc's centre (nucleus pulposus).
- Nucleus pulposus is a gel-like structure consisting of embryonic spinal cord remnants and few cells containing an amorphous matrix with high concentration of mucopolysaccharides binded to water.
- Annulus fibrosus is a lamellar structure of collagen and fibrous cartilage layers which are under tension.
- Intervertebral discs are thicker in craniocaudal direction and higher anteriorly in cervical and lumbar spine and posteriorly in thoracic spine

Patient positioning:

- Patient lying in supine position for percutaneous disc decompression in the cervical spine
- Patient lying in prone position for percutaneous disc decompression in the thoracic and lumbar spine

Technique:

- Prepare sterile field of the region of interest, and apply strict sterility measures throughout the whole session (use scrubs, sterile drapes and coverings, gloves, etc.).

Cervical spine:

- Patient in supine position.
- In A-P fluoroscopy view, the selected intervertebral disc is recognized, and the vertebral end plates are superimposed.
- A skin projection is marked and a trocar is advanced under an anterolateral approach.
- Apply pressure pushing the vessels laterally, and advance the needle under continuous fluoroscopy between the larynx and jugular-carotid vessels, till the level of the anterior longitudinal ligament.
- Trocar is placed centrally in the disc, verified on lateral and A-P fluoroscopy views (Fig. 17.2).
- Final position of the trocar should be in the midline (on P-A view) and in the junction of middle posterior third (on lateral view) of the intervertebral disc, midway between the two vertebral end plates.

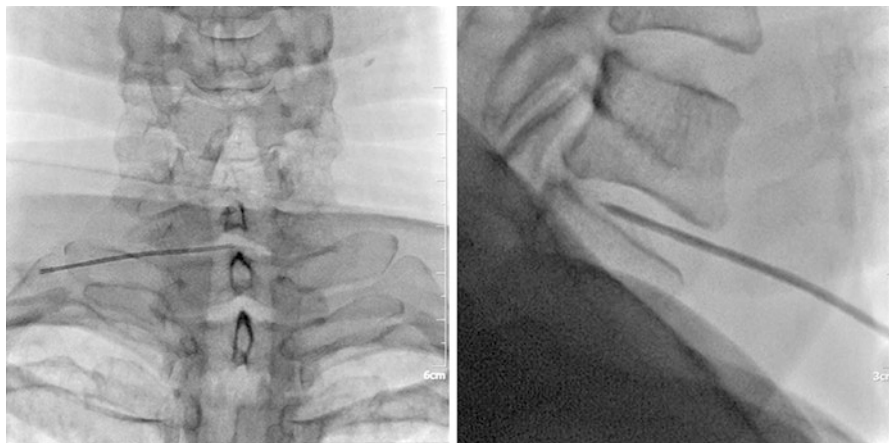


Fig. 17.2 A-P (*left image*) and lateral (*right image*) view illustrating the trocar's final position in the disc of interest (C6–C7 at this case); trocar should be towards the midline in A-P projection and towards the posterior third in lateral projection

Thoracic spine:

- Patient in prone position.
- The disc space at the thoracic level is defined using a lateral oblique projection; the selected intervertebral disc is recognized, and the vertebral end plates are superimposed.
- A skin projection is marked and a trocar is advanced under a posterolateral approach.
- The entry point is situated laterally to the superior articulation of the lower vertebral body and medially to the head of the ipsilateral rib.
- Trocar is placed centrally in the disc, verified on lateral and P-A fluoroscopy views.
- Final position of the needle should be in the midline (on P-A view) and in the anterior third (on lateral view) of the intervertebral disc, midway between the two vertebral end plates.

Lumbar spine:

- Patient in prone position.
- The disc space at the lumbar level is defined using a lateral oblique projection (Scottie dog projection); the selected intervertebral disc is recognized, and the vertebral end plates are superimposed.
- A skin projection is marked and a trocar is advanced under a posterolateral approach.
- The entry point is situated just ventrolateral to the superior articular process.
- Trocar is placed centrally in the disc, verified on lateral and P-A fluoroscopy views.

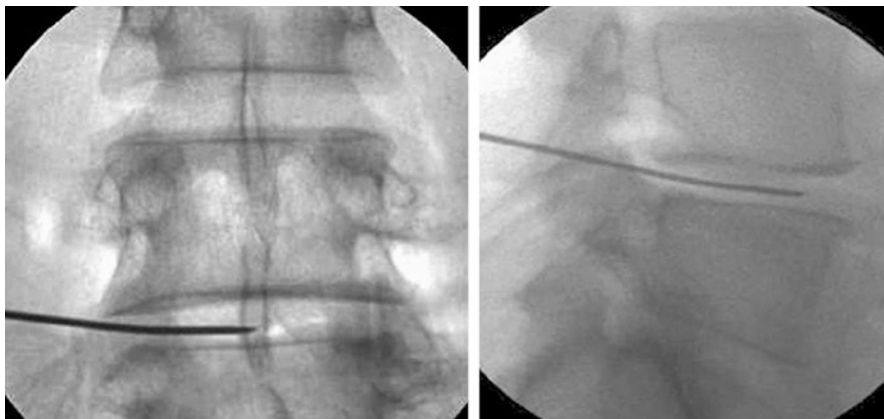


Fig. 17.3 A-P (*left image*) and lateral (*right image*) view illustrating the trocar's final position in the disc of interest (L4–L5 at this case); trocar should be towards the midline in A-P projection and towards the anterior third in lateral projection

- Final position of the trocar should be in the midline (on P-A view) and in the anterior third (on lateral view) of the intervertebral disc, midway between the two vertebral end plates (Fig. 17.3).
- Once the trocar is in the desired position within the intervertebral disc of interest, you can insert any decompression device (mechanical, thermal, chemical) and perform decompression according to the manufacturer's guidelines (Table 17.1).

Tips and tricks:

- Discogel injection is similar to an embolization procedure and should be performed under continuous fluoroscopy.
- Fluoroscopy as guiding modality in percutaneous disc decompression techniques provides real-time monitoring.
- Thermal techniques seem to be governed by a slightly higher rate (2.5%) of thermal sterile end plate inflammation.

Aftercare:

- Adhesive tape at the puncture site.
- Patient should be observed for 2–4 h.
- Patients exit the hospital with an accompanying person; they are instructed to avoid driving for several hours post disc decompression because they might experience temporary weakness or delayed reflexes due to the local anaesthetic.

Table 17.1 Percutaneous decompression techniques (types, methods, definition, success and complication rates) and biomaterial implantation material

Decompression type	Method	Definition	Success rate	Complication rate
Mechanical decompression	Automated percutaneous lumbar discectomy (APLD)	Air- or water-driven, suction-cutting probe	All percutaneous decompression techniques are governed by a median success rate of 85%	All percutaneous decompression techniques are governed by a median Complication rate <0.5% Exception is thermal decompression techniques: 2.5% rate of sterile-dermal inflammation of vertebral end plates
	Percutaneous disc decompression (PDD)	Mechanical high rotation per minute device		
	Percutaneous discectomy	Herniotome		
Thermal decompression	Percutaneous laser decompression			
	Intradiscal electrothermal therapy (IDET)			
	Intervertebral disc nucleoplasty with bipolar radiofrequency energy			
Chemical decompression	Discogel (gelified ethanol)			
	Ozone therapy (leads to breakdown of nucleus pulposus)			
Biomaterial implantation	Hydrogel, platelet-rich plasma and stem cell therapy (aim in intervertebral disc regeneration)		Further and more extended studies with larger patient samples are necessary for a solid evaluation concerning the success and complication rates	

Procedure-related symptoms and treatment:

- Pain at the puncture site could be treated with cold compression.
- Temporary pain exacerbation could be treated with oral analgesics.
- Discitis is the most fearsome complication (<0.5%).

17.3 Epidural Infiltrations

17.3.1 Transforaminal Approach

Indication:

- Neuralgia of a single nerve root caused by a pain generator arising at a specific level
- Therapeutic infiltration (for pain reduction)
- Diagnostic infiltration (to verify whether therapy can be beneficial at a specific level)

Contraindication:

- Coagulation pathology
- Local or systemic infection
- Pregnancy due to ionizing radiation's teratogenic effects
- Patient unwilling to consent to the procedure

Pre- and post-procedural medications:

- No medication

Equipment:

- Fluoroscopy (X-ray fluoroscopic equipment with small focus and collimation, C-arm equipment, angiography suite with or without cone beam option)
- CT suite

Syringe and needle:

- 2.5–5 mL Luer-lock syringe for injected mixture
- 2.5–5 mL Luer-lock syringe for iodinate contrast medium
- 5–10 mL syringe for local anaesthesia (optional)
- 22 G, 90–150 mm spinal needle with Quincke type point
- Extension set with three cocks connecting of the needle and syringes

Injection drugs:

- Long-acting corticosteroid (triamcinolone acetate, cortivazol, betamethasone injectable suspension, methylprednisolone suspension); recommended dose is up to 50 mg of triamcinolone acetate or 80 mg of methylprednisolone.
- Local anaesthetic (lidocaine hydrochloride 2% or bupivacaine hydrochloride 0.25–0.5%); use local anaesthetics free of paraben or phenol in order to avoid steroid flocculation.
- 1–3 mL non-ionic iodinated myelographic contrast medium.
- Injected mixture for diagnostic and therapeutic purpose contains:
 - 1–1.5 mL long-acting corticosteroid
 - 1–1.5 mL local anaesthetic

Anatomy of the region:

- The margins of neuroforamen include the facet joint (posterior), the vertebral pedicles (superior and inferior) and the vertebral body-intervertebral disc (anterior).
- In cervical foramen the nerve exits anterolaterally, whereas the vertebral artery is usually located anterior to the nerve passing through the foramen transversarium.

- In thoracic and lumbar foramina, nerve and vessels exit anteriorly and at the cephalad part.
- In transforaminal infiltrations (in all three spine levels), target point is at the lower and posterolateral foraminal margin.

Patient positioning:

- Patient lying in supine position for transforaminal infiltration in the cervical spine
- Patient lying in prone position for transforaminal infiltration in the thoracic and lumbar spine

Technique:

Fluoroscopy:

- Prepare sterile field of the region of interest, and apply strict sterility measures throughout the whole session (use scrubs, sterile drapes and coverings, gloves, etc.).

Cervical spine:

- Patient in supine position.
- In oblique-lateral fluoroscopy view, the selected level is recognized, and the vertebral end plates are superimposed in order to maximize circular appearance of the foramen.
- A skin projection is marked and the needle is advanced under a posterolateral approach.
- A-P view controls the depth of needle penetration inside the foramen (remember always stay at the lower and posterolateral foraminal margin).
- Contrast medium injection will verify the desired needle position inside the foramen (in most cases contrast medium will outline the nerve root) and *NOT* intravascularly.

Thoracic spine:

- Patient in prone position.
- In 30° oblique fluoroscopy view, the selected level is recognized, and the vertebral end plates are superimposed.
- A skin projection is marked and the needle is advanced under an inferolateral approach.
- A-P view controls the depth of needle penetration inside the foramen.
- In A-P view needle should be located in the lateral third of the pedicle, whilst in lateral view the needle should not advance beyond the posterior vertebral wall (or anterior foraminal margin).

- Remember always stay at the lower and posterolateral foraminal margin.
- Contrast medium injection will verify the desired needle position inside the foramen (in most cases contrast medium will outline the nerve root) and not intravascularly.

Lumbar spine:

- Patient in prone position.
- In a lateral oblique projection (Scottie dog projection), the selected level is recognized, and the vertebral end plates are superimposed.
- A skin projection is marked and the needle is advanced under a posterolateral approach.
- A-P view controls the depth of needle penetration inside the foramen.
- In A-P view needle should be located in the lateral fourth of the pedicle, whilst in lateral view the needle should not advance beyond the posterior vertebral wall (or anterior foraminal margin).
- Remember always stay at the lower and posterolateral foraminal margin (Fig. 17.4).

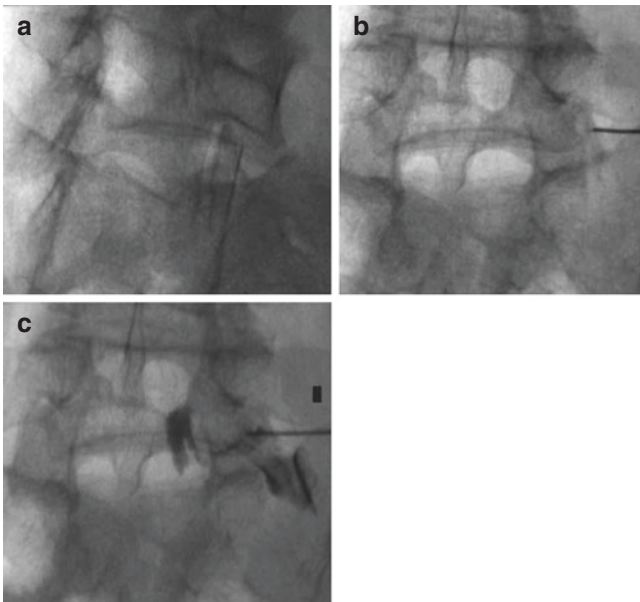


Fig. 17.4 (a) Scottie dog projection (oblique view); end plates of L5-S1 level are aligned, (b) needle is advanced under a posterolateral approach, (c) A-P projection illustrating needle at the lateral third of the foramen; contrast medium injection verifies proper needle position outlining the nerve root

- Contrast medium injection will verify the desired needle position inside the foramen (in most cases contrast medium will outline the nerve root) and not intravascularly.

Sacral spine:

- Patient in prone position.
- In A-P view (steep cephalo-caudal projection is required in order to overlap posterior and anterior foramina), the selected level is recognized.
- Needle is advanced perpendicular to the sacrum's dorsal surface in A-P view, whilst in lateral view it should be approaching the presacral space.
- Contrast medium injection will verify the desired needle position inside the foramen (in most cases contrast medium will outline the nerve root) and not intravascularly (Fig. 17.5).
- In case of CT-guided transforaminal infiltrations, a similar direct axial approach is performed for each spinal level. Once the needle is safely placed in the lower and posterolateral foraminal border, inject 1–3 mL of iodinated contrast medium to verify extravascular position. Then, inject the solution.

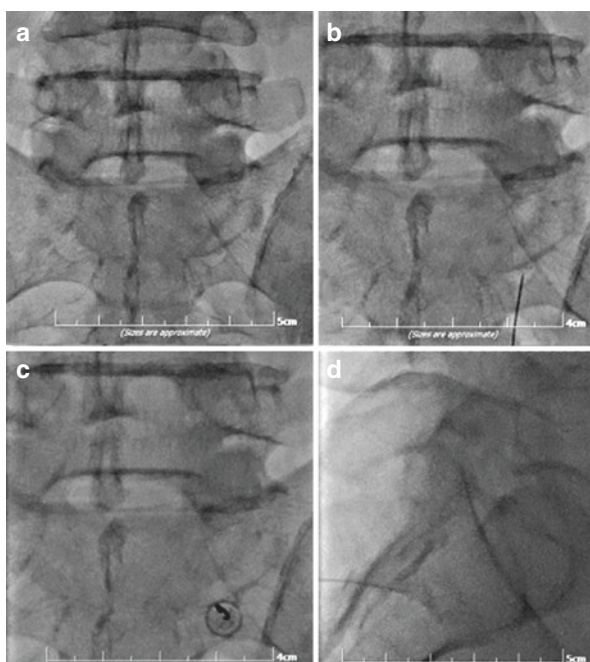


Fig. 17.5 (a) A-P projection, anterior and posterior foramen parts are aligned, (b) a skin projection is marked, (c) needle is advanced under a posterior approach, (d) lateral projection illustrating needle inside the epidural space; contrast medium injection verifies proper needle position

Tips and tricks:

- Corticosteroids act at cellular level and require a 3–5 day period for the effects of their action; therefore the initial pain reduction is due to local anaesthetic; instruct patient to continue analgesic medication for the first 3–5 days.
- Particulate corticosteroids are potential embolic agents in case of intravascular injection; avoid intravascular injection by verifying proper needle positioning by means of contrast medium injection.
- Do not look for troubles: always stay at the lower and posterolateral foraminal margin.
- In the cervical spine, a safer and of equal efficacy approach might be performing facet joint infiltration; during injection there is capsular rupture and dispersion of the injectate in the foraminal and epidural space.
- Alternative safer approaches include placing the patient in prone position and, under CT-guidance, approaching the posterior and lateral border of the facet joint and performing the injection at this location.

Aftercare:

- Adhesive tape at the puncture site.
- Patient should be observed for 15–30 min (prior to discharge perform motor strength and sensory evaluation).
- Patients exit the hospital with an accompanying person; they are instructed to avoid driving for several hours post the infiltration because they might experience temporary weakness or delayed reflexes due to the local anaesthetic.
- Follow-up reschedule within 7–10 days.

Procedure-related symptoms and treatment:

- Pain at the puncture site could be treated with cold compression.
- Temporary pain exacerbation could be treated with oral analgesics.
- Infection is the most fearsome complication (<0.5%).

17.3.2 Interlaminar Approach

Indication:

- Spinal stenosis
- Intervertebral disc herniation with resultant nerve root compression/inflammation
- Therapeutic infiltration (for pain reduction)

Contraindication:

- Coagulation pathology
- Local or systemic infection

- Pregnancy due to ionizing radiation's teratogenic effects
- Patient unwilling to consent to the procedure

Pre- and post-procedural medications:

- No medication

Equipment:

- Fluoroscopy (X-ray fluoroscopic equipment with small focus and collimation, C-arm equipment, angiography suite with or without cone beam option)
- CT suite

Syringe and needle:

- 2.5–5 mL Luer-lock syringe for injected mixture
- 2.5–5 mL Luer-lock syringe for iodinate contrast medium
- 5–10 mL syringe for local anaesthesia (optional)
- 22 G, 70–120 mm spinal needle with Quincke type point
- Extension set with three cocks connecting of the needle and syringes

Injection drugs:

- Long-acting corticosteroid (triamcinolone acetate, cortivasol, betamethasone injectable suspension, methylprednisolone suspension); recommended dose is up to 50 mg of triamcinolone acetate or 80 mg of methylprednisolone.
- Local anaesthetic (lidocaine hydrochloride 2% or bupivacaine hydrochloride 0.25–0.5%); use local anaesthetics free of paraben or phenol in order to avoid steroid flocculation.
- 1–3 mL non-ionic iodinated myelographic contrast medium; in case of allergy use a gadolinium contrast medium.
- Injected mixture for diagnostic and therapeutic purpose contains:
 - 1–1.5 mL long-acting corticosteroid
 - 1–1.5 mL local anaesthetic

Anatomy of the region:

- The boundaries of spinal canal in a circumferential route include the spinous process, two vertebral laminae, two vertebral pedicles, two transverse processes and the posterior vertebral wall.
- Epidural space lies beyond the flaval ligaments and contains fat, blood vessels, nerve roots and dural sac.
- The lateral margin of epidural space is the intervertebral foramen.

Patient positioning:

- Patient lying in prone position

Technique:

Fluoroscopy:

- Patient in prone position
- Prepare sterile field of the region of interest, and apply strict sterility measures throughout the whole session (use scrubs, sterile drapes and coverings, gloves, etc.).
- In A-P view in the midline, slightly lateral to the spinous process (either left or right) towards the epidural fat which is seen in fluoroscopy as radiolucent globules.
- A skin projection is marked and the needle is advanced under a posterior approach.
- Lateral view controls the depth of needle penetration beyond the flaval ligaments inside the epidural space.
- Contrast medium injection will verify the desired needle position inside the epidural space, outside the dura matter and not intravascularly (Fig. 17.6a, b).

Computed tomography:

- Prepare sterile field of the region of interest, and apply strict sterility measures throughout the whole session (use scrubs, sterile drapes and coverings, gloves, etc.).
- Perform scans with 1–3 mm axial images; scan area should the whole vertebral body-intervertebral disc-vertebral body complex.
- Selection of entry point at the skin should preferentially provide a route vertical to the epidural space, parallel to the spinous process.
- Local anaesthesia at the puncture site is optional.
- Advance the 22 G spinal needle through the spinal muscles inside the epidural space under the selected route; an increased resistance will be felt at when entering the flaval ligaments, and resistance loss will occur upon epidural space entrance.
- Proper needle positioning (inside the epidural space, outside the dura matter and not intravascularly) is verified with CT scan postinjection of 1–3 mL of iodinated contrast medium or air (in levels caudal to L2–L3) which will be dispersed inside the space (Fig. 17.6c, d).
- Inject solution.

Tips and tricks:

- Corticosteroids act at cellular level and require a 3–5 day period for the effects of their action; therefore the initial pain reduction is due to local anaesthetic; instruct patient to continue analgesic medication for the first 3–5 days.
- Particulate corticosteroids are potential embolic agents in case of intravascular injection; avoid intravascular injection by verifying proper needle positioning by means of contrast medium injection.
- Interlaminar infiltrations serve no diagnostic purposes.

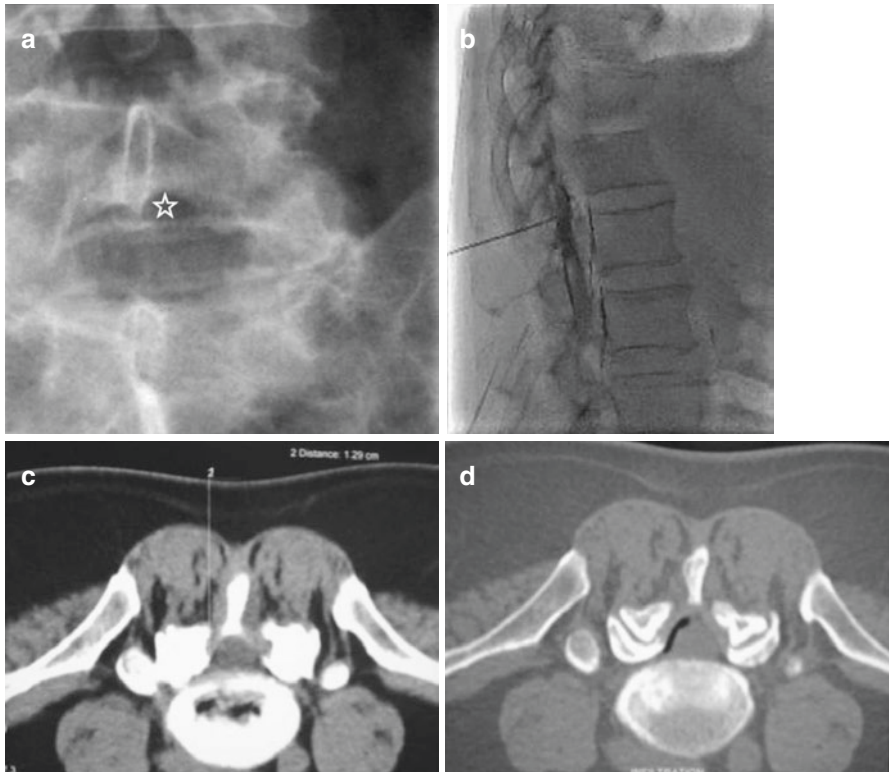


Fig. 17.6 (a) A-P projection; asterisk marks the target point for interlaminar epidural infiltration under fluoroscopy; (b) lateral projection illustrating needle inside the epidural space, contrast medium injection verifies proper needle position; (c) CT axial scan, entrance point in the skin and needle route are illustrated; needle is advanced under a posterior approach; (d) CT axial scan, air injection verifies proper needle position

- Occasionally posterior epidural space is an attractive alternative for injecting the solution.
- If you cannot approach the level of interest (e.g. due to severe stenosis of facet joint hypertrophy), perform the infiltration at the level above, and let gravity play its role.

Aftercare:

- Adhesive tape at the puncture site.
- Patient should be observed for 1–2 h (prior to discharge perform motor strength and sensory evaluation).
- Patients exit the hospital with an accompanying person; they are instructed to avoid driving for several hours post the infiltration because they might experience temporary weakness or delayed reflexes due to the local anaesthetic.
- Follow-up reschedule within 7–10 days

Procedure-related symptoms and treatment:

- Infection is the most fearsome complication (<0.5%).

17.3.3 Caudal Approach

Indication:

- Spinal stenosis
- Operated spine
- Therapeutic infiltration (for pain reduction)

Contraindication:

- Coagulation pathology
- Local or systemic infection
- Pregnancy due to ionizing radiation's teratogenic effects
- Patient unwilling to consent to the procedure

Pre- and post-procedural medications:

- No medication

Equipment:

- Fluoroscopy (X-ray fluoroscopic equipment with small focus and collimation, C-arm equipment, angiography suite with or without cone beam option)
- CT suite

Syringe and needle:

- 20 mL Luer-lock syringe for injected mixture
- 2.5–5 mL Luer-lock syringe for iodinate contrast medium
- 5–10 mL syringe for local anaesthesia (optional)
- 22 G, 70–90 mm spinal needle with Quincke type point
- Extension set with three cocks connecting of the needle and syringes

Injection drugs:

- Long-acting corticosteroid (triamcinolone acetate, cortivazol, betamethasone injectable suspension, methylprednisolone suspension); recommended dose is up to 50 mg of triamcinolone acetate or 80 mg of methylprednisolone.

- Local anaesthetic (lidocaine hydrochloride 2% or bupivacaine hydrochloride 0.25–0.5%); use local anaesthetics free of paraben or phenol in order to avoid steroid flocculation.
- 1–3 mL non-ionic iodinated myelographic contrast medium.
- Injected mixture for diagnostic and therapeutic purpose contains:
 - 1–1.5 mL long-acting corticosteroid
 - 1–1.5 mL local anaesthetic

Anatomy of the region:

- The boundaries of spinal canal in a circumferential route include the spinous process, two vertebral laminae, two vertebral pedicles, two transverse processes and the posterior vertebral wall.
- Epidural space lies beyond the flaval ligaments and contains fat, blood vessels, nerve roots and dural sac.
- The inferior margin of epidural space is the sacral hiatus.

Patient positioning:

- Patient lying in prone or lateral decubitus position

Technique:

Fluoroscopy:

- Prepare sterile field of the region of interest, and apply strict sterility measures throughout the whole session (use scrubs, sterile drapes and coverings, gloves, etc.).
- In A-P view in the lower sacral area, occasionally an inverted U-shaped orifice is seen, and this corresponds to the sacral hiatus which is the entry point to the epidural space from a caudal approach.
- A skin projection is marked and the needle is advanced under a posterior approach.
- Lateral view controls the depth of needle penetration.
- Contrast medium injection will verify the desired needle position inside the epidural space, outside the dura matter and not intravascularly (remember that dural sac extends until S2 level in adults) (Fig. 17.7).
- Inject the solution.

Tips and tricks:

- Corticosteroids act at cellular level and require a 3–5 day period for the effects of their action therefore the initial pain reduction is due to local anaesthetic; instruct patient to continue analgesic medication for the first 3–5 days.
- Larger volumes are required for caudal approach (15–20 mL), so dilute the steroid with sterile saline and local anaesthetic.

Fig. 17.7 Lateral projection illustrating needle through the sacrococcygeal hiatus inside the epidural space; contrast medium injection verifies proper needle position



Aftercare:

- Adhesive tape at the puncture site.
- Patient should be observed for 1–2 h (prior to discharge perform motor strength and sensory evaluation).
- Patients exit the hospital with an accompanying person; they are instructed to avoid driving for several hours post the infiltration because they might experience temporary weakness or delayed reflexes due to the local anaesthetic.
- Follow-up reschedule within 7–10 days

Procedure-related symptoms and treatment:

- Infection is the most fearsome complication (<0.5%).

17.4 Facet Joint

17.4.1 Infiltration

Indication:

- Unilateral or bilateral paravertebral neck pain; pain is aggravated on extension or rotation.
- Unilateral or bilateral paravertebral low back pain; pain is aggravated on extension or rotation, upon changing positions from sitting to standing.
- Local tenderness to palpation over the facet joint(s) of interest.
- Absence of radicular pain.
- Diagnostic injection.
- Therapeutic infiltration.

Contraindication:

- Coagulation pathology
- Local or systemic infection
- Patient unwilling to consent to the procedure

Pre- and post-procedural medications:

- No medication

Equipment:

- Fluoroscopy (X-ray fluoroscopic equipment with small focus and collimation, C-arm equipment, angiography suite with or without cone beam option)
- CT suite

Syringe and needle:

- 2.5–5 mL Luer-lock syringe for injected mixture
- 2.5–5 mL Luer-lock syringe for iodinate contrast medium
- 5–10 mL syringe for local anaesthesia (optional)
- 22 G, 70–120 mm spinal needle with Quincke type point
- Extension set with three cocks connecting of the needle and syringes

Injection drugs:

- Long-acting corticosteroid (triamcinolone acetate, cortivasol, betamethasone injectable suspension, methylprednisolone suspension); recommended dose is up to 50 mg of triamcinolone acetate or 80 mg of methylprednisolone.
- Local anaesthetic (lidocaine hydrochloride 2% or bupivacaine hydrochloride 0.25–0.5%); use local anaesthetics free of paraben or phenol in order to avoid steroid flocculation.
- 1–3 mL non-ionic iodinated myelographic contrast medium; in case of allergy, use a gadolinium contrast medium.
- Injected mixture for diagnostic purpose contains:
 - 2.5 mL local anaesthetic
- Injected mixture for therapeutic purpose contains:
 - 1–1.5 mL long-acting corticosteroid
 - 1–1.5 mL local anaesthetic

Anatomy of the region:

- Facet joint (zygapophysial joint) is a synovial joint for the articulation of adjacent vertebral bodies.
- The posterior part of the joint lies in an oblique sagittal plane and is easily accessible.

- The posterior part of the joint is lined by a fibrous capsule.
- A posterior-inferior synovial recess extends beyond the capsule and is easily accessible.

Patient positioning:

- Patient lying in prone position for thoracic and lumbar spine
- Patient in sitting or prone position for cervical spine

Technique:

Fluoroscopy:

- Prepare sterile field of the region of interest, and apply strict sterility measures throughout the whole session (use scrubs, sterile drapes and coverings, gloves, etc.).
- The fluoroscopy beam is angulated at Scottie dog (lateral oblique) projection.
- Local anaesthesia at the puncture site is optional.
- With a course parallel to the fluoroscopy beam, advance the 22 G spinal needle through the capsule inside the facet joint; aim towards a target point located approximately at the joint's caudal margin (where the posterior-inferior recess lies).
- Proper intra-articular needle positioning is verified fluoroscopically with injection of 1–3 mL of iodinated contrast medium which will be dispersed inside the joint either lining its margins or being collected at the joint's recess (Figs. 17.8 and 17.9).
- Inject solution depending on the indication for the procedure.

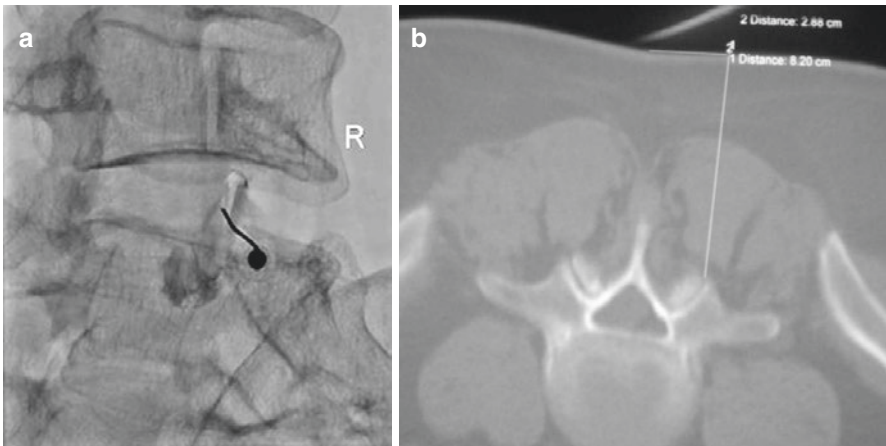


Fig. 17.8 (a) Scottie dog projection (oblique view); end plates of L4–L5 level are aligned; needle is inside the right L4–L5 facet joint; contrast medium injection verifies proper intra-articular needle position; (b) CT axial scan, entrance point in the skin and needle route are illustrated; needle is advanced under a posterior approach

Fig. 17.9 Lateral fluoroscopy view in the cervical spine; end plates of C5–C6; contrast medium injection verifies proper intra-articular needle position



Computed Tomography:

- Prepare sterile field of the region of interest, and apply strict sterility measures throughout the whole session (use scrubs, sterile drapes and coverings, gloves, etc.).
- Perform scans with 1–3 mm axial images; scan area should cover the whole vertebral disc-vertebral complex.
- Selection of entry point at the skin should provide a route parallel to the joint orientation.
- Local anaesthesia at the puncture site is optional.
- Advance the 22 G spinal needle through the ligaments and the capsule inside the facet joint under the selected route (parallel to the joint orientation); aim towards the joint's caudal part (a minor resistance loss might be felt when entering the joint).
- Proper intra-articular needle positioning is verified with CT scan postinjection of 1–3 mL of iodinated contrast medium which will be dispersed inside the joint either lining its margins or being collected at the joint's recess.
- Inject solution depending on the indication for the procedure.

Tips and tricks:

- A minor resistance loss might be felt when entering the joint.
- Corticosteroids act at cellular level and require a 3–5 day period for the effects of their action; therefore the initial pain reduction is due to local anaesthetic; instruct patient to continue analgesic medication for the first 3–5 days.
- Particulate corticosteroids are potential embolic agents in case of intravascular injection; avoid intravascular injection by verifying proper needle positioning by means of contrast medium injection.

Aftercare:

- Adhesive tape at the puncture site.
- Patient should be observed for 15–30 min (prior to discharge perform motor strength and sensory evaluation).
- Patients exit the hospital with an accompanying person; they are instructed to avoid driving for several hours post the infiltration because they might experience temporary weakness or delayed reflexes due to the local anaesthetic.
- Follow-up reschedule within 7–10 days

Procedure-related symptoms and treatment:

- Temporary pain exacerbation (2.5% of the cases) could be treated with oral analgesics.

17.4.2 Denervation

Indication:

- Unilateral or bilateral paravertebral neck pain.
- Unilateral or bilateral paravertebral low back pain; pain is aggravated on extension or rotation, upon changing positions from sitting to standing.
- Local tenderness to palpation over the facet joint(s) of interest.
- Absence of radicular pain.
- Therapeutic infiltration with short-term efficacy.

Contraindication:

- Coagulation pathology
- Local or systemic infection
- Patient unwilling to consent to the procedure

Pre- and post-procedural medications:

- No medication

Equipment:

- Fluoroscopy (X-ray fluoroscopic equipment with small focus and collimation, C-arm equipment, angiography suite with or without cone beam option)
- CT suite

Syringe and needle:

- RF generator
- RF needles
- RF electrodes
- 5–10 mL syringe for local anaesthesia
- Extension set with three cocks connecting of the needle and syringes

Injection drugs:

- Local anaesthetic (lidocaine hydrochloride 2% or bupivacaine hydrochloride 0.25–0.5%)

Anatomy of the region:

- Facet joint (zygapophysial joint) is a synovial joint for the articulation of adjacent vertebral bodies.
- Facet joints are innervated from branches of two consecutive median branch nerves.
- Any median branch nerve innervates two consecutive facet joints: the inferior part of the upper one and the superior part of the lower one.

Patient positioning:

- Patient lying in prone position for lumbar spine

Technique:

Fluoroscopy:

- Prepare sterile field of the region of interest, and apply strict sterility measures throughout the whole session (use scrubs, sterile drapes and coverings, gloves, etc.).
- The fluoroscopy beam is angulated at Scottie dog (lateral oblique) projection.
- Local anaesthesia at the puncture site is optional.
- With a course parallel to the fluoroscopy beam, advance the 22 G spinal needle; aim towards a target point located at the junction of transverse process and superior articulating process (Figs. 17.10 and 17.11).
- Proper needle positioning is confirmed by performing sensory and motor stimulation tests.
- Apply local anaesthetic.
- Perform the RF treatment.

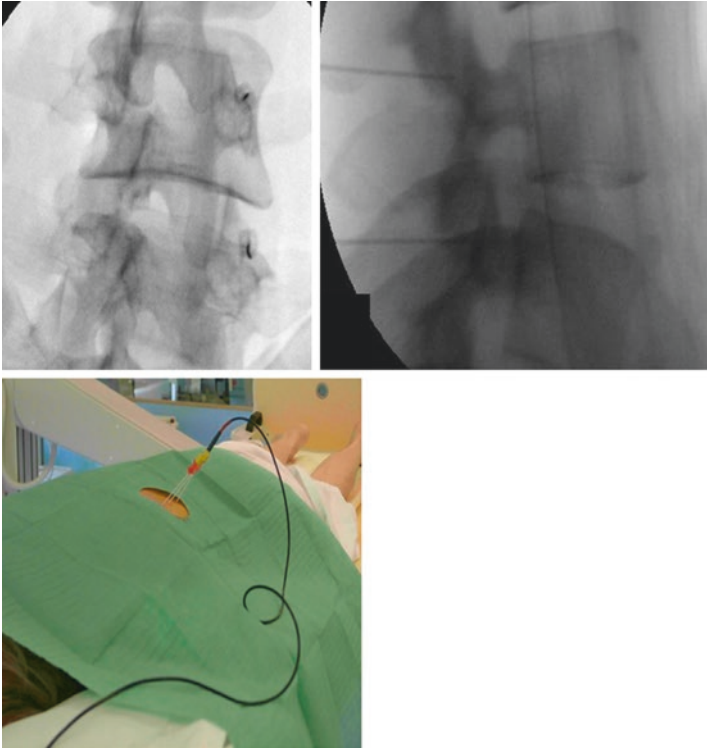


Fig. 17.10 Oblique (*upper left image*) and lateral (*upper right image*) views illustrating needle position during facet joint denervation. Needles are placed in two levels due to the dual nerve supply of the facet joint. Once needles are in position coaxially RF electrodes are introduced (*lower image*)

Fig. 17.11 Lateral fluoroscopy view illustrating needle's final position during facet joint denervation in the cervical spine



In case of CT-guided facet joint denervation, a similar direct axial approach is performed for each level. Once the needle is safely placed at the junction of transverse process and superior articulating process, perform sensory and motor stimulation tests, apply local anaesthesia and, then, perform the RF treatment.

Tips and tricks:

- Proper patient selection for facet joint denervation requires an efficient facet joint infiltration (even with short-term results).

Aftercare:

- Adhesive tape at the puncture site.
- Patient should be observed for 30–60 min (prior to discharge perform motor strength and sensory evaluation).
- Patients exit the hospital with an accompanying person; they are instructed to avoid driving for several hours post the infiltration because they might experience temporary weakness or delayed reflexes due to the local anaesthetic.
- Follow-up reschedule within 7–10 days.

Procedure-related symptoms and treatment:

- Temporary pain exacerbation could be treated with oral analgesics.

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