

Chapter 7

DORSAL ROOT GANGLION PULSED RADIOFREQUENCY LESIONING

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Conventional heat radiofrequency lesioning of the dorsal root ganglion (DRG) remains controversial owing to the potential risk of deafferentation pain. For this reason, DRG pulsed radiofrequency lesioning (PRFL), as a nondestructive neuromodulation technique, would be more attractive for chronic pain management [1–6]. Although the results of PRFL for neuropathic pain are anecdotal, the technique can be used as a potential treatment for chronic neuropathic pain [5–7]. There are two theories of the mechanisms of PRFL. One theory is that the electric field coming from the large current density of the cannula tip activates sensory fibers in the DRG and the spinal neurons to which they relay. The other theory is that temporal heat during each pulse might be responsible for the therapeutic effect [3].

TREATMENT OBJECTIVES

The main objectives of DRG PRFL are to treat chronic segmental spinal nerve pain [1–6], segmental neuropathic pain, such as postherpetic neuralgia [8,9], and cervicogenic headache [6,10–12].

INDICATIONS

The indications for DRG PRFL are as follows [4,5,13–17]:

- Chronic cervicobrachialgia
- Cervicogenic headache
- Thoracic segmental pain with referral into one or more particular spinal segments
- Postherpetic neuralgia
- Lower back pain with radiating pain to lower extremities
- Failed back surgery syndrome
- Other chronic segmental pain not responding to the conventional treatments

CONTRAINDICATIONS

DRG PRFL should not be performed in patients with the following conditions:

- Patient refusal
- Skin infection over the puncture site or systemic infection
- Hypersensitivity to contrast agent or local anesthetics
- Major psychological disorder
- Coagulopathy (prothrombin time international normalized ratio value > 1.5 or platelet count < 50,000/mm³) or anticoagulant therapy

The patient on anticoagulant therapy may undergo the procedure if such therapy is temporarily suspended. Depending on

the particular anticoagulant, therapy should be stopped for 3 to 7 days before and after the procedure.

COMPLICATIONS

Complications of DRG PRFL are usually minimal. Unlike conventional heat radiofrequency (RF) thermocoagulation, PRFL does not cause deafferentation pain, such as spontaneous pain, hypesthesia and allodynia and motor complications. The complications seen with this procedure include the following:

- Postprocedural pain
- Spinal cord, nerve root, or vascular injury
- Infection
- Pneumothorax at thoracic region
- Hematoma

PREOPERATIVE PREPARATION

History Taking and Physical Examination

When examining a patient to determine whether he/she may be a potential candidate for DRG PRFL, the physician should look for the signs and symptoms of one of the following three classes of pain: chronic segmental pain of spine origin, chronic segmental pain of non-spine origin, or cervicogenic headache.

The signs and symptoms of chronic segmental pain of spine origin are as follows [4,13,18–21]:

- Pain with a constant localization of limited area
- Chronic segmental pain (for longer than 3 months at a minimum) originating from the spine
- Radiating pain in the distribution of one or more particular spinal segments (Fig. 7-1)

The signs and symptoms of chronic segmental pain of non-spine origin are as follows:

- Segmental hyperalagia, paresthesia, and allodynia with a constant localization of limited area
- Chronic segmental pain (for longer than 3 months at a minimum) originating in areas other than the spine such as postherpetic neuralgia or postthoracotomy pain syndrome.

The signs and symptoms of cervicogenic headache [10] are as follows:

- Headache induced by neck movements and/or sustained awkward head positioning or by external pressure
- Neck pain spreading to the ipsilateral shoulder and arm as vague, non-radicular pain appears in a third to half of patients with cervicogenic headache

Table 7.2
The Mean Values for Each Measurement (Mean \pm SD)

Measurement	L1	L2	L3	L4	L5	S1
NRA ($^{\circ}$)	40.9 \pm 9.7	32.9 \pm 7.4	30.8 \pm 7.1	27.6 \pm 7.3	27.7 \pm 8.0	17.9 \pm 5.8
NRL (mm)	6.4 \pm 1.7	7.1 \pm 1.4	8.7 \pm 2.2	11.5 \pm 3.1	14.1 \pm 3.1	11.2 \pm 2.8
DRGW (mm)	3.7 \pm 0.7	4.6 \pm 0.7	5.7 \pm 0.7	6.2 \pm 0.7	5.9 \pm 0.7	6.2 \pm 0.4
DRGL (mm)	4.3 \pm 0.8	5.7 \pm 1.2	7.1 \pm 1.3	8.4 \pm 1.1	9.4 \pm 1.4	11.2 \pm 1.7
DRGR (%) [*]	86.2 \pm 8.2	82.2 \pm 8.9	80.4 \pm 9.5	73.9 \pm 8.6	63.2 \pm 8.8	56.0 \pm 9.7
DRGH (mm)	4.3 \pm 0.9	5.6 \pm 1.2	7.3 \pm 1.4	8.2 \pm 0.9	8.3 \pm 1.2	—
PW (mm)	9.6 \pm 1.6	9.6 \pm 1.4	11.2 \pm 2.3	13.8 \pm 2.6	16.9 \pm 3.9	—
PH (mm)	20.2 \pm 3.4	18.1 \pm 2.4	18.1 \pm 2.1	17.8 \pm 1.9	19.8 \pm 3.7	—
	L1-L2	L2-L3	L3-L4	L4-L5	L5-S1	
FH (mm)	17.1 \pm 2.0	18.4 \pm 1.7	18.1 \pm 1.5	17.3 \pm 1.8	17.1 \pm 3.6	
DRGH/FH (%) [†]	25.2 \pm 4.9	30.5 \pm 6.7	40.9 \pm 9.6	47.7 \pm 7.9	51.2 \pm 14.2	

^{*}DRGR (%) = DRGW/DRGL \times 100.
[†]DRGH/FH (%) = DRGH/FH \times 100.
NRA = nerve root sleeve angulation; NRL = length of nerve root; DRG = dorsal root ganglion; DRGW = DRG midpoint width; DRGL = DRG midpoint length; DRGH = DRG height; PW = pedicle width; PH = pedicle height; FH = foramen height.
From Hasegawa T, Mikawa Y, Watanabe R, et al: Morphometric analysis of the lumbosacral nerve roots and dorsal root ganglia by magnetic resonance imaging. Spine 1996; 21:1005-1009.

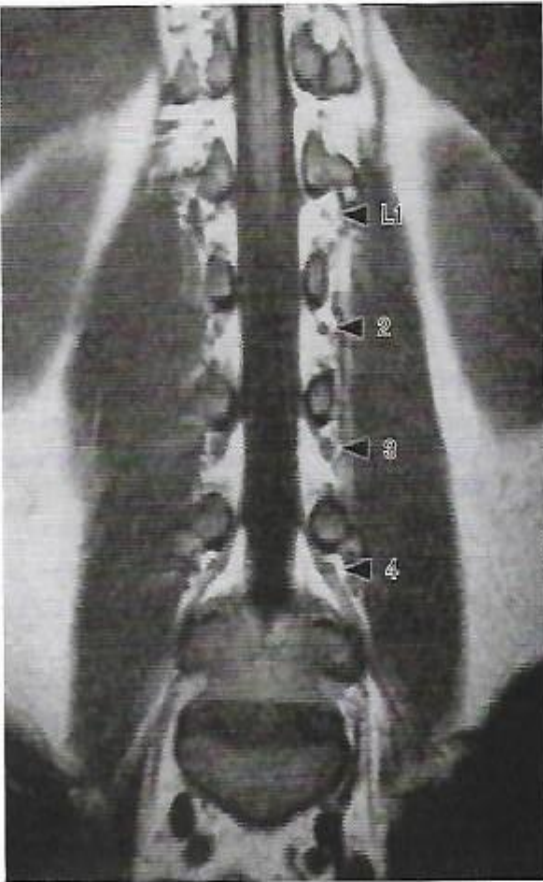


Figure 7-5
T1-weighted coronal magnetic resonance image of lumbar nerve roots and dorsal root ganglia (arrowheads). (From Hasegawa T, Mikawa Y, Watanabe R, et al: Morphometric analysis of the lumbosacral nerve roots and dorsal root ganglia by magnetic resonance imaging. Spine 1996; 21:1005-1009.)

- The average nerve root sleeve take-off angulation gradually decreases from L1 to S1 (Fig. 7-5).
- The average dimension of the DRG gradually increases from L1 to S1. The S1 DRG is the largest (Table 7.2). The relatively large DRG and the greater DRG-to-foramen

height ratios in the lower lumbar region may explain the higher incidence of L5 or S1 radiculopathy.

- Most lumbar DRGs are located in the foraminal region (Fig. 7-5). In contrast, the sacral DRGs are located in the intraspinal region and more cephalad than the corresponding neural foramina.

INSTRUMENTATION

- 26-gauge, 1.5-inch and 3.5-inch needles for skin infiltration
- An RF lesion generator, a connecting cable, and a probe (Fig. 7-6)
- RF cannulas: curved or straight (Fig. 7-6)
- Local anesthetics and contrast agent

PROCEDURE

Cervical Dorsal Root Ganglion Pulsed Radiofrequency Lesioning

The C2 Dorsal Root Ganglion

TARGET

The targets for DRG PRFL at C2 are as follows:

- The intervertebral foramen between the arch of the atlas and the lamina of the axis in the lateral projection
- The center of the C2 pedicle in an anteroposterior (AP) projection

PROCEDURE

1. The patient's written informed consent is obtained.
2. The patient is placed in the lateral position.
3. An adhesive grounding pad is placed on the patient's posterior shoulder (if the probe is not the self-grounded type).
4. The patient is draped with a sterile dressing.
5. The C-arm (fluoroscope) is set to superimpose the bilateral articular pillars in a lateral projection.

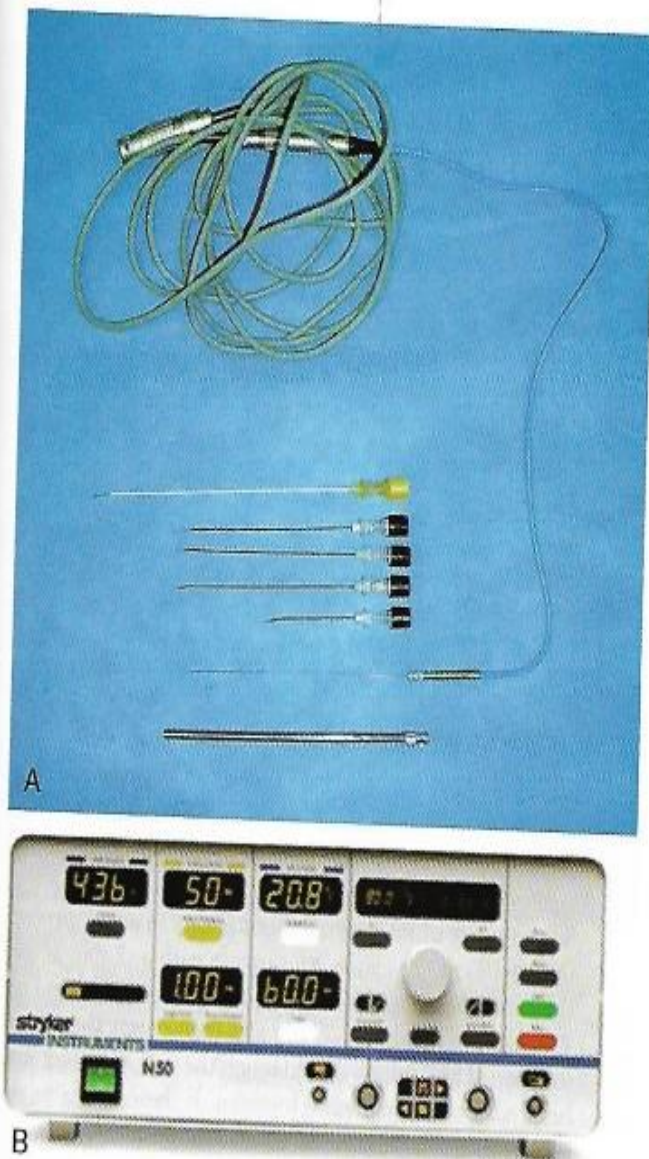


Figure 7-6

A, Curved (top) and straight (bottom) SMK cannulas (Integra Radionics, Burlington, MA). B, N50 RF lesion generator, connecting cable, and probes by Stryker Medical (Kalamazoo, MI).

6. Local anesthetic infiltration is performed with a 26-gauge, 1.5-inch needle just over the target point, the intervertebral foramen between the arch of the atlas and the lamina of the axis (Figs. 7-2 and 7-7).
7. With the use of intermittent fluoroscopy, a 5-cm (or 10-cm), 22-gauge, curved RF cannula with a 2-mm active tip is introduced directly to the target point by means of a tunnel vision technique.
8. The AP image is checked frequently to verify the depth of the cannula.
9. The cannula tip is inserted to the lateral border of the C2 pedicle as shown in the AP projection, and then sensory stimulation is started. Stimulation is started at 50 Hz, 0.7 V, and the cannula is carefully advanced farther until the stimulation threshold of less than 0.3 V is obtained. The cannula tip should not be advanced beyond the center of the C2 pedicle as shown in the AP projection.
10. If the electrical stimulation is not obtained properly after the placement of the cannula, 0.2-0.5 mL of contrast agent can be injected to confirm the location of the C2 DRG (Fig. 7-7).
11. PRFL is performed according to the following protocol: 42°C, 120 seconds, two to four times.

The C3-C8 DRGs

TARGET

The targets for DRG PRFL at C3 through C8 are as follows (Figs. 6-4 and 6-5):

- C3 to C7: Posteriorly in the foramen, at the division between the caudal and middle third as shown in an oblique projection and in the middle of the facet column as shown in an AP projection.
- C8: Posteriorly in the foramen, at the division between the upper and lower halves in an oblique projection and in the middle of the facet column in an AP projection.

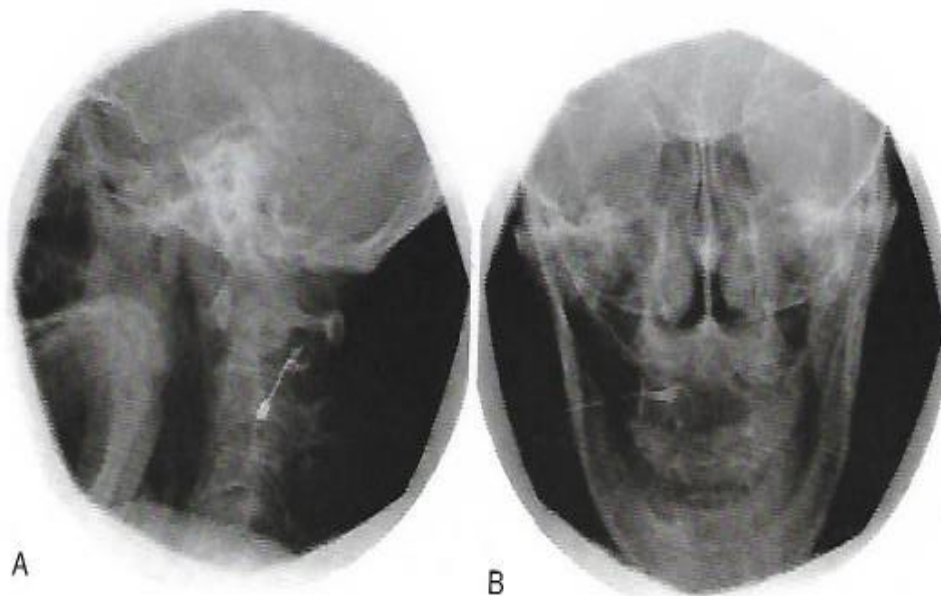


Figure 7-7

C2 dorsal root ganglion (DRG) pulsed radiofrequency lesioning. Note that the outline of the C2 DRG is clearly seen in the lateral radiographic image (A). In the anteroposterior radiograph (B), the cannula tip is located at the center of pedicle.

PROCEDURE

1. The patient's written informed consent is obtained.
2. The patient is placed in the supine position on a table with the head slightly extended. A grounding pad is needed and it is helpful to place a bolster beneath the shoulder.
3. The overlying skin is prepared and draped in a sterile fashion.
4. The C-arm is set in an AP projection to align the end plates parallel. Then the C-arm is rotated to the ipsilateral side by approximately 45 to 55 degrees to acquire the best view of the selected neural foramen. The skin entry point (red circle on Fig. 6-5) is identified and marked.
5. Under the C-arm guidance, infiltration of local anesthetics is performed with a 26-gauge, 1.5-inch needle at the skin entry site.
6. With the use of intermittent fluoroscopy, a 5-cm (or 10-cm), 22-gauge, curved RF cannula with a 2-mm active tip is introduced directly to the target point by means of a tunnel vision technique. Using a short cannula, when possible, provides better control.
7. First, the cannula is advanced to the superior articular process (Fig. 7-8A). After the cannula has entered the foramen, the RF probe is inserted, and 50 Hz, 0.7 V stimulation is started to evoke paresthesia while the cannula is advanced to the halfway point between the medial and lateral borders of the articular pillar according to the AP projection (Fig. 7-8B).
8. When the patient complains of paresthesia at 50 Hz, 0.7 V, the cannula is carefully advanced until the stimulation threshold of less than 0.3 V is obtained.
9. If the electrical stimulation is not obtained properly after the placement of the cannula, 0.2 to 0.5 mL of contrast agent can be injected to confirm the location of the cervical DRG.
10. PRFL is performed according to the following protocol: 42°C, 120 seconds, two to four times.

Thoracic Dorsal Root Ganglion Pulsed Radiofrequency Lesioning

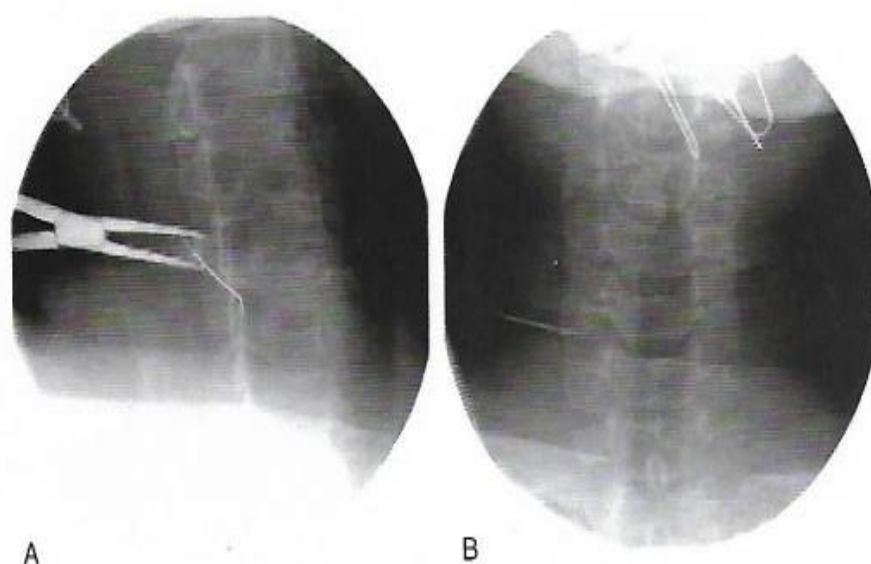
TARGETS

The targets for thoracic DRG PRFL are as follows (Table 7-1 and Figs. 7-3, 7-9 and 7-10)

- Craniodorsal quadrant of the intervertebral foramen in a lateral projection
- Just medial or just lateral portion of the intervertebral foramen in an AP projection

Procedure**AT T1 THROUGH T8**

1. The patient's written informed consent is obtained.
2. The patient is placed in the prone position.
3. An adhesive grounding pad is placed on the patient's posterior upper thigh (if the probe is not the self-grounded type).
4. The patient is draped with a sterile dressing.
5. The C-arm is aligned so that the vertebral end plates are parallel in an AP projection (Fig. 7-9).
6. Under the C-arm guidance, infiltration of local anesthetics is performed with a 26-gauge, 1.5-inch needle at the skin entry site (red squares on Fig. 7-9).
7. With the use of intermittent fluoroscopy in an AP projection, a 10-cm, 22-gauge, RF cannula with a 2-mm active tip is introduced to the target points (yellow x marks on Fig. 7-9; black arrow on Fig. 7-10) and then enters the neural foramen. The cannula should touch the yellow x mark just before it enters the neural foramen. If the cannula angle is too steep, pneumothorax can result; frequently checking the AP and lateral images and correcting the cannula direction are crucial in avoiding this complication.
8. When the cannula has entered the foramen, the direction of the cannula is turned to the anterior surface of the lamina, the RF probe is inserted, and stimulation at 50 Hz, 0.7 V is started to evoke paresthesia while

**Figure 7-8**

Pulsed radiofrequency lesioning of the C6 dorsal root ganglion. **A**, Oblique radiographic image showing the cannula is introduced directly to the target point, anterior border of the superior articular process. **B**, The anteroposterior image shows the cannula advancing to the middle of the facet column.

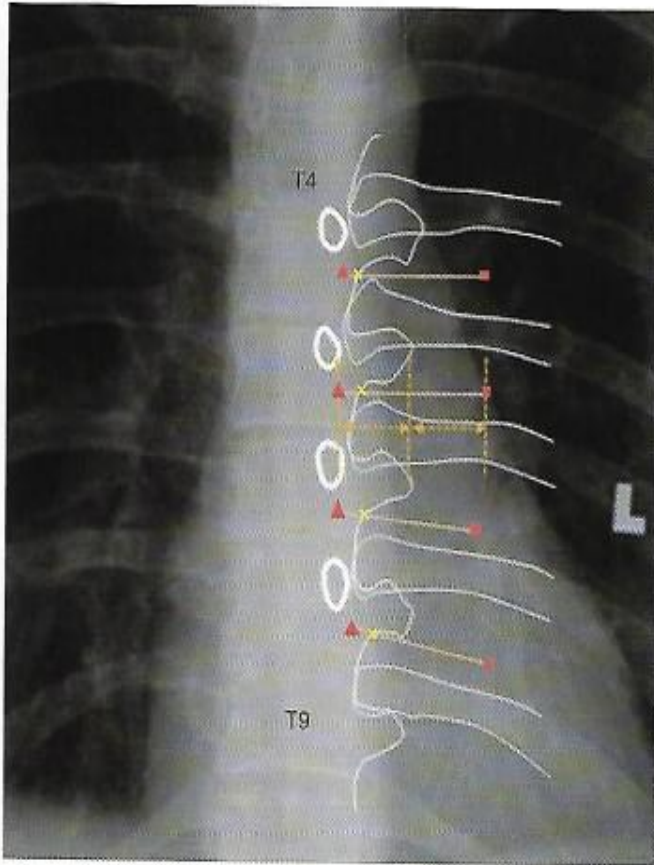


Figure 7-9

Skin entry point (red square), direction of cannula (pink line), and target (red triangle). The location of the skin entry point is 2 times the distance from the lateral margin of the pedicle to the lateral margin of the transverse process (about 3–5 cm from the tip of the spinous process). The imaginary line of the cannula direction should avoid any obstacles, transverse process, and rib. The yellow x mark should be touched by the cannula just before entrance into the neural foramen.

the cannula is advanced horizontally anterior to the anterior surface of the lamina in the AP projection until the stimulation threshold of less than 0.3 V is obtained (Fig. 7-11).

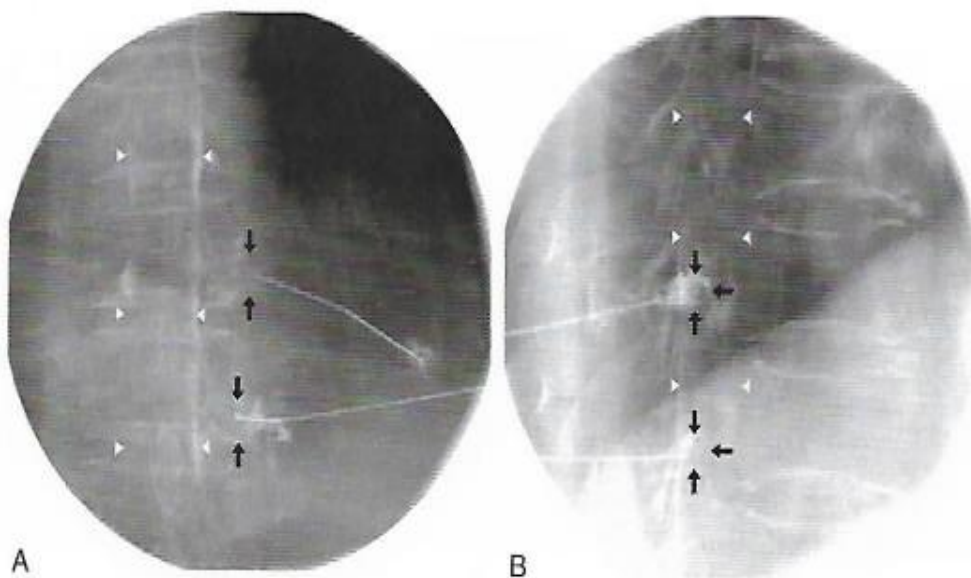


Figure 7-10

Anteroposterior (AP) (A) and lateral (B) intraoperative fluoroscopic images of the final position of the cannula tips for T7 and T8 dorsal root ganglion (DRG) pulsed radiofrequency lesioning. Black arrows indicate DRGs. White arrowheads indicate epidural spread of the contrast agent. Note that two 2.5-cm, curved cannulas are located at the centers of the DRGs in the AP image and just posterior to the surfaces of the DRGs.

9. If the electrical stimulation is not obtained properly after the placement of the cannula, 0.2 to 0.5 mL of contrast agent can be injected to confirm the location of the thoracic DRG (Figs. 7-10 and 7-12).
10. PRFL is performed according to the following protocol: 42°C, 120 seconds, two to four times.

AT T9 THROUGH T12

See Figure 7-13. At this level, the procedure is the same as that for lumbar DRG PRFL.

Lumbar Dorsal Root Ganglion Pulsed Radiofrequency Lesioning

The procedure of lumbar DRG PRFL is almost the same as lumbar Transforaminal Epidural Block (TFEB) (refer to Chapter 6).

Target

The targets for thoracic DRG PRFL are as follows (Fig. 7-14):

- "6 o'clock" position when the pedicle is regarded as a clock face in an oblique projection
- Craniodorsal quadrant of the intervertebral foramen in a lateral projection

Procedure

1. The patient's written informed consent is obtained.
2. The patient is placed in the prone position.
3. The patient is draped with a sterile dressing.
4. An adhesive grounding pad is placed on the patient's posterior upper thigh (if the probe is not self-grounded type). The C-arm is aligned to show the vertebral end plates parallel in an AP projection.
5. The C-arm is then turned 20 to 30 degrees obliquely until a "Scotty dog" appearance is noted.
6. The target is the "6 o'clock" position if the pedicle is regarded as a clock face (Fig. 7-14).

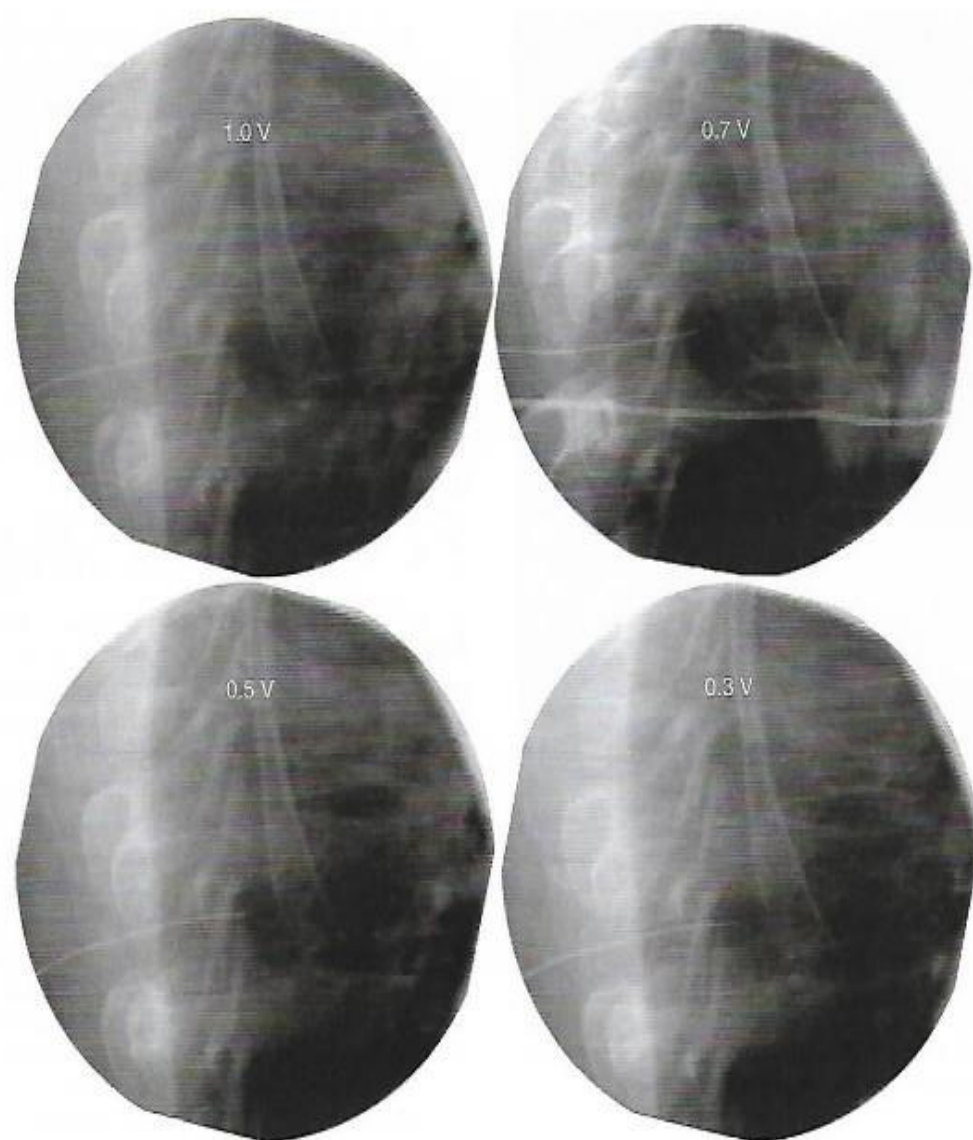


Figure 7-11

The relationship between the depth of the cannula and the intensity of stimulation at 50 Hz. If paresthesia is evoked at 50 Hz, 1.0 V, the advancement is performed slowly and carefully with step-by-step reduction of stimulation intensity to 0.3 V.

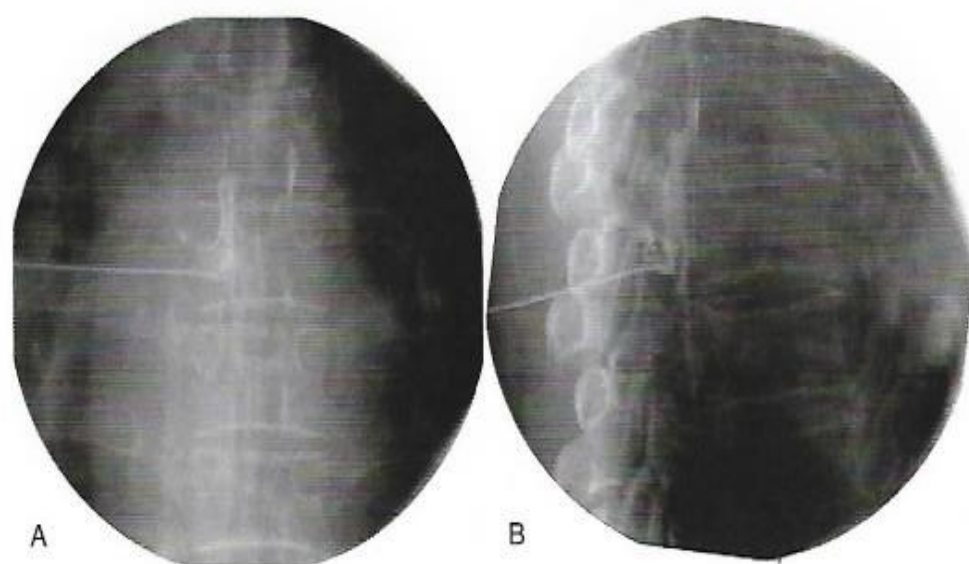


Figure 7-12

Anteroposterior (A) and lateral (B) images of T5 dorsal root ganglion pulsed radiofrequency lesioning. The cannula is located too low and therefore should be adjusted by being withdrawn and redirected slightly cephalad.

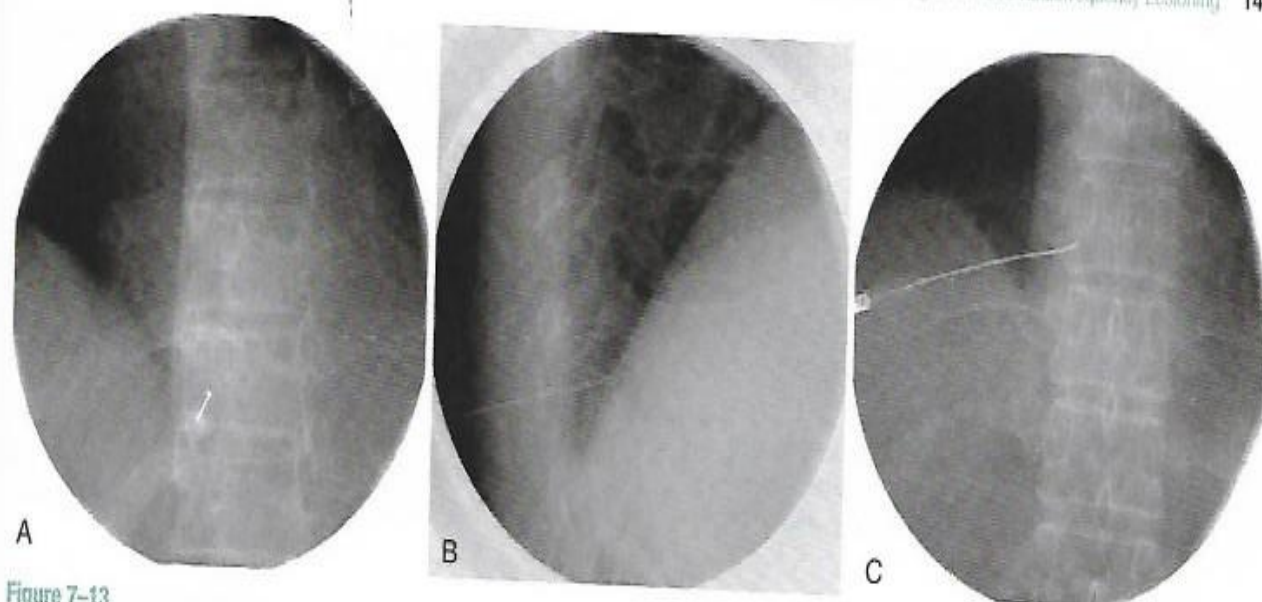


Figure 7-13

Pulsed radiofrequency lesioning of the T9 dorsal root ganglion. **A**, A 15-degree oblique C-arm image. A curved radiofrequency cannula is introduced directly to the target point, the concavity of the base of the transverse process. **B**, The cannula tip is projected over the craniodorsal quadrant of the intervertebral foramen in this lateral projection. **C**, Anteroposterior image from the C-arm. The cannula is located at the just medial portion of the intervertebral foramen.

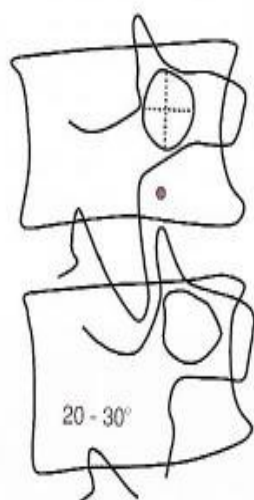


Figure 7-14

Target point (red dot) of lumbar dorsal root ganglion pulsed radiofrequency lesioning.

7. Under the C-arm guidance, infiltration of local anesthetics is performed with a 26-gauge, 1.5-inch needle at the skin entry site (red dot on Fig. 7-14).
8. With use of intermittent fluoroscopy in an oblique projection, a 10-cm, 22-gauge, curved RF cannula with a 2-mm active tip is introduced directly to the target point. The cannula is projected lower in the pedicle and is advanced to the craniodorsal quadrant of the intervertebral foramen in a lateral projection (Fig. 7-15).
9. When the cannula has entered the neural foramen, the RF probe is inserted into the cannula, and 50 Hz, 0.7 V stimulation is given to evoke paresthesia while the cannula is advanced.
10. When the patient complains of paresthesia at 50 Hz, 0.7 V, the cannula is carefully advanced further until the stimulation threshold of less than 0.3 V is obtained.

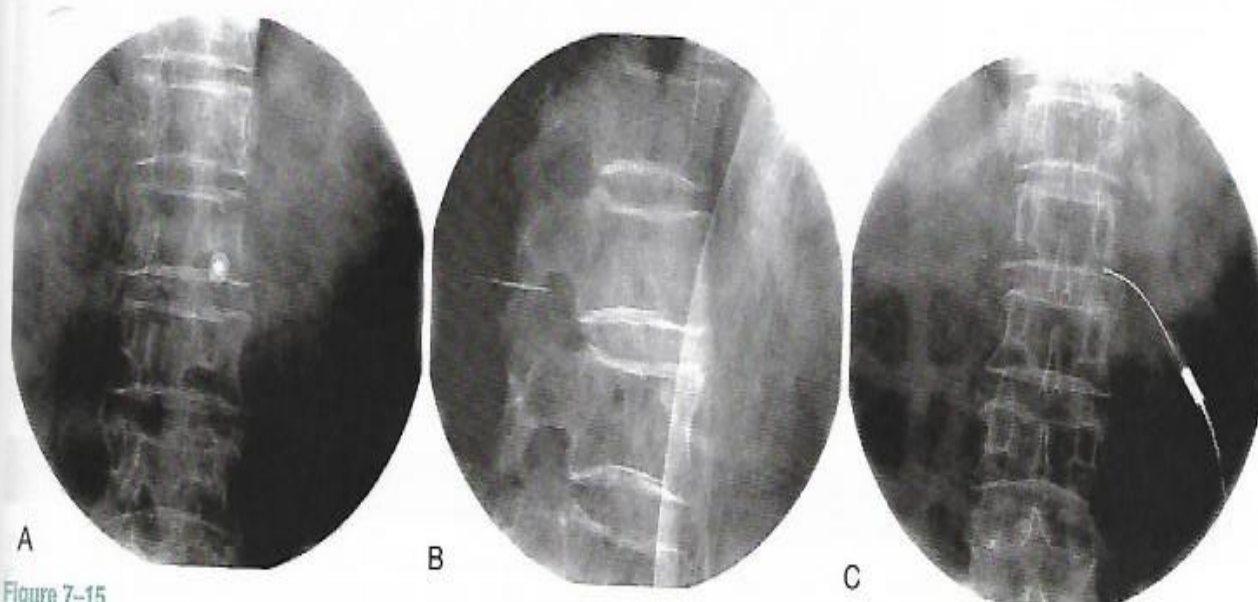


Figure 7-15

Pulsed radiofrequency lesioning of the L2 dorsal root ganglion (DRG). **A**, The C-arm is rotated to a 30-degree oblique angle, toward the side being injected, which brings the "Scotty dog" appearance into view. **B**, On the lateral C-arm image, the cannula tip is projected over the craniodorsal quadrant of the intervertebral foramen. Contrast agent is spreading around the DRG. **C**, On the anteroposterior image, the cannula tip is located lower than the pedicle. This view shows the contrast agent outlining the epidural space and L2 nerve root.

11. If the electrical stimulation is not obtained properly after the placement of the cannula, 0.3–0.5 mL of contrast agent can be injected to confirm the location of the thoracic DRG.
12. PRFL is performed according to the following protocol: 42°C, 120 seconds, two to four times.

Sacral Nerve Pulsed Radiofrequency Lesioning

Although the sacral DRGs are located in intraspinal regions more cephalad than the neural foramina, sacral DRG PRFL can be performed without use of the burr hole technique. A curved-needle technique makes it possible to obtain a more adjacent positioning of the electrode for the DRG procedure, and PRFL allows

the surgeon to perform a neuromodulation in a more peripheral position [22]. The cannula depth for sacral nerve PRFL, which is the center of the sacral body, is somewhat deeper than the depth required for selective nerve root block, which is 1 to 2 mm anterior to the posterior surface of the sacral body.

POSTPROCEDURAL MANAGEMENT

- No bed rest is needed unless the patient has been sedated.
- Most patients can be discharged on the day of the surgery.
- Before discharge, the patient should understand that postprocedural pain may persist for 1 to 2 weeks and that the response to treatment may be delayed for up to 1 month.

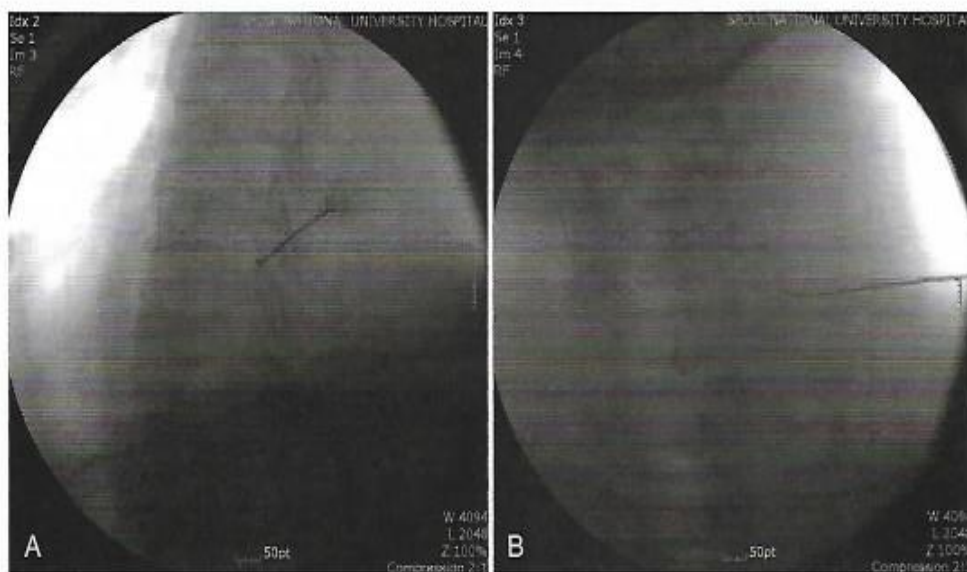
CASE STUDY 7.1

A 65-year-old man presented with left shoulder and arm pain involving the C6 dermatome secondary to left-sided herniated nucleus pulposus. Electromyography and nerve conduction velocity testing revealed chronic left C6 radiculopathy. His pain was not relieved by oral medications, which consisted of 600 mg gabapentin PO tid, 10 mg OxyContin PO bid, and 10 mg amitriptyline PO at bedtime. A series of left C6 transforaminal epidural blocks (TFEBs) with local anesthetic and 40 mg of triamcinolone showed only transient pain relief. After failure of these standard treatments, a left C6 DRG PRFL was performed under fluoroscopic guidance (Fig. 7-16).

With the patient in the supine position, a 5-cm, 22-gauge, curved RF cannula with a 2-mm active tip was introduced directly to the anterior border of the superior articular process via a left anterolateral approach (Fig. 7-16A). When the cannula touched the superior articular process, the cannula tip was rotated to the anterior direction of the vertebral body. Then, the cannula was carefully advanced, searching for the DRG with stimulation of 50 Hz. When the stimulation threshold below 0.3 V was obtained, PRFL was performed with three repetitions at 42°C for 120 seconds (Fig. 7-16B). After the procedure, the patient's pain was decreased enough for him to execute his daily activities.

Figure 7-16

A, An anterolateral oblique fluoroscopic view at the left C6 neural foramen. The size of the neural foramen is the largest in this oblique projection. The curved radiofrequency cannula is shown with the tip at the anterior border of the superior articular process. **B**, Anteroposterior image shows the cannula advancing to the lateral one third of the facet column, where the stimulation threshold was obtained below 0.3 V.



CASE STUDY 7.2

A 57-year-old woman was referred with a 1-year history of constant axial back pain and radiating pain to the left anterior thigh at the L2 and L3 dermatomes. Her pain was a continuous, deep aching with intermittent lancinating and stinging pain with allodynia and hypesthesia. She had tried various treatments without success. She had received medications including opioids, physical treatments, repetitive

epidural blocks, selective TFEBs, trigger point injections, and so on. Because these treatments failed to provide pain relief, left L2 and L3 DRG PRFL was performed under fluoroscopic guidance.

With the patient in the prone position, curved RF cannulas were introduced to the target sites below the L2 and L3 pedicles using an anterolateral oblique C-arm view for guidance (Fig. 7-17). When the

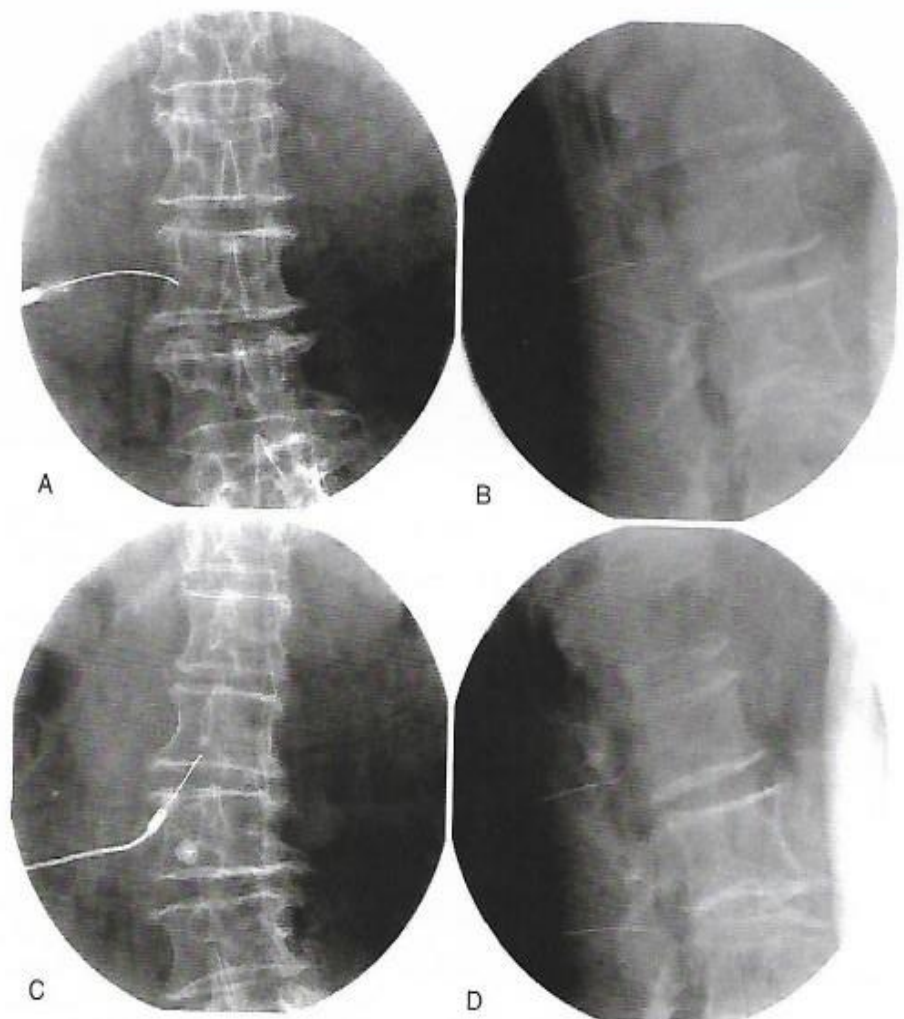


Figure 7-17

Left L2 and L3 dorsal root ganglion (DRG) pulsed radiofrequency lesioning in an anteroposterior (A), lateral (B), and oblique images (C). Another left L3 pulsed radiofrequency lesioning in lateral view (D).

cannula tips began to enter the neural foramina in the lateral projection, the stylets were replaced with RF probes. Then, the cannulas were carefully advanced, searching for the DRGs with stimulation at 50 Hz. When a stimulation threshold below 0.3 V was obtained, PRFL was performed (42° C, 120 seconds, three times at each level).

After the procedure, the patient's pain was moderately decreased. Her visual analog scale score decreased from a preoperative value of 9/10 to 5/10.

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Chapter 8

MEDIAL BRANCH BLOCK AND RADIOFREQUENCY LESIONING

Yong-Chul Kim, MD, PhD

Medial branch block (MBB) and radiofrequency lesioning yield good results both after failure of conservative treatment in patients with mechanical back pain and in patients with failed back surgery syndrome. The complications of these procedures are usually minor and transient, and the complication rates are low.

TREATMENT OBJECTIVES

Medial Branch Block

The treatment objectives are to diagnose and treat facet joint syndrome. Facet joints are one of the most common sources of back pain. Facet joint syndrome cannot be diagnosed clinically or radiographically but can be identified with MBB or facet joint injection [1–5]. A series (3–5 times) of local anesthetic injections with or without corticosteroids sometimes achieves long-term relief of back pain.

Radiofrequency Neuromodulation (Pulsed Radiofrequency Lesioning) or Neuroablation (Radiofrequency Thermocoagulation) of the Medial Branch

The treatment objective of radiofrequency lesioning is to treat facet joint syndrome. This procedure offers pain relief by modulating (pulsed radiofrequency lesioning [PRFL]) or denaturing (radiofrequency thermocoagulation [RFTC]) medial branches that innervate the painful facet joints. The typical durations of pain relief experienced after such procedures are as follows [6]:

- Initial radiofrequency procedure: 223–730 days
- Repeat radiofrequency procedure: 144–478 days

PREOPERATIVE PREPARATION

History Taking and Physical Examination

The symptoms and signs that should be sought during history taking and on physical examination include the following:

- Pain aggravation on hyperextension and rotation of spine and alleviation on spine flexion
- Local deep tenderness over the facet joint(s)
- Limitation of motion
- Referred pain (Figs. 8-6 to 8-9)

Imaging Diagnosis

The following imaging modalities are used to identify surgical candidates:

- Plain radiography (Fig. 8-1)
- Bone scanning (Fig. 8-2)
- Computed tomography (CT) (Fig. 8-3)
- Magnetic resonance imaging (MRI) (Figs. 8-4 and 8-5)

INDICATIONS

Medial Branch Block

Indications for MBB in the cervical spine include the following:

- Local tenderness over the cervical facet joints
- Pain aggravation upon hyperextension or rotation of the neck
- Referred pain (Fig. 8-6)
- Decrease in or absence of cervical mobility
- No objective neurologic signs
- Radiologic signs of facet osteoarthritis

Indications for MBB in the thoracic spine include the following:

- Paravertebral pain and tenderness over the thoracic facet joints
- Referred pain (Figs. 8-7 and 8-8)
- Pain aggravation on hyperextension and rotation and in the sitting position
- No objective neurologic signs
- Radiologic signs such as severe kyphoscoliosis, osteoporosis, vertebral compression fracture, and facet osteoarthritis

Indications for MBB in the lumbar spine include the following:

- Paravertebral pain and tenderness over the lumbar facet joints
- Referred pain (Fig. 8-9)
- Decrease or absence of mobility in the painful region of the back
- Pain aggravation on hyperextension and rotation and in the sitting position
- No objective neurologic signs
- Radiologic signs such as severe scoliosis, osteoporosis, vertebral compression fracture, and facet osteoarthritis



Figure 8-1

Radiographic findings in facet osteoarthritis. Note the foraminal stenosis due to the osteophyte from facet joint (arrow) in **A** and the facet joint space narrowing and subchondral sclerosis (yellow arrows) in **B**.

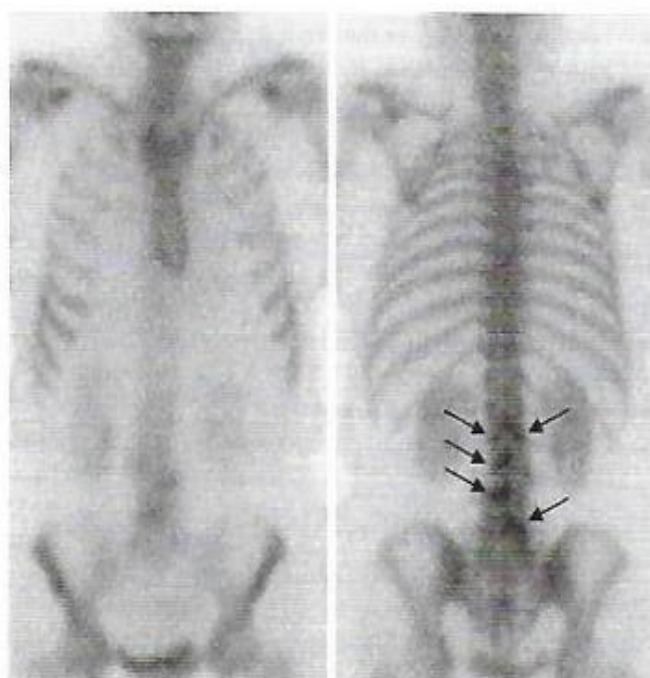


Figure 8-2

Bone scan findings in facet osteoarthritis. High radiotracer uptake can be seen at multiple facet joints (arrows) on the posterior image (right), whereas relatively low uptake is shown on the anterior image (left).

Pulsed Radiofrequency Lesioning or Radiofrequency Thermocoagulation of the Medial Branch

Indications for PRFL or RFTC in any area of the spine are as follows:



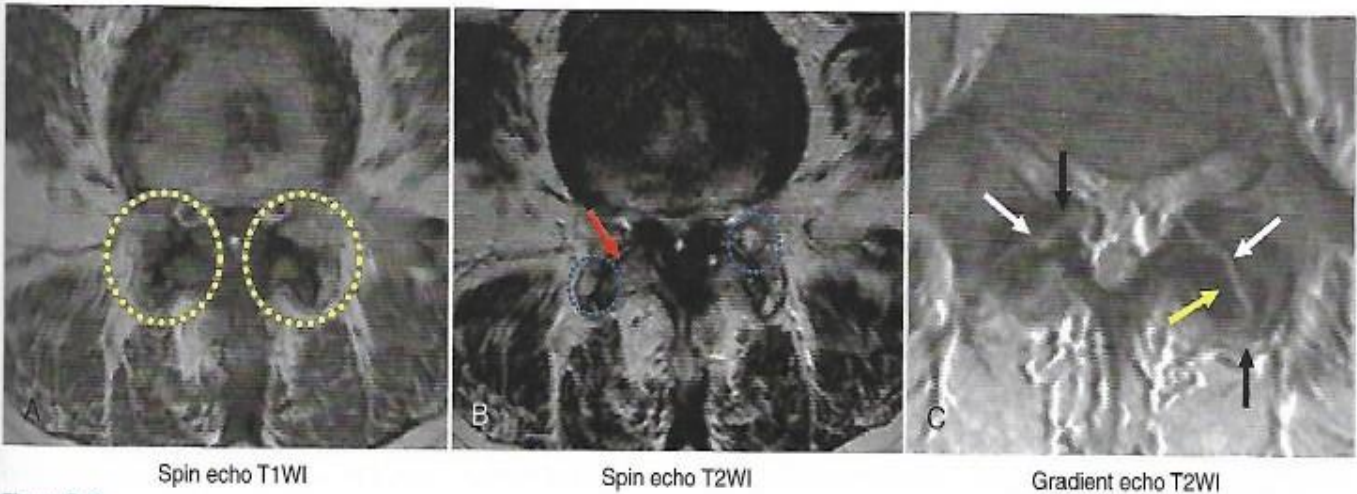
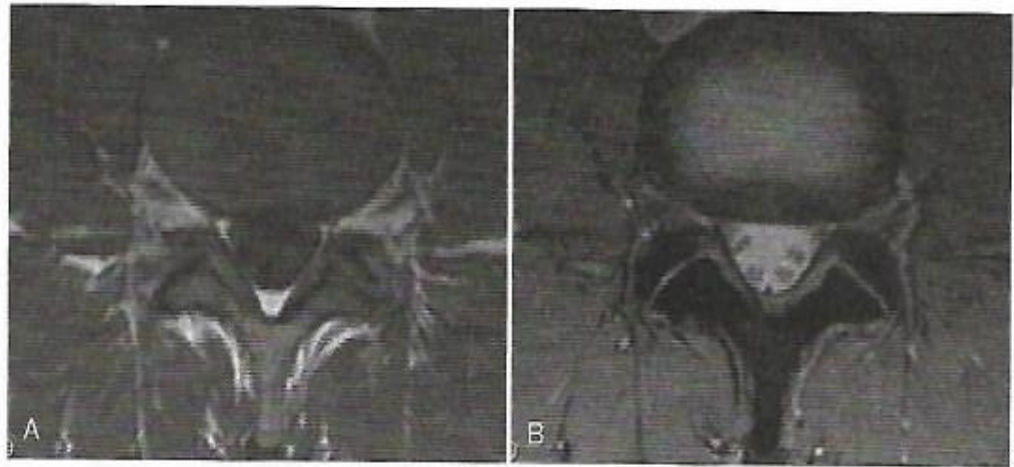
Figure 8-3

Computed tomography findings in facet osteoarthritis. Note the osteophyte (white arrows), vacuum change (red arrow), and subchondral sclerosis.

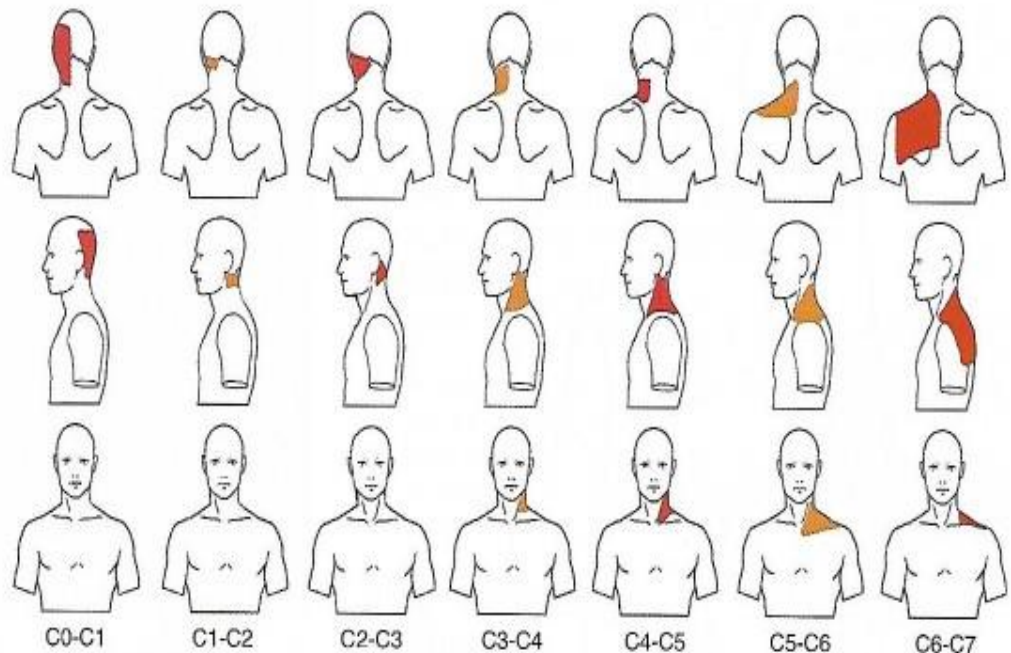
- Response to the diagnostic MBB is positive.
- A series of MBBs (3 to 5 times at 2-week intervals) with local anesthetics and steroids show significant relief of pain, but its effect does not persist more than 6 months.

Figure 8-4

Magnetic resonance imaging features of the facet joints. Note that the gradient-echo image (B) shows more detail of the facet joint structure than the spin-echo image (A).

**Figure 8-5**

Magnetic resonance imaging findings in facet osteoarthritis. **A**, Spin-echo T1-weighted image; **B**, spin-echo T2-weighted image; **C**, gradient-echo T2-weighted image. Note the geode appearance (yellow dotted circle), effusion (red arrow), subchondral cyst (blue dotted circle), joint space narrowing (white arrows), subchondral sclerosis (yellow arrow), and osteophyte (black arrows).

**Figure 8-6**

Patterns of pain (shaded areas) evoked by stimulation of the facet joints at segments C2-C3 to C6-C7. (Adapted from Dwyer A, Aprill C, Bogduk N: Cervical zygapophyseal joint pain patterns: I: A study in normal volunteers. Spine 1990;15:453-457.)

CONTRAINDICATIONS

Contraindications to MBB, PRFL, and RFTC are as follows:

- Patient's refusal
- Skin infection over the puncture site or systemic infection

- Coagulopathy (International Normalized Ratio [INR] value > 1.5 or platelet count < 50,000/mm³) or anticoagulant therapy

In terms of the third contraindication, if anticoagulant therapy can be suspended temporarily, the patient should stop taking the medication 3 to 7 days before the procedure

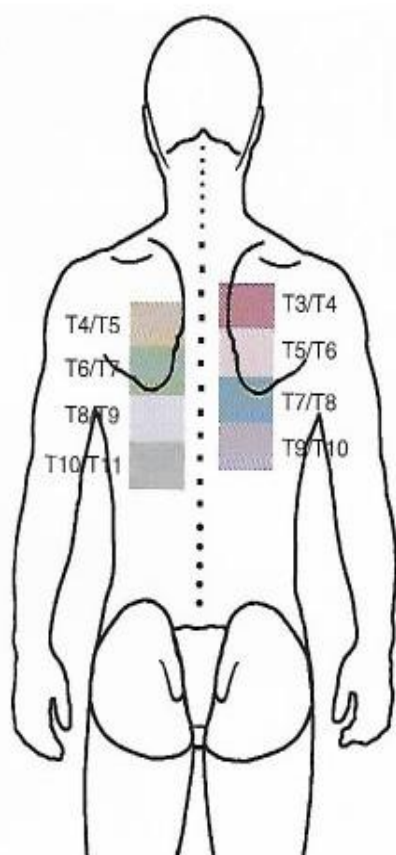


Figure 8-7

A composite map shows pain referral patterns from the T3-T4 to the T10-T11 thoracic facet joints. (Modified from Dreyfuss P, Tibiletti C, Dreyer S: Thoracic zygapophyseal joint pain patterns. *Spine* 1994;19:807-811.)

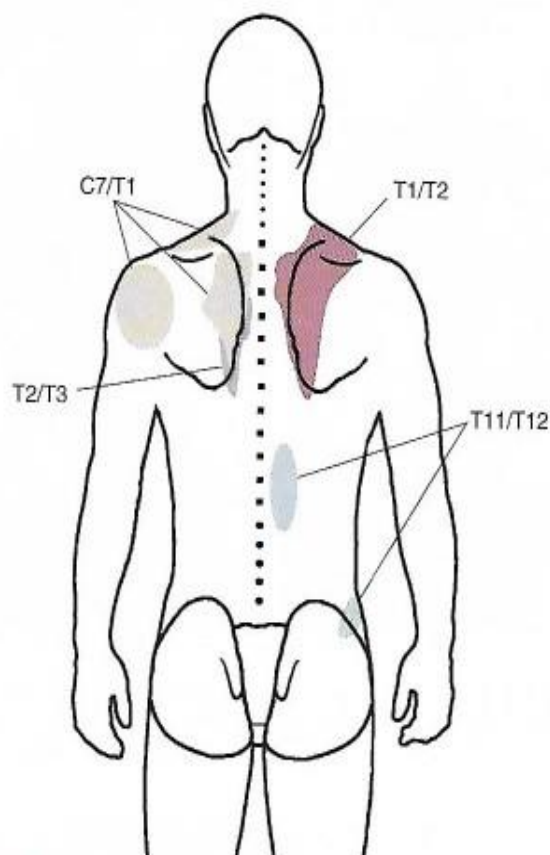


Figure 8-8

A composite map shows pain referral patterns at the C7-T1, T1-T2, T2-T3, and T11-T12 thoracic facet joints. (Modified from Fukui S, Ohseto K, Shiotani M: Patterns of pain induced by distending the thoracic zygapophyseal joints. *Reg Anesth* 1997;22:332-336.)

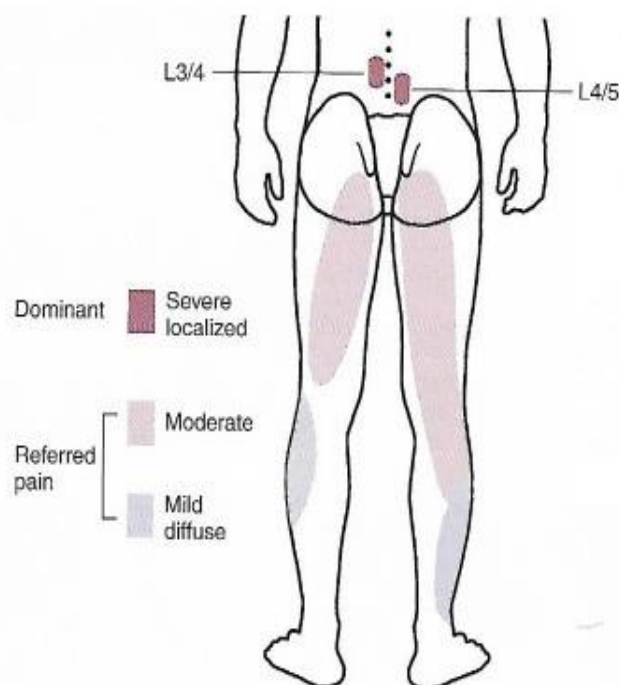


Figure 8-9

A schematic drawing shows the referred pain pattern for the lumbar facet joints. (Modified from Bous RA: Facet joint injections. In Stanton-Hicks M, Bous RA [eds]: *Chronic Low Back Pain*. New York, Raven, 1982, pp 199-211.)

and resume 3 to 7 days after it. In the patient in whom anti-coagulant therapy cannot be stopped temporarily and who is to undergo MBB, a 26-gauge block needle should be used and an ice pack should be applied for 10 minutes immediately after the procedure; in the patient undergoing RF lesioning, an ice pack should be applied for 10 minutes immediately after the procedure and a compression dressing should be used.

COMPLICATIONS

Medial Branch Block

Complications of MBB are usually minor and are resolved within a couple of days of the procedure; they include the following:

- Pain associated with the procedure
- Accidental spinal cord or nerve root injury, especially at the cervical region (Fig. 8-19)
- Infection
- Hematoma

Pulsed Radiofrequency Lesioning or Radiofrequency Thermocoagulation of the Medial Branch [7]

Complications of PFRL and RFTC are usually minor and are resolved in a short time (<1 month) after the procedure [7]. They include the following:

- Postprocedural pain usually lasting for 1-16 days
- Numbness or dysesthesia in the cutaneous territory of the coagulated nerves (in 42% of cases)
- Psoriatic rash at the skin puncture site (Köbner phenomenon) (8%)

- Failure to control pain (25%)
- Infection
- Hematoma
- Ataxia, especially at the third occipital nerve
- Accidental spinal cord or nerve root injury, especially at the cervical region
- Pneumothorax at thoracic region

ANATOMY

At each level, facet joint innervation is derived from the medial branch of the adjacent spinal nerve, as well as the medial branches located one level above and perhaps one level below. Figures 8-10 through 8-12 show facet joint innervation of the three regions of the spine.

INSTRUMENTS AND SOLUTIONS

Medial Branch Block

The instruments (Fig. 8-13) and solutions used in MBB are as follows:

- 26-gauge, 1.5-inch and 3.5-inch needles for skin infiltration
- 22-gauge, 3.5-inch spinal needle
- 1-mL, 2-mL, and 10-mL syringes

Solutions: 2% lidocaine or 0.5% levobupivacaine (Chirocaine), water-soluble contrast agent with or without steroids.

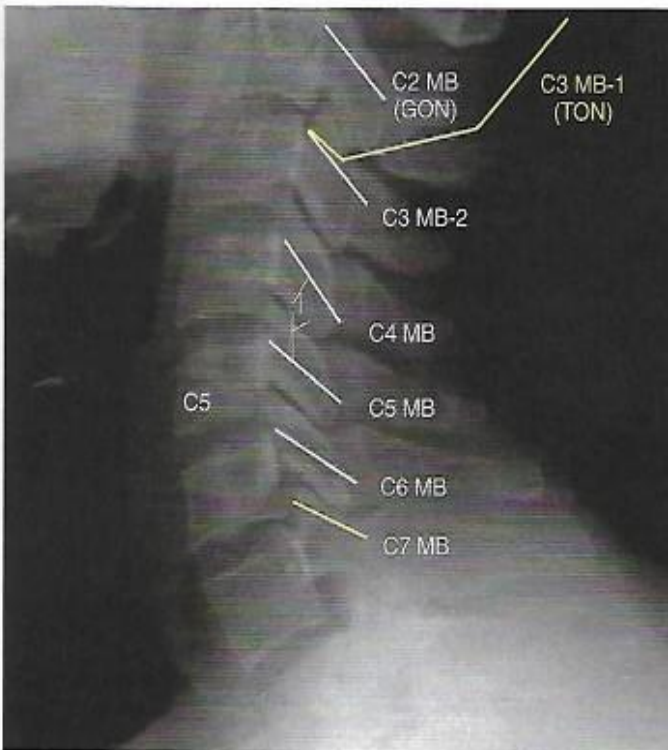


Figure 8-10

Lateral radiograph of the cervical dorsal rami. The third occipital nerve (TON) crosses the inferior pole of the C2-C3 zygapophyseal joint, running close to the C3 deep medial branch (C3 MB-2). The C4 through C6 medial branches course around the waists of the articular pillars. The C7 medial branch crosses the root of the C7 transverse process and therefore lies higher on the lateral projection of the C7 articular pillar. GON, greater occipital nerve.

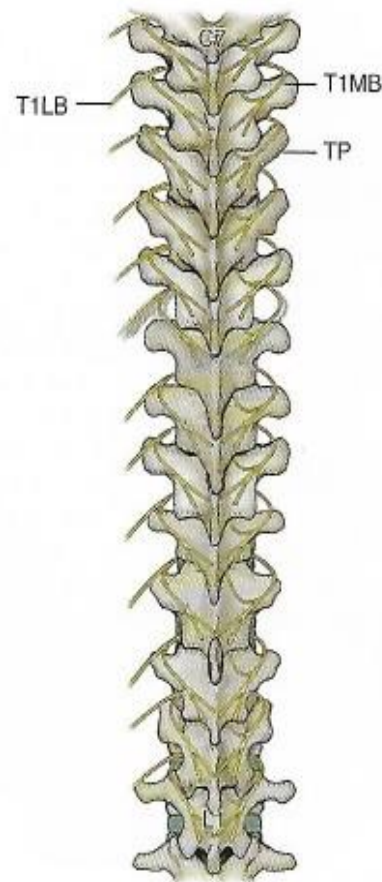


Figure 8-11

An illustration of the medial branches of the thoracic dorsal rami viewed from behind. T1 through T4, T9, and T10 medial branches typically cross the superolateral corners of the transverse processes. T5 through T8 medial branches show an atypical course that sometimes appears to be suspended in the intertransverse space. T11 and T12 medial branches assume a course analogous to that of the lumbar medial branches, crossing the junction of the superior articular process and the base of the transverse process. C7, seventh cervical vertebra; L1, first lumbar vertebra; LB, lateral branch; MB, medial branch; TP, transverse process. (Modified from Chua WH, Bogduk N: *The surgical anatomy of thoracic facet denervation*. *Acta Neurochir [Wien]* 1995;136:140-144.)

Pulsed Radiofrequency Lesioning or Radiofrequency Thermocoagulation of the Medial Branch

The following instruments and solutions are used in PRFL and RFTC:

- A radiofrequency lesion generator, a connecting cable, and a probe (Fig. 8-14)
- Radiofrequency cannulas: curved or straight (Fig. 8-15)
- 26-gauge, 1.5-inch and 3.5-inch skin infiltration needles
- Local anesthetics

BASIC MECHANISMS OF RADIOFREQUENCY LESIONING

Figure 8-16 illustrates the difference in lesioning between PRFL and RFTC. RFTC cannot produce a lesion distal to cannula tip, as PRFL does. Instead, RFTC produces lesions only circumferentially around the shaft of the uninsulated active tip; the RFTC cannula must lie parallel to and within 2 mm of the target nerve.

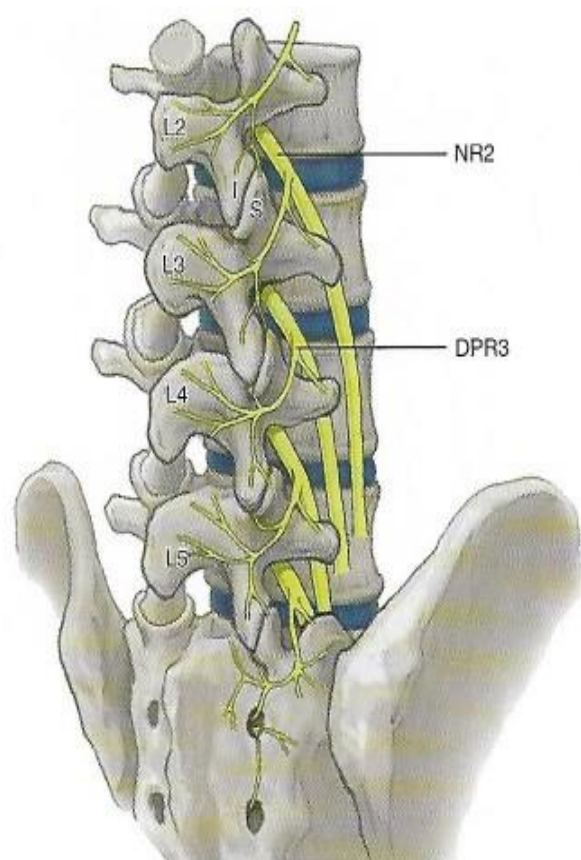


Figure 8-12

An illustration of the right posterior oblique view of the lumbar spine from L2 to L5. Each of the L1 through L4 medial branches crosses the junction of the superior articular process (S) and the base of the transverse process. The L5 dorsal rami cross the junction of the superior articular processes and the ala of the sacrum. DPR3, L3 dorsal primary ramus; I, inferior articular process; NR2, L2 nerve root.



Figure 8-13

Instruments for medial branch block. Contrast agent is prepared in a 2-mL syringe with an extension tube. To avoid false-negative results of this block due to inadvertent vascular injection, continuous fluoroscopic guidance is applied during the injection of 0.2 mL of a contrast agent at each cervical segment.

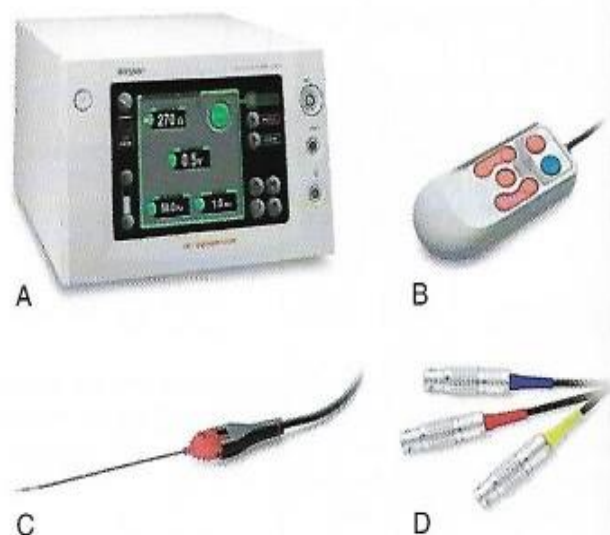


Figure 8-14

The RF Generator (A), along with its hand controller (B), self-grounded NITRODE cannula and probe (C), and connecting cables (D), manufactured by Stryker Instruments, (Kalamazoo, MI). Product images from Stryker website, www.stryker.com.

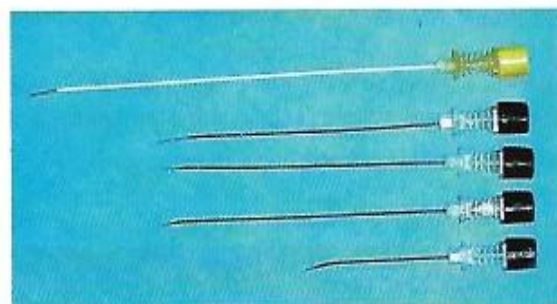


Figure 8-15

Curved and straight SMK cannulas (Integra Radionics, Burlington, MA). For cervical lesioning, a 5-cm SMK cannula is needed, whereas for thoracic or lumbar lesioning, a 10-cm (sometimes a 15-cm) SMK cannula is necessary.

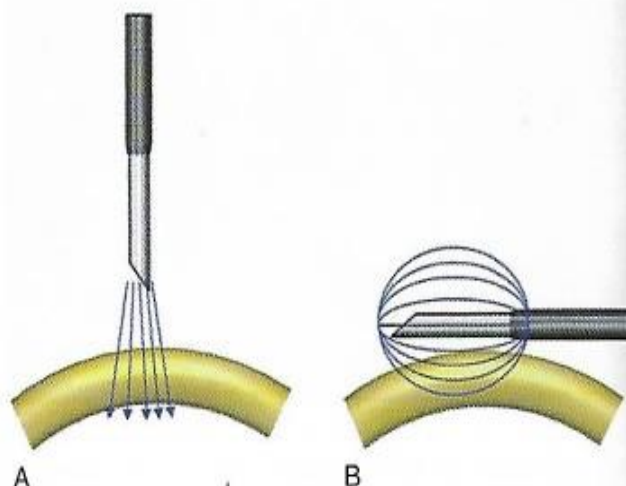


Figure 8-16

The electric field in relation to the type of radiofrequency lesioning. A, In pulsed radiofrequency lesioning, strong electric fields emanate from the active tip of the cannula. B, Radiofrequency thermocoagulation occurs along the shaft of the cannula.

Radiofrequency Lesioning

For radiofrequency lesioning of cervical medial branches, PRFL is preferred over RFTC, which is associated with serious complications such as ataxia.

RADIOFREQUENCY THERMOCOAGULATION

The following principles apply to RFTC:

- Impedance should be checked before lesioning and should register less than 500 ohms; if the impedance is greater than 500 ohms, the probe should be removed, 0.5 mL of local anesthetics should be injected, and the probe should be re-inserted.
- After injection of 0.5 mL of local anesthetics, a lesion is made by raising the temperature of the cannula tip to 80°C for 90 seconds. Thereafter, the curved tip of the cannula is rotated cephalad and caudad by rotation of the cannula hub, and second and third lesions are made using the same parameters (Figs. 8-19 and 8-21 for the cervical spine; Fig. 8-25 for the thoracic spine; and Fig. 8-27 for the lumbar spine).
- After RFTC, 5 mg of triamcinolone per segment is injected through the cannula for relief of postprocedural pain attributable to the trauma of the cannula insertion and the thermal lesion around the target nerve.

PULSED RADIOFREQUENCY LESIONING

PRFL is performed with the following parameters: 42°C, 120 seconds, 2 to 4 times. The following principles apply:

- Impedance should be checked before lesioning and should register less than 500 ohms; if the impedance is greater than 500 ohms, the probe should be taken out, 1 mL of normal saline should be injected, and the probe should be re-inserted.
- Steroid injection after the procedure is not mandatory.

PROCEDURE

Technical problems of the radiofrequency procedure may affect its efficacy. For accurate placement of the cannula, it is usually preferable to perform motor stimulation of the medial branch with 2 Hz and less than 0.5 V, followed by

radiofrequency lesioning with the rotating curved needle technique (Figs. 8-19, 8-21, and 8-25).

Care must be taken, during injection of local anesthetics as well as during removal and re-insertion of the probe before radiofrequency lesioning, to avoid displacement of cannula, which can easily occur. Tandem placement of another block needle for injection of local anesthetics near the radiofrequency cannula has been suggested as an alternative method to avoid cannula displacement during the manipulation of the probe (Fig. 8-17).

If paravertebral rhythmic contractions cannot be elicited despite repeated attempts at motor stimulation, lesioning of a broader area can be performed on the basis of the radiographic anatomy. For PRFL based on the radiographic anatomy, the cannula tip is usually located 2 to 3 mm behind the cannula tip position for RFTC, because the PRFL lesion is made from the tip of the cannula (Fig. 8-16).

If radiofrequency lesioning does not achieve significant pain relief even if the corresponding diagnostic MBB resulted in effective pain relief, radiofrequency lesioning should be repeated 1 month after the initial procedure.

If motor stimulation yields any of the following abnormal findings, RFTC should not be performed:

- Cervical area: contractions occur in the face and upper extremities
- Thoracic area: contractions occur in the segmental intercostal muscle
- Lumbar area: contractions occur in the buttock and lower extremities

Procedures at the Cervical Level

The most commonly involved facet joints in patients with whiplash injury are the C2-C3 and C5-C6 facet joints [2].

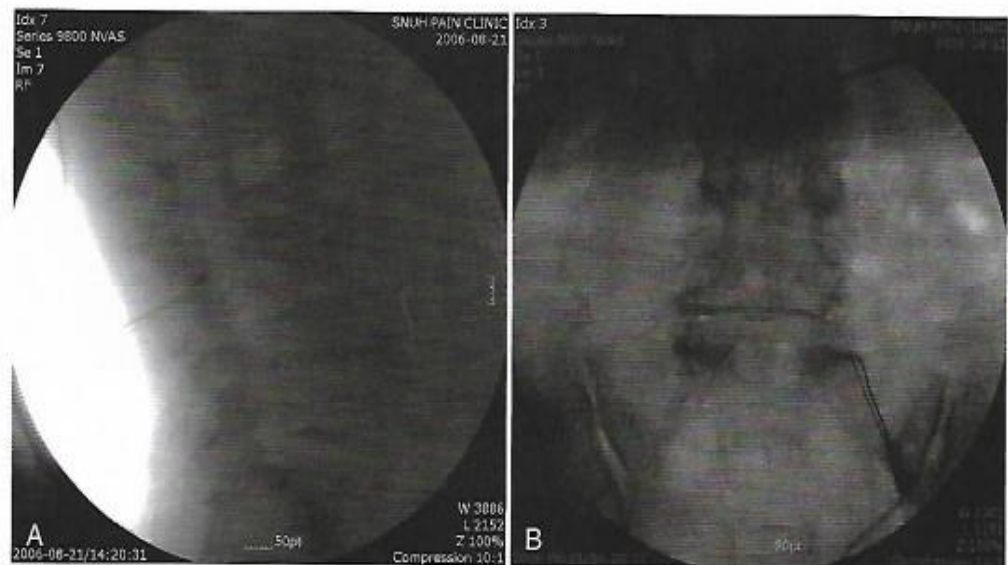
Third Occipital Nerve and Medial Branch Blocks

Target medial branches for third occipital nerve and medial branch blocks are as follows:

- For upper neck pain (usually C2-C3 through C4-C5 joint problems): third occipital nerve, C3 to C5 medial branches
- For lower neck or upper back pain (usually C4-C5 through C6-C7 joint problems): C4 through C7 medial branches

Figure 8-17

Tandem placement of block needles along with the radiofrequency cannula at L3-L4 medial branch on lateral view (A) and at left L5-S1 medial branch on AP view (B).



The procedure for third occipital nerve block or MBB is as follows:

1. The patient's written informed consent is obtained.
2. The patient is placed in the lateral position with the cervical and upper thoracic spinous processes aligned. The area of skin at the target points is prepared and draped in a sterile fashion.
3. With the fluoroscope, the bilateral articular pillars are superimposed in a lateral projection.
4. Infiltration of local anesthetics is performed with a 26-gauge, 1.5-inch needle just over the target points (Fig. 8-18).
5. With the use of intermittent fluoroscopic guidance, a 23-gauge, 1.5-inch (sometimes 3.5-inch) needle is introduced directly to the target point, the centroid of the projection of the articular pillar, by means of the tunnel vision technique, until contact is made with the bone.
6. AP and lateral C-arm images are checked and recorded to verify the final position of the needle tip.
7. After correct placement of the needle is confirmed by administration of 0.2 mL of a contrast agent, 0.5 mL of local anesthetic (2% lidocaine or 0.5% levobupivacaine) is injected with or without corticosteroids.

Pulsed Radiofrequency Lesioning or Radiofrequency Thermocoagulation of the Medial Branch

AT THE THIRD OCCIPITAL NERVE

The procedure for PRFL or RFTC at the third occipital nerve is as follows:

1. The patient's written informed consent is obtained.
2. The patient is placed in the lateral position with the cervical and upper thoracic spinous processes aligned. The area of skin at the target points is prepared and draped in a sterile fashion. An adhesive grounding pad is placed on



Figure 8-18

The target points for a third occipital block (white circle) and medial branch blocks (red circles) in a lateral projection obtained with the C-arm. The bilateral articular pillars are superimposed.

the patient's posterior upper arm if the probe is not self-grounded.

3. With the fluoroscope, the bilateral articular pillars are superimposed in a lateral projection (Fig. 8-18).
4. Infiltration of local anesthetics is performed with a 26-gauge, 1.5-inch needle at the skin entry site (Fig. 8-18).
5. With use of intermittent fluoroscopic guidance, a 5-cm (sometimes 10-cm) cannula with a 5-mm active tip is introduced toward the midline of the C2-C3 facet line until contact is made with bone. Thereafter the cannula is carefully advanced to the anterior surface of the facet column while remaining in contact with the bone. The cannula should not be advanced beyond the anterior margin of the facet column.
6. AP and lateral C-arm images are checked and recorded to verify the final position of the cannula tip.
7. The first lesion is made at this site by means of the rotating curved needle technique (Figs. 8-19 and 8-20). The second lesion is made with the same needle technique after the cannula is withdrawn about 5 mm from the first lesion site (Fig. 8-20).

Motor and sensory stimulations are not mandatory.

AT THE C3-C4 THROUGH C7-T1 FACET JOINTS

The procedure for PRFL or RFTC at the C3-C4 through C7-T1 facet joints is as follows:

1. The patient's written informed consent is obtained.
2. The patient is placed in the lateral position with the cervical and upper thoracic spinous processes aligned. The area of skin at the target points is prepared and draped in a sterile fashion. An adhesive grounding pad is placed on the patient's posterior upper arm if the probe is not self-grounded.
3. With the fluoroscope, the bilateral articular pillars are superimposed in a lateral projection (Figs. 8-21 to 8-23).
4. With C-arm guidance, infiltration of local anesthetics is performed with a 22-gauge, 1.5-inch needle at the skin entry site (Fig. 8-21).

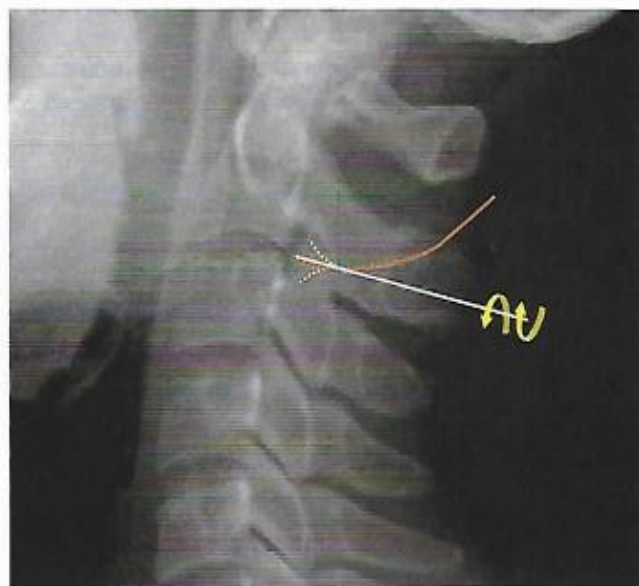


Figure 8-19

Radiofrequency lesioning of the third occipital nerve with the rotating curved needle technique. The white line indicates the radiofrequency cannula and the yellow dotted lines indicate the tip positions of the curved cannula when it is rotated cephalad or caudad (arrows). With the rotating curved needle technique, a large lesion can be obtained easily within few minutes.

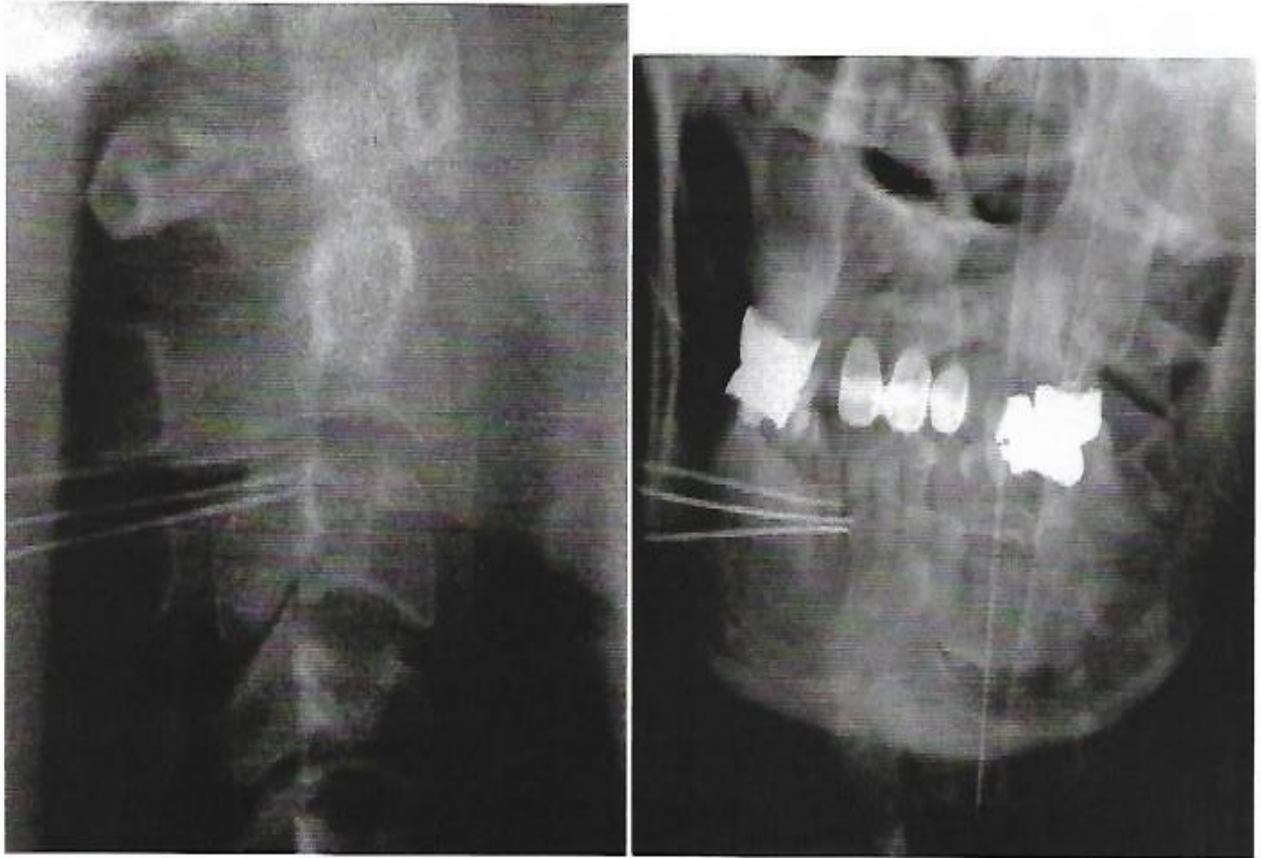


Figure 8-20

Multiple-needle technique using straight cannulas. The multiple-needle technique is an alternative to the rotating curved needle technique.

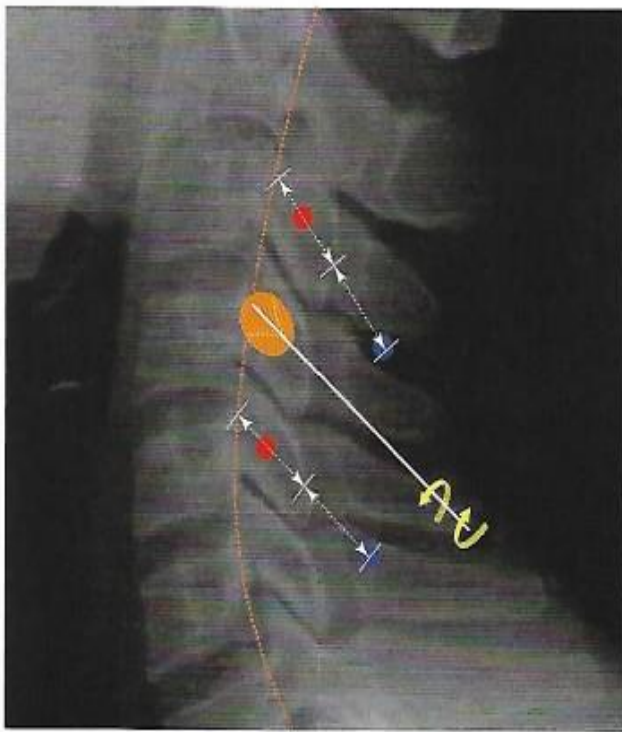


Figure 8-21

The placement of a cannula along a sagittal path. By means of the rotating curved needle technique, a large lesion (*orange translucent oval circle*) can be obtained easily within a few minutes. The cannula should not be advanced beyond the anterior margin of the facet column (*orange dotted line*). The *red circle* indicates the bone contact site, where nerve stimulation is commenced; the *blue circle* shows the skin entry site; the *white straight line* is the radiofrequency cannula; and the *yellow dotted curved lines* indicate the tip positions of the curved cannula when it is rotated cephalad or caudad (*curved arrows*).



Figure 8-22

Placement of the radiofrequency cannula at different cervical levels. The cannula is placed parallel to the upper and lower facet lines. At C3 through C6, the cannula (*white lines*) is placed midway between the upper and lower facet lines. At C7, the cannula (*yellow line*) should be located between upper and middle thirds of the C7 transverse process.

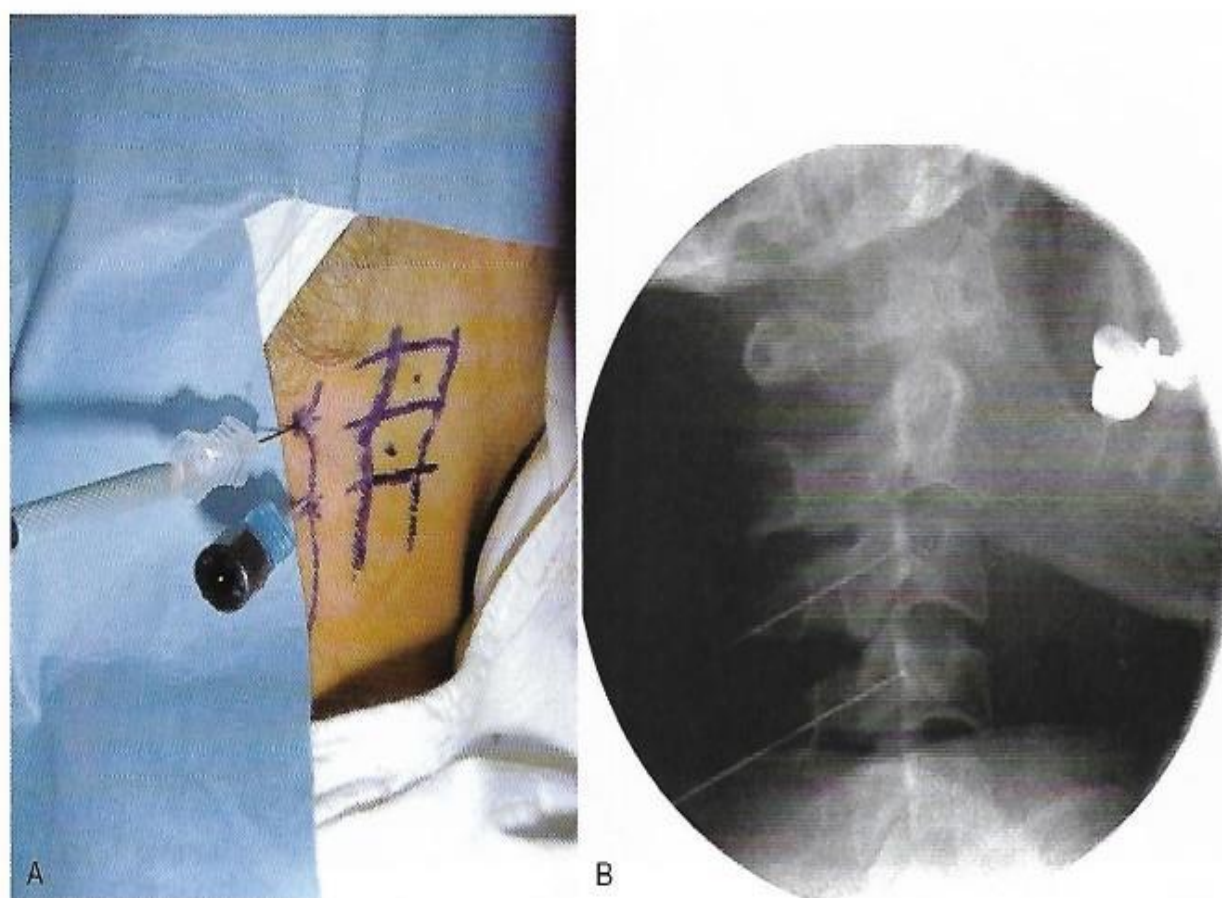


Figure 8-23

A, The area of skin at the target points is prepared and draped in a sterile fashion. **B**, Radiofrequency lesioning of the C3 and C4 medial branches is identified at lateral view.

5. With use of intermittent fluoroscopic guidance, a 5-cm (sometimes 10-cm) cannula with a 5-mm active tip is introduced to the centroid of the facet column (red circle on Fig. 8-21) until contact is made with the bone. The cannula is carefully advanced up to the anterior surface of the facet column while 2 Hz and less than 0.5 V of stimulation is administered and contact with the bone is maintained. The cannula should be stopped when contractions occur, even before the anterior margin of the facet column is reached.
6. AP and lateral images are checked to confirm the final position of the cannula tip.
7. Radiofrequency lesioning is performed with a rotating curved needle technique. The cannula should not be advanced beyond the anterior margin of facet column.

If paravertebral rhythmic contractions cannot be elicited despite repeated attempts at motor stimulation, lesioning of a broader area can be performed on the basis of the radiographic anatomy. The needle trajectories for different cervical levels are shown in Figures 8-22 and 8-23. Sensory stimulation is not mandatory.

Procedures at the Thoracic Region

In the thoracic region, MBB is recommended because facet joint injection is very difficult to approach.

Targets for MBB in the thoracic region are as follows:

- For T1 through T10 medial branches: superolateral corner of the transverse process
- For T11 and T12 medial branches: the junctions between the superior articular processes and transverse processes

Medial Branch Block

The procedure for MBB in the thoracic region is as follows:

1. The patient's written informed consent is obtained.
2. The patient is placed in the prone position. The area of skin at the target points is prepared and draped in a sterile fashion.
3. With the fluoroscope, the vertebral end plates are aligned parallel in an AP projection.
4. Under C-arm guidance, infiltration of local anesthetics is performed with a 26-gauge, 1.5-inch needle just over the target point (Fig. 8-24).
5. With intermittent fluoroscopic guidance, a 23-gauge, 1.5-inch (sometimes 3.5-inch) block needle is introduced directly toward the target point, 2 to 3 mm medial to the superolateral corner of the transverse process, by means of a tunnel vision technique, until contact is made with the bone.
6. AP and lateral C-arm images are checked and recorded to verify the final position of the needle tip.
7. After correct placement of the needle is confirmed by administration of 0.2 mL of a contrast agent, 0.5 mL of local anesthetic (e.g., 2% lidocaine or 0.5% levobupivacaine) is injected with or without steroids.

Pulsed Radiofrequency Lesioning or Radiofrequency Thermocoagulation of the Medial Branch

The procedure for PRFL or RFTC in the thoracic region is as follows:

1. The patient's written informed consent is obtained.
2. The patient is placed in the prone position. The area of skin at the target points is prepared and draped in a sterile

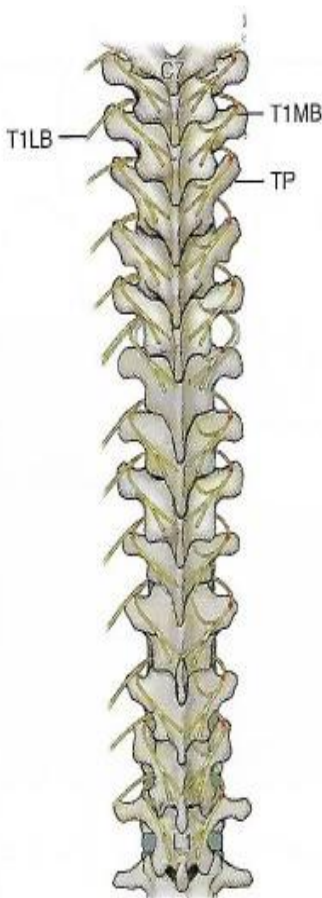


Figure 8-24

Target points (red circles) for local anesthetic infiltration and medial branch block. C7, seventh cervical vertebra; L1, first lumbar vertebra; LB, lateral branch; MB, medial branch; T1, first thoracic vertebra; TP, transverse process. (Modified from Chua WH, Bogduk N: *The surgical anatomy of thoracic facet denervation*. *Acta Neurochir [Wien]* 1995;136:140-144.)

fashion. An adhesive grounding pad is placed on the patient's posterior upper thigh if the probe is not self-grounded.

3. With the C-arm, the vertebral end plates are aligned parallel in an AP projection.
4. Under C-arm guidance, infiltration of local anesthetics is performed with a 26-gauge, 1.5-inch needle just over the skin entry site (Fig. 8-25)

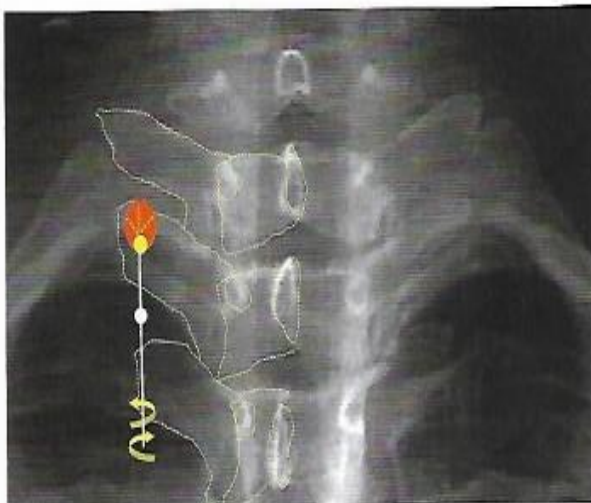


Figure 8-25

Placement of the radiofrequency cannula for T2 medial branch thermocoagulation. The white line indicates the cannula; yellow dotted curved lines indicate the tip positions of the curved cannula when it is rotated laterally or medially; the orange translucent oval circle indicates the lesion size; the white circle indicates the skin entry site; and the yellow circle indicates the bone contact site where nerve stimulation is commenced.

5. With intermittent fluoroscopic guidance, a 5-cm (sometimes 10-cm) cannula with a 5-mm active tip is introduced toward the target point (Fig. 8-25) by means of a tunnel vision technique until contact is made with the bone. The cannula is carefully advanced toward the superolateral corner of the transverse process while 2 Hz and less than 0.5 V stimulation is administered. The cannula should not be advanced past the point at which contractions occur, even if this is before the target point.
6. AP and lateral C-arm images are obtained to confirm placement of the cannula tip.
7. Radiofrequency lesioning should be performed with a rotating curved needle technique (Fig. 8-25). The cannula should not be advanced beyond the corner of the transverse process.

If paravertebral rhythmic contractions cannot be elicited despite repeated attempts at motor stimulation, lesioning of a broader area can be performed on the basis of the radiographic anatomy; sensory stimulation is not mandatory.

Procedures in the Lumbar Region

Medial Branch Block (L1-L4) or Dorsal Ramus Block (L5)

AT THE L1-L2 THROUGH L4-L5 FACET JOINTS

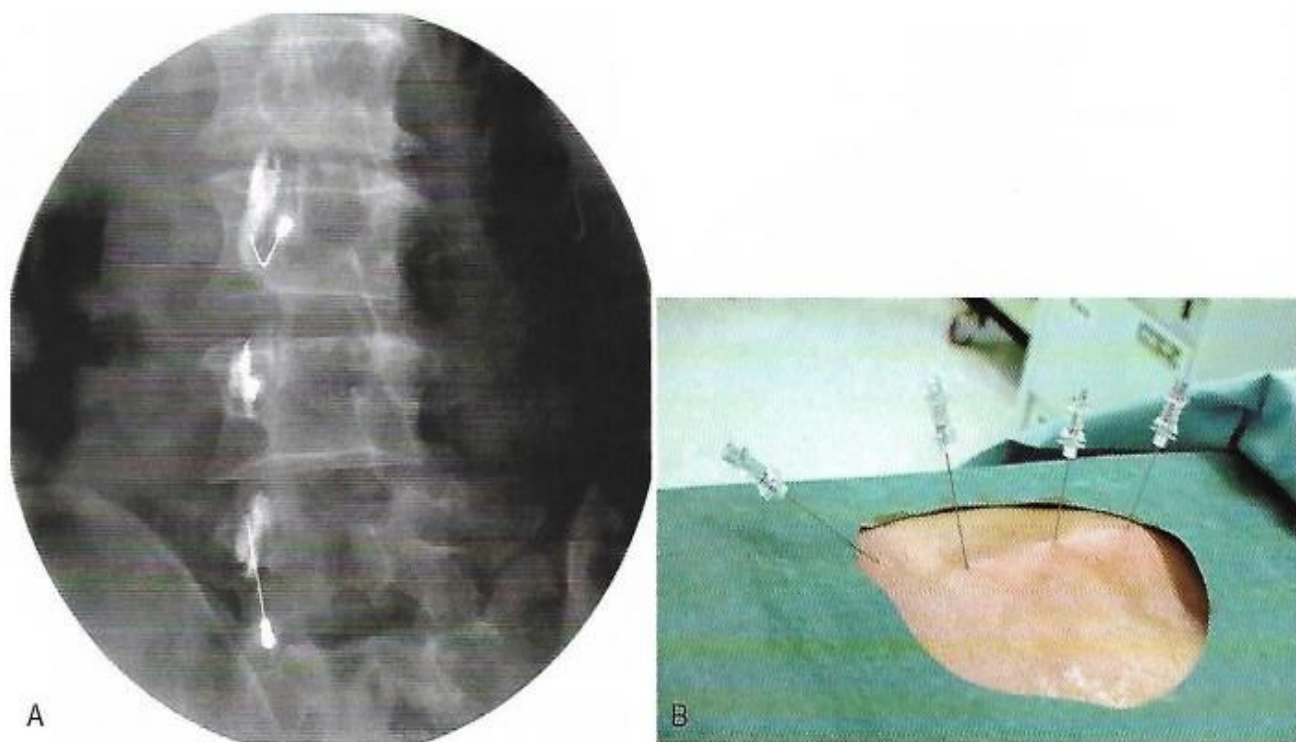
The procedure for MBB at the L1-L2 through L4-L5 facet joints is as follows:

1. The patient's written informed consent is obtained.
2. The patient is placed in the prone position. The area of skin at the target points is prepared and draped in a sterile fashion.
3. With the C-arm, the vertebral end plates are aligned parallel in an AP projection. The C-arm is then turned 20 to 40 degrees obliquely.
4. Under C-arm guidance, infiltration of local anesthetics is performed with 26-gauge, 1.5-inch and 3.5-inch needles just over the target point, centroid of the eye of the Scottie dog, with a tunnel vision technique.
5. With the use of intermittent fluoroscopic guidance, a 22-gauge, 3.5-inch block needle is introduced directly to the target point until contact is made with the bone.
6. AP and lateral C-arm images are checked and recorded to verify the final position of the needle tip.
7. After correct placement of the needle is confirmed by administration of 0.2 mL of a contrast agent, 0.5 mL of local anesthetic (e.g., 2% lidocaine or 0.5% levobupivacaine) is injected with or without corticosteroids (Fig. 8-26).

AT THE L5-S1 FACET JOINT

The procedure for MBB at the L5-S1 facet joint is as follows:

1. The patient's written informed consent is obtained.
2. The patient is placed in the prone position. The area of skin at the target points is prepared and draped in a sterile fashion.
3. With the C-arm, the vertebral end plates are aligned parallel in an AP projection.
4. With C-arm guidance in a true AP view, infiltration of local anesthetics is performed with a 26-gauge, 1.5-inch needle over the target point, about 5 mm inferior to the junction of the superior articular process and the ala of the sacrum.
5. With the use of intermittent fluoroscopic guidance, a 22-gauge, 3.5-inch block needle is introduced directly to the target point with a tunnel vision technique until contact is made with the bone.

**Figure 8-26**

An example of lumbar medial branch blocks. **A.** The needle direction and C-arm projection differ depending on the degree of lumbar lordosis. **B.** Different direction of needles are shown at oblique view.

6. AP and lateral C-arm images are checked and recorded to verify the final position of the needle tip.
7. After correct placement of the needle is confirmed by administration of 0.2 mL of a contrast agent, 0.5 mL of local anesthetic (e.g., 2% lidocaine or 0.5% levobupivacaine) is injected with or without corticosteroids.

Pulsed Radiofrequency Lesioning or Radiofrequency Thermocoagulation of the Medial Branch (L1-L4) or Dorsal Ramus (L5)

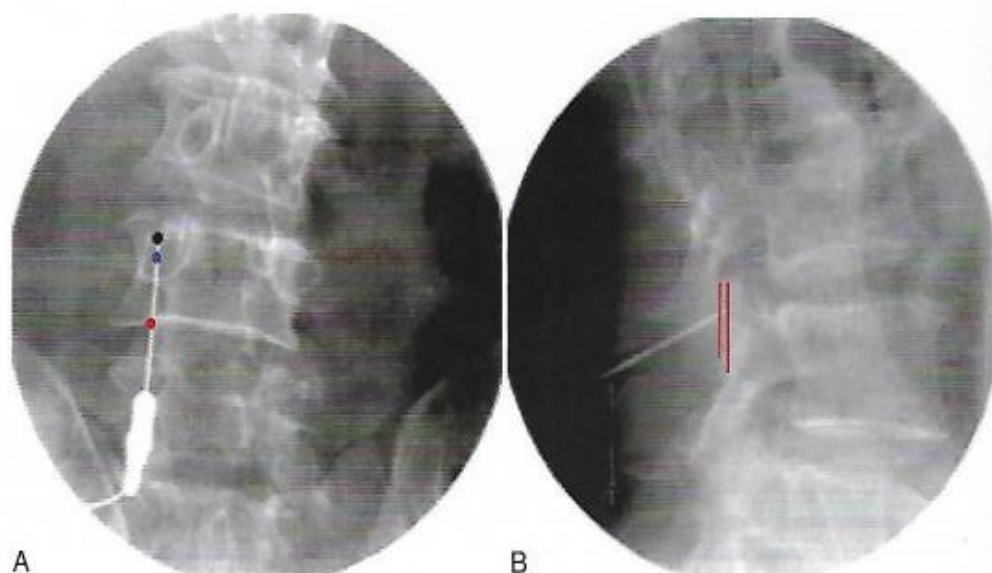
AT THE L1-L2 THROUGH L4-L5 FACET JOINTS

The procedure for PRFL or RFTC at the L1-L2 through L4-L5 facet joints is as follows:

1. The patient's written informed consent is obtained.
2. The patient is placed in the prone position. The area of skin at the target points is prepared and draped in a sterile fashion.

An adhesive grounding pad is placed on the patient's posterior upper thigh if the probe is not self-grounded.

3. With the C-arm, the vertebral end plates are aligned parallel in an AP projection. The C-arm is then turned 20 to 40 degrees obliquely.
4. Under C-arm guidance, infiltration of local anesthetics is performed with a 26-gauge, 1.5-inch needle at the skin entry site (red dot on Fig. 8-27A).
5. With the use of intermittent fluoroscopic guidance, a 10-cm (sometimes 15-cm) cannula with a 10-mm active tip is introduced toward the target point (blue dot on Fig. 8-27A) until contact is made with the bone. The cannula is carefully advanced toward Burton point (black dot on the Fig. 8-27A) while 2 Hz and less than 0.5 V stimulation is administered (Fig. 8-28) and contact with the bone is maintained. Advance of the cannula should be stopped when contractions occur, even if this is before Burton point is reached.

**Figure 8-27**

Radiorefrequency thermocoagulation of the right L3 medial branch. **A.** Oblique view. The red dot indicates the skin entry site; the blue dot indicates the bone contact site where nerve stimulation is commenced; and the black dot indicates the final location of the cannula. **B.** Lateral view. The cannula should not be advanced beyond the red lines, which indicate the facet surfaces.

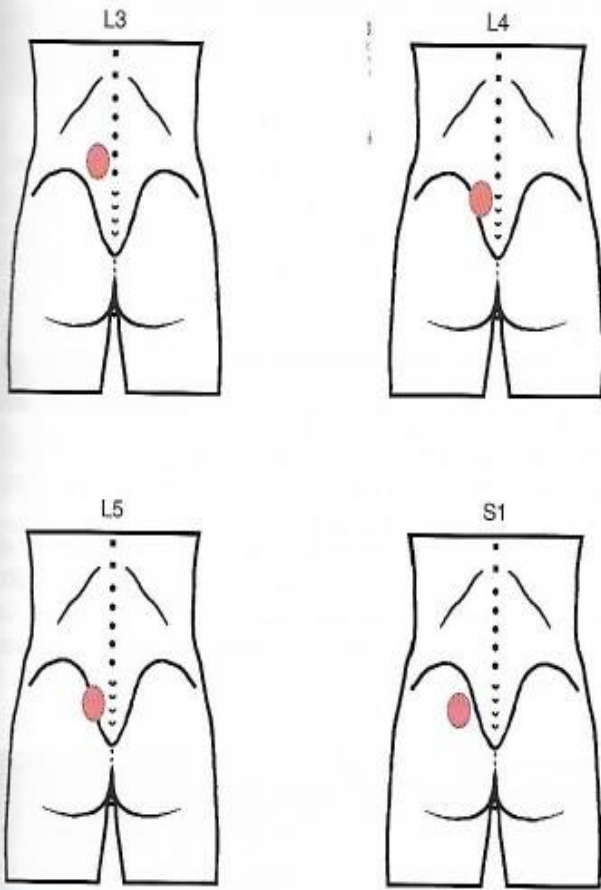


Figure 8-28

Illustrations showing the typical twitching responses provoked by 2-Hz stimulation to locate the medial branch. If thumping, rhythmic contractions cannot be elicited at those sites with three or four stimulation trials, the final placement of the cannula is based on the physician's judgment of a satisfactory location based on radiographic views. (Adapted from Shin KM, Choi SE, Yun SH, et al: A new more reliable indicator for confirmation of the medial branch in radiofrequency neurotomy; Korean J Pain 2000;13:242-246.)

6. AP and lateral C-arm images are obtained to confirm placement of the cannula tip.
7. Radiofrequency lesioning should be performed with a rotating curved needle technique. The cannula should not be advanced beyond the facet line on a lateral view (Fig. 8-27B).

If paravertebral rhythmic contractions cannot be elicited despite repeated attempts at motor stimulation, lesioning of

a broader area can be performed on the basis of the radiographic anatomy.

AT THE L5-S1 FACET JOINT

The procedure for PRFL or RFTC at the L5-S1 facet joint is as follows:

1. The patient's written informed consent is obtained.
2. The patient is placed in the prone position. The area of skin at the target points is prepared and draped in a sterile fashion. An adhesive grounding pad is placed on the patient's posterior upper thigh if the probe is not self-grounded.
3. With the C-arm (fluoroscope), the vertebral end plates are aligned parallel in the AP projection. The C-arm is then turned 10 to 20 degrees obliquely.
4. Under C-arm guidance, infiltration of local anesthetic is performed with a 26-gauge, 1.5-inch needle at the skin entry site (red dot on the Fig. 8-29A).
5. With the use of intermittent fluoroscopic guidance, a 10 cm-cannula with a 10-mm active tip is introduced toward the target point until contact is made with the bone (blue dot on the Fig. 8-29A). The cannula is advanced carefully toward the target point (black dot on the Fig. 8-29A) while 2 Hz and less than 0.5 V stimulation is administered (Fig. 8-28) and contact with the bone is maintained. Cannula advance should be stopped when contractions occur, even if this is before the target point is reached.
6. AP and lateral C-arm images are obtained to confirm placement of the cannula tip.
7. Radiofrequency lesioning should be performed with a rotating curved needle technique. The cannula should not be advanced beyond the facet line on the lateral view of the C-arm image (Fig. 8-29B).

To elicit rhythmic contraction with motor stimulation is sometimes a very difficult and time-consuming procedure. If paravertebral rhythmic contractions cannot be elicited despite repeated attempts at motor stimulation, lesioning of a broader area can be performed on the basis of the radiographic anatomy.

POSTPROCEDURAL MANAGEMENT

Medial Branch Block

One hour after MBB, the block's effect should be evaluated.

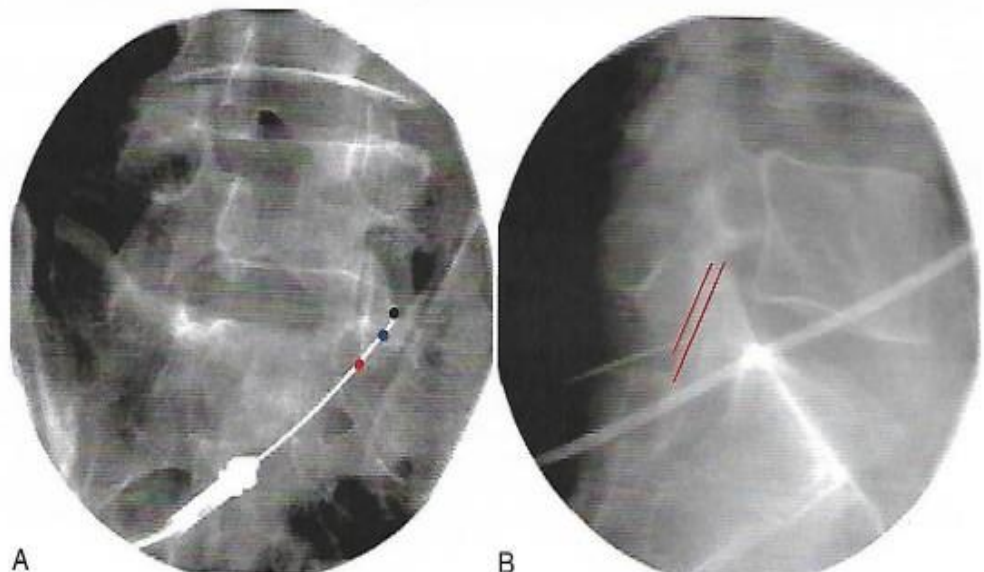


Figure 8-29

Radiofrequency thermocoagulation of the right L5 dorsal ramus. **A**, Oblique view. The red dot indicates the skin entry site; the blue dot indicates the bone contact site where nerve stimulation is commenced; and the black dot indicates the final location of the cannula. **B**, Lateral view. The cannula should not be advanced beyond the red lines, which indicate the facet lines.

Pulsed Radiofrequency Lesioning or Radiofrequency Thermocoagulation of the Medial Branch

Most patients undergoing PRFL or RFTC can be discharged on the day of the surgery. No bed rest is needed. Patients

should be told that postprocedural pain may persist for 1 to 2 weeks and that the response to treatment may be delayed for 1 month.

CASE STUDY 8.1 CERVICAL MEDIAL BRANCH RADIOFREQUENCY THERMOCOAGULATION

A 60-year-old man was injured in a traffic accident 6 months ago. He had left neck and shoulder pain. He had limited neck motion, especially for bending and rotating the neck to the left. Physical examination found the patient's reflexes and the strength of the arm to be normal. However, he complained of the concordant pain when the examiner pressed the C5-C6 and C6-C7 facet joint area. Simple cervical spine AP, lateral, and oblique radiographic films showed only the straightening of the curvature and otherwise no

specific findings. The patient was diagnosed as having facet joint syndrome at the C5-C6 and C6-C7 facet joints due to whiplash injury.

We proceeded with diagnostic MBB using 0.25% levobupivacaine, and the result of the procedure was positive (**Fig. 8-30**). Thereafter the patient was also treated with RFTC of the left C5 and C6 medial branches (**Fig. 8-31**). The patient had complete pain relief and improved range of motion of the neck for 3 weeks.



Figure 8-30

Diagnostic C5 medial branch block (MBB). The needle appears as a dot at the center of the C5 articular pillar. Needle placement for diagnostic C6 MBB has not yet been performed.



Figure 8-31

Radiofrequency thermocoagulation of the C5 and C6 cervical medial branches.

CASE STUDY 8.2 LUMBAR MEDIAL BRANCH BLOCK AND MEDIAL BRANCH RADIOFREQUENCY THERMOCOAGULATION

A 73-year-old woman had had left-sided low back pain for 3 years. Three months prior to visiting the clinic, her low back pain was aggravated, and she experienced referred pain to the left paraspinal, hip, and posterior thigh area. Her pain was aggravated while sitting and was most severe in the morning. Medical treatments, such as nonsteroidal anti-inflammatory drugs and physical therapy, resulted in minimal improvement and re-aggravation of the low back pain.

Motor and sensory test results were normal; results of the straight-leg raising test and Patrick test were negative. A bone scan demonstrated abnormal radiotracer uptake at the left lumbosacral junction and L4-L5 facet joint areas (**Fig. 8-32**). Magnetic resonance imaging showed left L4-L5 facet arthrosis (**Fig. 8-33**).

The patient had excellent pain relief on each occasion after injection of 0.5 mL of 0.18% ropivacaine at each left L3 and L4 medial branch. RFTC at 80°C for 90 seconds at the L3 and L4 medial branches followed. On the patient's follow-up visit 3 months after the procedure, she remained pain free.



Figure 8-32

A bone scan demonstrating abnormal uptake at the left lumbosacral junction and the L4-L5 facet joint area.



Figure 8-33

Lumbar magnetic resonance imaging shows left L4-L5 facet arthrosis at sagittal view (**A**) and at axial view (**B**).

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Chapter 11

SACROILIAC JOINT BLOCK AND NEUROABLATION

Kyung-Hoon Kim, MD, PhD, and Sang-Wook Shin, MD, PhD

The sacroiliac joint (SIJ) is the largest axial joint in the body with an average surface area of 17.5 cm² [1]. It is a large, auricular-shaped, diarthrodial synovial joint. However, only the anterior third of the interface between the sacrum and ilium is a true synovial joint; the rest of the junction is comprised of an intricate set of ligamentous connections. If the joints become painful, they may cause pain in the low back, buttocks, abdomen, groin or legs (Figs. 11-1 and 11-2).

The *primary function* of the sacroiliac joint is to lend stability, which it accomplishes through the following mechanisms:

- The transmission and dissipation of truncal loads to the lower extremities
- Limiting of x-axis rotation
- Facilitation of parturition

The *biomechanics* of the SIJ withstand a medially directed force six times greater than the lumbar spine, but only half of the torsion and 1/20 of the axial compression load.

SACROILIAC JOINT DYSFUNCTION

Typically, SIJ dysfunction is initially symptomatic after a minor traumatic event, such as a fall onto the buttocks or a slip while pushing a heavy object. It is then aggravated by transitional activities, such as climbing stairs, getting up from a chair, and getting out of a car. Pain in the SIJ can also be provoked by activities requiring asymmetrical loading through the lower extremities or pelvis, such as skating, gymnastics, golfing, and step aerobics.

Dreyfuss and colleagues [2] have shown that the pain referral pattern in asymptomatic volunteers consists of the following areas:

- The buttock, the groin, and the entire lower limb, but not the back above the L5 level
- An area extending 10 cm caudally and 3 cm laterally from the posterior superior iliac spine

The diagnostic criteria for *sacroiliac joint syndrome*, as defined by the International Association for the Study of Pain (IASP), are as follows:

- Pain in the region of the SIJ with possible radiation to the groin, medial buttocks, and posterior thigh
- Reproduction of pain by physical examination techniques that stress the joint
- Elimination of pain with intra-articular injection of a local anesthetic

- An ostensibly morphologically normal joint without demonstrable pathognomonic radiographic abnormalities

One of the most consistent physical findings in patients with SIJ dysfunction is point-specific tenderness over the sacral sulcus as well as the posterior sacroiliac spine.

The *prevalence of SIJ pain* in carefully screened patients with low back pain (LBP) is in the range of 15% to 25%. 39% of patients with SIJ dysfunction were also diagnosed [3] with an associated spinal disorder. Of these spinal disorders complicated by SIJ dysfunction, the most common are as follows:

- Facet joint syndrome (41%)
- Spondylolisthesis (29%)

SIJ dysfunction can stem from both intra-articular and extra-articular sources, although *extra-articular sources* such as enthesopathy and fractures are more common. Nociception in the SIJ can also be caused by *pathologic changes* affecting many different SIJ structures, such as the following:

- Capsular or synovial disruption
- Capsular and ligamentous tension
- Hypomobility or hypermobility
- Extraneous compression or shearing forces
- Abnormal joint mechanics
- Microfractures or macrofractures
- Chondromalacia
- Soft tissue injury
- Inflammation

The following factors predispose an individual to SIJ dysfunction:

- Degenerative joint disease
- Joint (ligamentous) laxity and pregnancy
- A history of minor direct trauma, such as a fall onto the buttocks

The average mechanical threshold of the SIJ nociceptive unit is shown in Table 11.1.

SIJ *treatment options* are injections, nerve blocks, and denervation. A sacroiliac joint injection serves the following two purposes:

- Injecting anesthetic medication into the joint confirms whether or not pain comes from the joint.
- The local anesthetic and cortisone can help break a pain cycle, possibly facilitating a rehabilitative exercise program.

The evidence for the effectiveness of SIJ block and denervation as diagnostic and therapeutic methods for SIJ dysfunction is shown in Table 11.2.

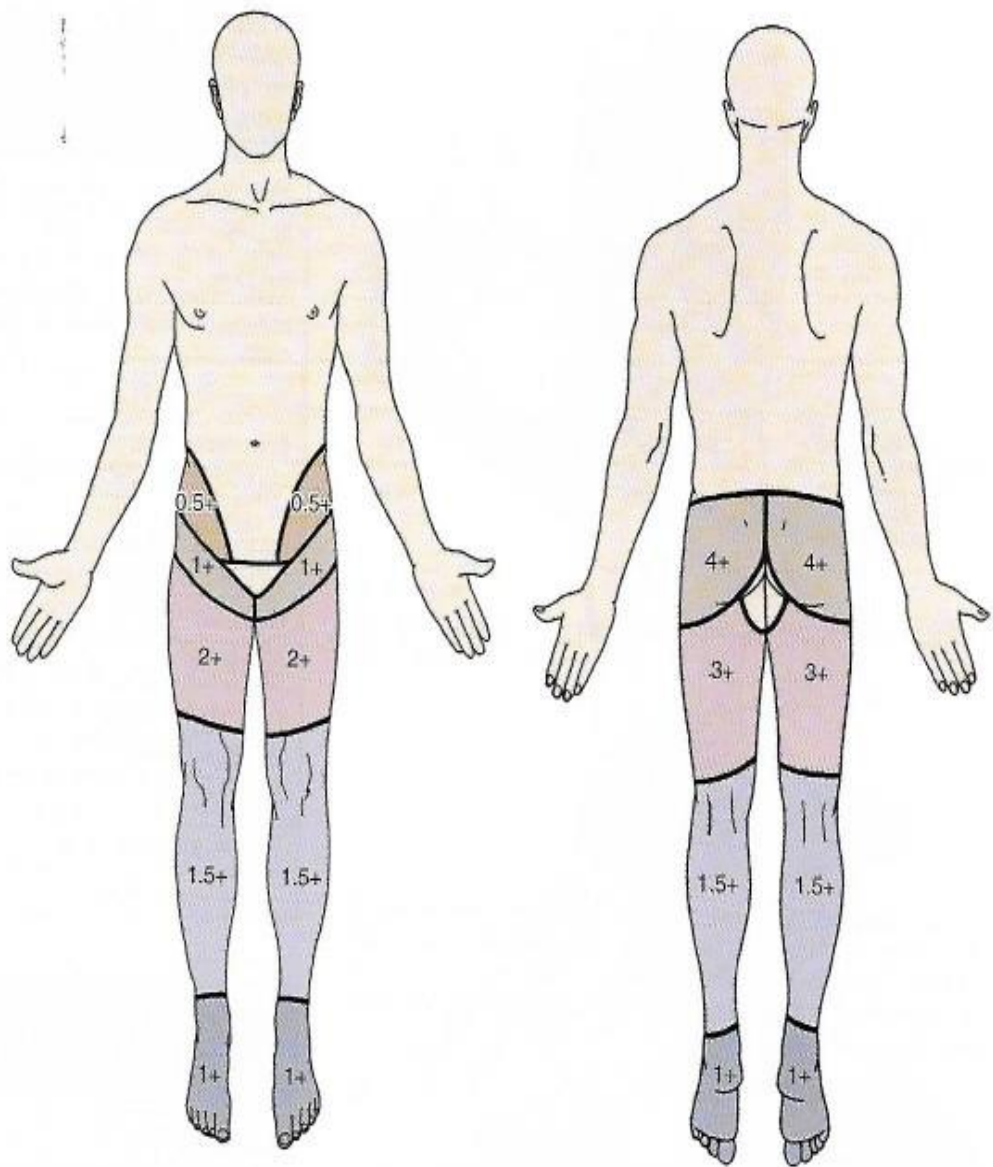


Figure 11-1

Density of referral zones for sacroiliac joint pain. 0.5+ is the least common referral zone, 4+ the most common.

INDICATIONS

The primary indication for treatment with SIJ block and neuroablation is intra-articular sacroiliac joint pain. The diagnostic criteria for identifying idiopathic intra-articular sacroiliac joint pain are as follows:

- Absence of neurologic deficits
- Absence of dural tension signs
- Absence of laboratory, imaging, or clinical evidence of medical causes of sacroiliac joint pain
- Maximal pain below L5
- No evidence of lumbar pain generators (if indicated, this can be confirmed through negative results of zygapophysial joint block and discography)
- At least 75% relief with controlled, dual, fluoroscopically guided, contrast-enhanced intra-articular SIJ injections

Several major diagnostic tests are used to confirm a diagnosis of intra-articular SIJ pain; they are described in Table 11.3 and Box 11.1, and shown in Figures 11-3 through 11-5.

COMPLICATIONS

Sacroiliac Joint Injection

Complications of SIJ injection are as follows:

No pain relief: If the cause of the pain was not the SIJ itself, injecting it will not relieve the pain. Attempting an SIJ injection without fluoroscopic guidance is very difficult and increases the chance that pain relief will not be achieved.

Temporary leg weakness: The sciatic nerve runs just in front of the SIJ. In some patients, the local anesthetic mixture spreads from the joint onto the nerve, causing temporary weakness and inability to stand. The magnitude and duration of the complication depend on the type and strength of the local anesthetic used.

Infection: The procedure must be performed under aseptic conditions to reduce the risk of infection.

Increased pain: As in any pain procedure, the pain can appear to be worse afterwards. The cause of this complication cannot always be explained.

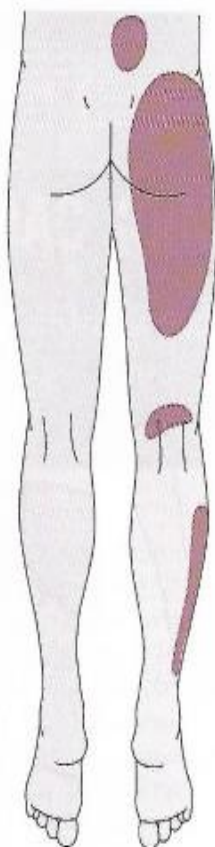


Figure 11-2
Common referral zones for sacroiliac joint pain. The sacroiliac joint can become inflamed from an acute injury or from chronic postural abnormalities. Undue stress on the joint following low back fusion surgery can also cause inflammation and pain here. Pain from sacroiliac joint abnormalities occurs in the low back, buttock/hip, abdomen, groin, or legs.

Table 11.1
Average Mechanical Threshold of Sacroiliac Joint and Other Nociceptive Units

Nociceptive Unit	Average Mechanical Threshold (g)
Sacroiliac joint	70
Lumbar facet joint	6
Anterior lumbar disc	241

Table 11.2
Level of Evidence for Intra-articular Injection and Neurotomy

Intra-articular injection:	
Diagnostic method	Moderate evidence for diagnosis of pain from the sacroiliac joint (SIJ)
Therapeutic method	Moderate evidence for short-term relief (<3 months) Limited evidence for long-term relief
Radiofrequency neurotomy	Indeterminate evidence for managing SIJ pain

Table 11.3
Sensitivity and Specificity of Major Diagnostic Tests Used to Identify Patients with Intra-articular Sacroiliac Joint Pain

Test	Sensitivity	Specificity
Sacroiliac joint pain	++++	+
Groin pain	+	+++
Buttock pain	++++	+
Indication of posterior superior iliac spine as pain source	++++	++
Abnormal sitting posture	+	++++
Pain lessens with:		
Nonsteroidal anti-inflammatory drugs	++	++
Exercise	++	++++
Manipulation	+++	++++
Gillet test	++	+++
Patrick test	+++	+
Gaenslen test	+++	++
Sacral sulcus tenderness	++++	+
Midline sacral thrust	+++	++
Bone scan	++	++++
Computed tomography	+++	+++
+, 0-25%; ++, 26%-50%; +++, 51%-75%; +++, 76%-100%		

BOX 11.1 COMMON TESTS UTILIZED IN EVALUATION OF SACROILIAC JOINT DYSFUNCTION

Laguerre Test

To differentiate hip pain from sacroiliac pain, the patient is supine. The examiner passively flexes the patient's hip and knee 90°. Then the hip is passively abducted and placed in extreme external rotation. This maneuver moves the femoral head into the anterior part of the joint capsule of the hip. Pain within the hip suggested degenerative disease, hip dysplasia, or contracture of the iliopsoas muscle. Pain felt posteriorly in the sacroiliac joint suggests a disease process at that site.

Gillet Test

Also called sacral fixation test, ipsilateral posterior rotation test. The Gillet test has been described as the one leg standing test, sacral fixation test, ipsilateral posterior rotation test, marching test, and the ipsilateral flexion kinetic test. To perform this test, the patient stands while the examiner palpates the posterior superior iliac spine (PSIS) with one thumb and palpates the sacrum with the other thumb staying parallel to the first thumb. The patient is then instructed to stand on one leg while pulling the opposite knee up toward the chest. The test is then repeated on the other side and compared bilaterally. A positive test is noted when the PSIS on the ipsilateral side of the knee flexion does not move or moves minimally in the inferior direction. The PSIS on the side of hip flexion should move slightly anterior.

Patrick Test (see Fig. 11-4)

The knee is flexed to 90° on the affected side and the foot is rested on the unaffected knee. Holding the [HYPERLINK "http://en.wikipedia.org/wiki/Pelvis"](http://en.wikipedia.org/wiki/Pelvis) to "Pelvis"pelvis firm against the

BOX 11.1 COMMON TESTS UTILIZED IN EVALUATION OF SACROILIAC JOINT DYSFUNCTION—Cont'd

examination table, the affected-side knee is pushed towards the examination table, a maneuver which provides external rotation of the leg at the hip [HYPERLINK "http://en.wikipedia.org/wiki/Joint" \o "Joint"](http://en.wikipedia.org/wiki/Joint%20Joint) joint. If pain results, this is considered a positive Patrick's test and sacroiliitis is more likely.

Gaenslen Test (see Fig. 11-3)

Also called the pelvis torsion test.

The hip joint is flexed maximally on one side and the opposite hip joint is extended, stressing both sacroiliac joints simultaneously. This is often done by having the patient lying on his or her back, lifting the knee to push towards the patient's chest while the other leg is allowed to fall over the side of an examination table, and is pushed toward the floor, flexing both sacroiliac joints. The test can also be performed with the patient in the supine position. The examiner passively flexes the hip while stabilizing the other limb to keep the contralateral limb in a neutral position. The test is considered positive if the patient experiences pain while this test is performed, and may indicate a need for further testing, such as an [HYPERLINK "http://en.wikipedia.org/wiki/X-ray" \o "X-ray"](http://en.wikipedia.org/wiki/X-ray) x-ray or lumbar [HYPERLINK "http://en.wikipedia.org/wiki/Computer_tomography" \o "Computer tomography"](http://en.wikipedia.org/wiki/Computer_tomography) CT scan.

Yeoman Test (see Fig. 11-5)

Yeoman's test stresses the sacroiliac joint by extending the leg and rotating the ilium. A positive test produces pain over the back of the sacroiliac joint.

Cortisone-related side effects: Fluid retention, weight gain, increased blood sugar (mainly in diabetic patients), elevated blood pressure, mood swings, irritability, insomnia, and suppression of the body's own natural production of cortisone. Fortunately, the serious side effects and complications relating to cortisone are uncommon.



Figure 11-3

Gaenslen test is often done by having the patient lying on his or her back, lifting the knee to push towards the patient's chest while the other leg is allowed to fall over the side of an examination table, and is pushed toward the floor, flexing both sacroiliac joints (See the detail in BOX 11.1).



Figure 11-4

Patrick test stresses the hip and sacroiliac joints. In a positive result, the test produces back, buttocks, or groin pain.



Figure 11-5

Yeoman's test stresses the sacroiliac joint by extending the leg and rotating the ilium. A positive test produces pain over the back of the sacroiliac joint.

There is also a risk of tissue injury and bleeding. Injections near the spine carry the risk of dural puncture and spinal headache.

Neuroablation

Complications of SIJ neuroablation are as follows:

- Pain or discomfort around the injection site
- Numbness of skin covering the injection site
- Worsened pain due to muscle spasm in the area of the injection
- Permanent nerve pain
- Allergies or reactions to medications used
- Infection

PREOPERATIVE PREPARATION

Physical Examination

The physical examination performed before SIJ block or neuroablation consists of the following tests:

Fortin finger test: The patient points to the area of pain with one finger. The result is positive if the site is within 1 cm of and generally inferomedial to the posterior superior iliac spine (PSIS).

Gaenslen test: The patient is supine. The hip and knee of one leg are maximally flexed toward the trunk, and the other leg is extended. Some examiners perform this test with the patient's extended leg off the examining table to force the SIJ through the maximal range of motion. The result is positive if pain is felt across the SIJ. This maneuver also stresses the hip joint, producing trochanteric pain (see Fig. 11-3).

FABER maneuver (flexion, abduction, external rotation, and extension of hip; also called Patrick test): The patient is supine. One heel is placed on the other knee and the elevated leg is guided toward the examining table. The result is positive if pain is elicited along the SIJ. This also stresses the hip joint and may result in trochanteric pain (see Fig. 11-4).

Compression test: The patient lies on one side. The examiner applies pressure to one pelvic brim in the direction of the other. A positive result is pain across the SIJ.

Compression test at the SIJ: The patient is prone. The examiner places a palm along the SIJ or on the sacrum and makes a vertical downward thrust. Discomfort along the joint line is considered a positive result.

Pubic symphysis test: The patient is supine. Pressure is applied with the examining finger at the left or right pubic bone adjacent to the symphysis. The result is positive if pain is felt at the site. Most patients are not aware of this tenderness before it is elicited. The examiner should ask permission before applying pressure and might consider having a witness in the room to avoid the misconception of inappropriate sexual contact.

Distraction test: The patient is supine. The examiner alternately presses each anterior superior iliac spine (ASIS) in a posterolateral direction. The result is positive if the pressure produces pain or if movement is asymmetrical.

FADE test (flexion, adduction, extension): The patient is supine. The hip is flexed and adducted to the midline. The examiner applies pressure to the long axis of the femur to push the ilium posterior. Pain is considered a positive result of this test.

Passive straight-leg raising: The patient is supine. The examiner grasps the heel and lifts the leg vertically from the examining table with the knee extended. The patient is asked to hold the leg

elevated and then to slowly lower it. A positive result is ipsilateral pain, which suggests anterior rotation.

One-legged stork test: The patient stands in front of the examiner. The examiner's thumbs are placed on one PSIS and on the sacrum at S2. The patient then flexes the palpated hip to 90 degrees. If the examiner's thumb moves upward instead of inferolaterally, as would be expected, the result is positive.

Van Durson standing flexion test: The patient stands in front of the examiner. The examiner's thumbs are placed just below each PSIS. The patient flexes the trunk forward without bending the knees. A positive sign is asymmetrical motion (i.e., upward motion on the involved side).

Piedallu test or the seated flexion test: The patient is seated in front of the examiner. The examiner's thumbs are placed just below each PSIS. The patient flexes the trunk forward. A positive result is asymmetry of motion (i.e., upward motion on the involved side).

Rectal examination: Although it is not specific for SIJ involvement, a thorough rectal examination is necessary to search for referred pain from the prostate, uterus, or spasm in muscles of the pelvic floor. Piriformis muscle spasm can be localized at the end of the examiner's finger at the 2 o'clock or 10 o'clock position. Because piriformis muscle spasms are associated with sciatic nerve entrapment, compression of this muscle reproduces painful symptoms.

Yeoman test: With the subject prone, the test is performed by rotating the ilium with one hand and extending the hip while the knee is extended. Pain over the ipsilateral posterior sacroiliac joint area is indicative of sacroiliitis.

ANATOMY[1]

The anatomy of the pelvis is shown in (Figures 11-6 and 11-7):

- The pelvis consists of the two ilia and the sacrum
- The anterior side of the joint is lined with thick hyaline cartilage
- The posterior iliac side of the joint is lined with fibrocartilage

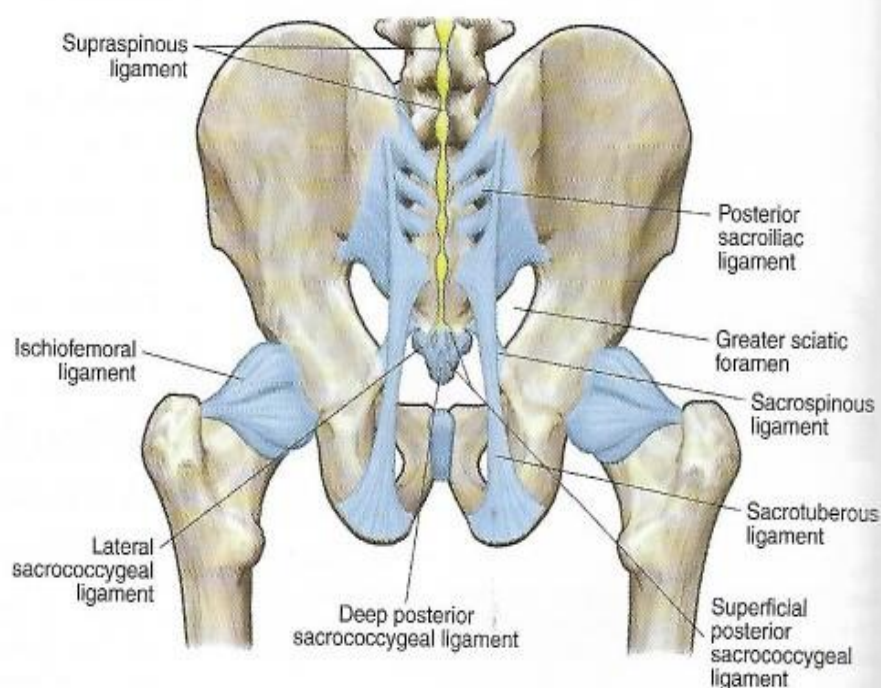


Figure 11-6

Posterior view of the articulations and associated ligaments of the sacroiliac joint and surrounding structures.

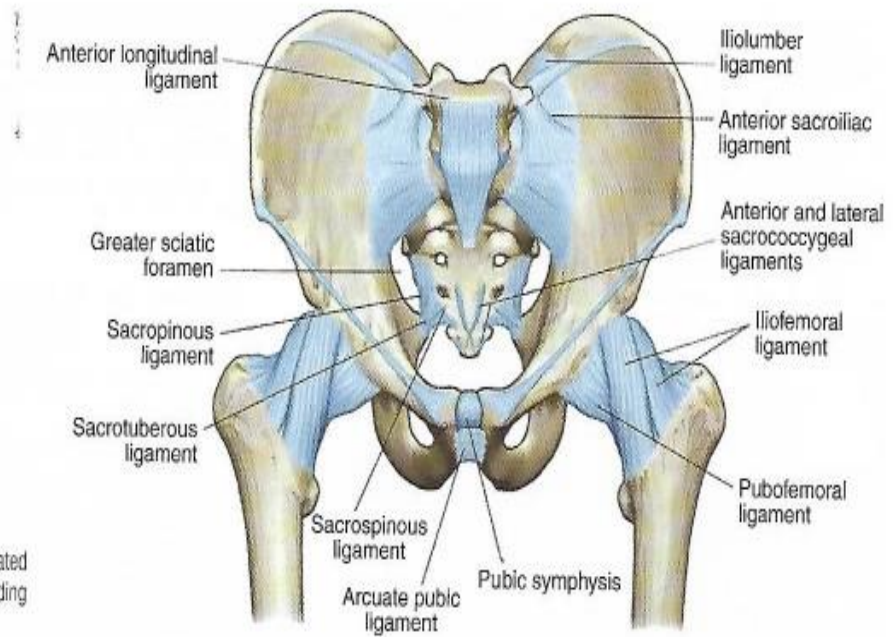


Figure 11-7
Anterior view of the articulations and associated ligaments of the sacroiliac joint and surrounding structures.

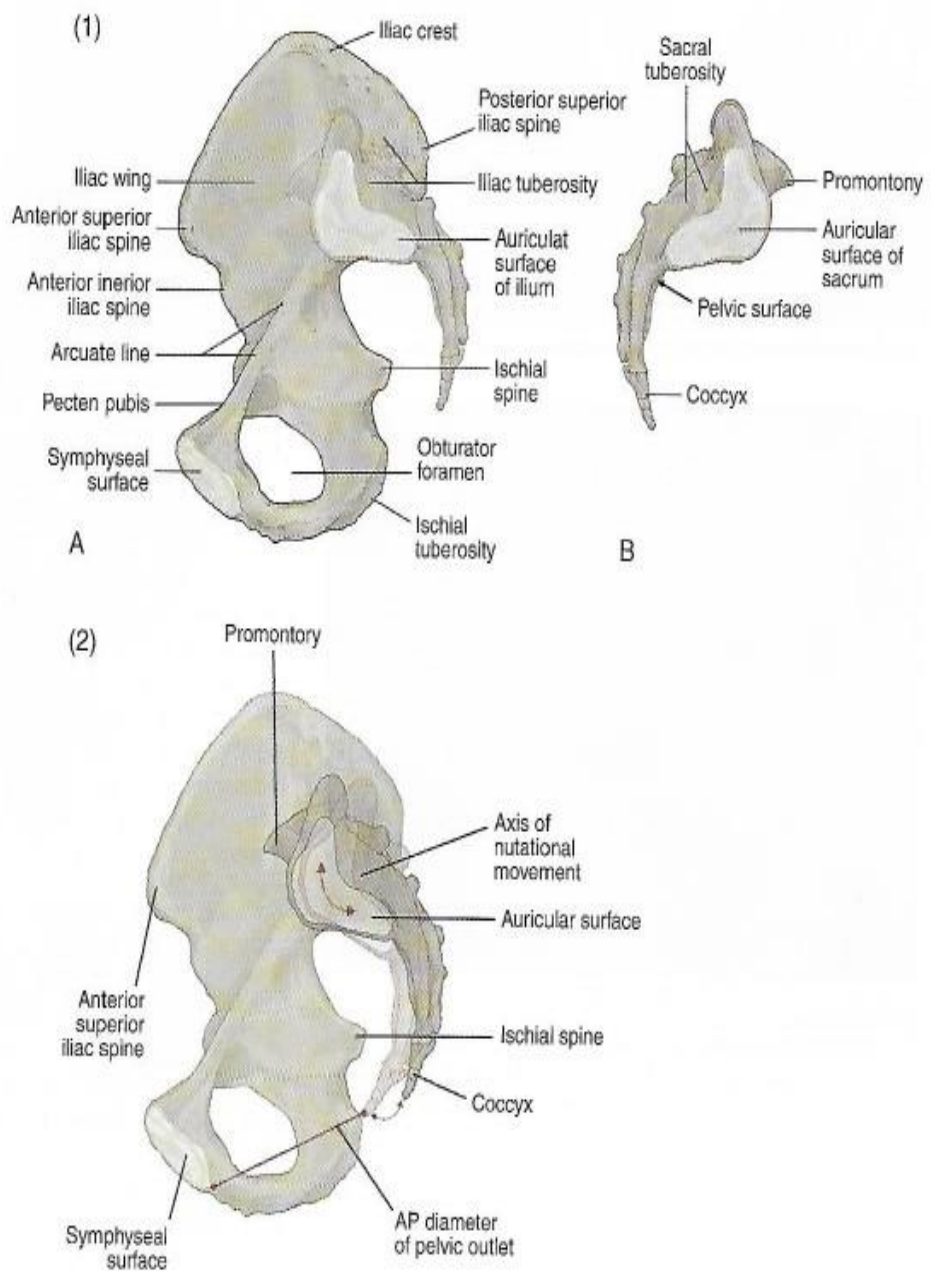


Figure 11-8
1, Articular surface of sacroiliac joint.
2, Nutation of the sacroiliac joint

Important aspects of the anatomy of the SIJ (Fig. 11-8) are as follows:

- The innervation of the SIJ is extremely complex, and while there is no clear consensus concerning the exact innervation, the most accepted view is described in Box 11.2.
- The sacroiliac joint connects the sacrum (the triangular bone at the bottom of the spine) with the pelvis (iliac crest).
- The joint transmits all the forces of the upper body to the pelvis and legs.
- It acts as a shock-absorbing structure.
- It does not have much motion.

BOX 11.2 INNERVATION OF THE SACROILIAC JOINT

Posterior innervation: The lateral branches of the L4-S3 (L3-S4) dorsal rami.

Anterior innervation: The L2-S2 (L4-S2 or L5-S2) ventral rami.

PROCEDURES

Sacroiliac Joint Injection

The procedure for sacroiliac joint injection is as follows:

1. The patient's written informed consent is obtained.
2. With the use of local anesthesia and sometimes light intravenous sedation, a small-diameter needle is placed into the joint in question under fluoroscopic guidance (Fig. 11-9).



Figure 11-9

The block needle is placed on the right sacroiliac joint.

3. Radiographic contrast medium is injected to confirm correct needle placement. A mixture of local anesthetic and steroid is injected (usually 5-10 mL of 0.4% lidocaine plus triamcinolone 20-40 mg).
4. After the injection, some patients may obtain further relief by wearing a specifically designed SIJ support belt.

Denervation of the Sacroiliac Joint

1. The patient's written informed consent is obtained.
2. The patient is placed in the prone position on the fluoroscopy table.
3. The fluoroscopy unit is angled inward so that the lines of the posterior aspects of the joint are seen.
4. The tube is angled caudad and obliquely from the side opposite the joint to be lesioned—that is, an oblique view at 15 to 20 degrees from the opposite side of the body is used to correctly visualize the posterior joint lines, approximately 5 mm lateral to the foramen, just before the nerves enter the surrounding ligaments (Fig. 11-10).
5. The procedure of denervation is done as usual manner.

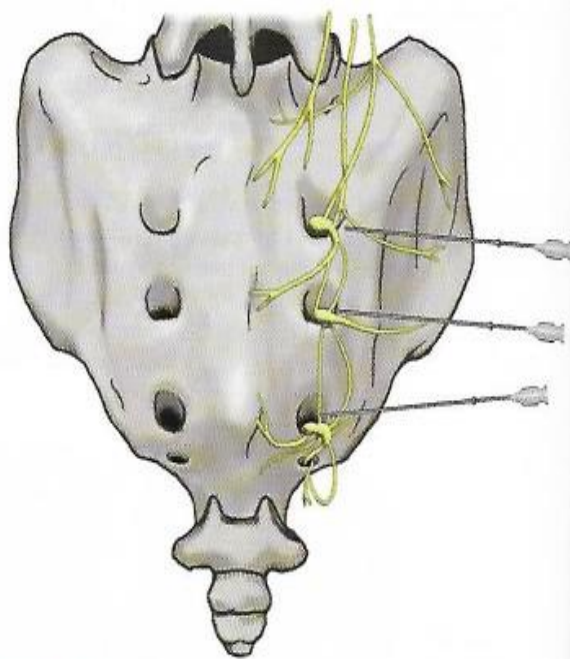


Figure 11-10

Schematic drawing showing the S1-S3 lateral branches innervating the sacroiliac joint and overlying ligaments. The needles depict the approximate location for the diagnostic lumbar branch block.[4] (From Dreyfuss P, Dreyer SJ, Cole A, Mayo K. Sacroiliac joint pain. *J Am Acad Orthop Surg* 2004;12:255-265.)

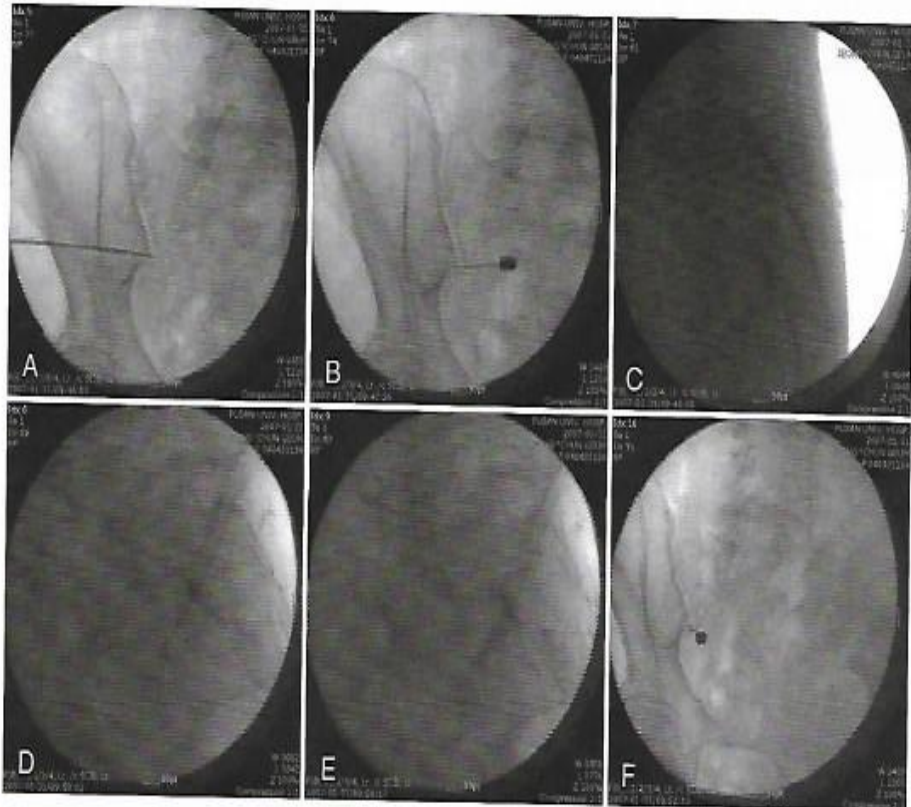
CASE STUDY 11.1

A 76-year-old woman had suffered from low back and left posterior buttock pain without radiating pain below the knee for 3 months. Physical examination elicited positive stress test results and severe tenderness on the left posterior superior iliac spine. The patient

underwent sacroiliac joint block. During the procedure the pain source was verified by pain provocation upon application of contrast medium and appropriate anesthetic agents were applied for pain relief (**Fig. 11-11**).

Figure 11-11

A, A K-wire indicates the left posterior sacroiliac joint (SIJ) within 0.5 cm distance of the lowest point of the SIJ. **B**, A 10-cm, 22-gauge block needle is placed in the left SIJ. **C**, The block needle is placed in the left SIJ on lateral view. The contrast medium is injected into the joint. **D** and **E**, The fluoroscope is rotated slowly from the lateral to anteroposterior view to monitor the configuration of the spread of contrast medium. **F**, Finally, the left SIJ becomes dark with the contrast medium in the shape of a gourd or flask. After confirmation of contrast medium spread and pain provocation, a mixture of 2 to 3 mL of 0.4% lidocaine and 20 mg of triamcinolone is injected.



POSTPROCEDURAL MANAGEMENT

Immediate postprocedure management consists of the following:

- The patient should be encouraged to walk and to try to perform a motion that would normally bring about pain.
- The patient is asked to report the percentage of pain relief and to record the relief experienced during the next week on a post-injection evaluation sheet ("pain diary").

The patient's leg(s) may feel numb for a few hours; the patient should be reassured that this is fairly uncommon but does occasionally happen. On occasion, the back or neck may feel odd or slightly weak for several weeks after the neuroablation procedure.

Success rates of neuroablation vary, but typically, about 30% to 50% of patients undergoing this procedure experience significant pain relief for as long as 2 years. Of the remaining patients, about 50% get some pain relief for a shorter period. Some patients do not experience any relief from pain with this procedure.

In some cases (<5%), pain is increased rather than relieved by the procedure. This result is believed to occur from

increased irritation of a nerve that was only partially damaged, not completely destroyed, during the procedure. It can be treated with medication and usually goes away in several months.

Full pain relief from neuroablation will typically not be experienced until about 2 to 3 weeks after the procedure, when the nerves have completely died. The nerves will eventually grow back (regenerate), but the patient's pain may or may not recur. If the pain does recur, a second neurotomy can be performed.

REFERENCES

1. Cohen SP. Sacroiliac joint pain: A comprehensive review of anatomy, diagnosis, and treatment. *Anesth Analg* 2005;101:1440-1453.
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