# Questions

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(1) A 37-year-old man fell from 24 ft and sustained a subarachnoid hemorrhage and closed femoral shaft fracture. What is most likely to lead to an adverse outcome?

(a) Intraoperative hypotension.
(b) Temporizing external fixation.
(c) Elevated cerebral perfusion pressure.
(d) Immediate reamed intramedullary nailing.
(e) Skeletal traction with intramedullary nailing in 72 h.

(2) What is the most common anatomic location of the lateral femoral cutaneous nerve?

(a) Deep to the psoas muscle.
(b) Medial to the femoral vein.
(c) Under the inguinal ligament.
(d) Adjacent to the femoral nerve.
(e) Deep to the iliopectineal fascia.

(3) A 28-year-old woman with a history of systemic lupus erythematosus was involved in a motor vehicle crash. She sustained a closed left tibia fracture and underwent surgery. During surgery, the tourniquet was left inflated while the surgeon reamed the tibial canal to place the largest diameter nail that could be fit. At 6 weeks' follow-up, there is evidence of massive bone necrosis. What event most likely led to the necrosis?

(a) History of steroid use.
(b) History of systemic lupus erythematosus.
(c) Over-reaming of the tibial canal.
(d) Reaming of the tibia with the tourniquet inflated.
(e) Reaming of the tibia with the knee in hyperflexion.

(4) When comparing the results of open reduction and internal fixation (ORIF) versus antegrade intramedullary nailing (IMN) fixation of the humeral diaphysis in prospective randomized trials, which of the following statements is most accurate?

(a) Union rates are higher with IMN.
(b) Reoperation rates are higher with IMN.
(c) Shoulder outcomes are similar for ORIF and IMN.
(d) Infection rates are higher with ORIF.
(e) Radial nerve complications are higher with ORIF.

(5) Which inflammatory marker is most closely tied to a systemic inflammatory response following orthopedic injury and treatment?

(a) Interleukin 1 (IL-1).
(b) Interleukin 6 (IL-6).
(c) Interleukin 10 (IL-10).
(d) Tumor necrosis factor-α.
(e) D-dimer.

(6) When attempting to treat a proximal tibial metadiaphyseal fracture with an intramedullary nail, what is the most common angular malalignment?

(a) Varus alone.
(b) Valgus alone.
(c) Varus and procurvatum.
(d) Valgus and procurvatum.
(e) Valgus and recurvatum.

(7) Of the following variables, which has the strongest influence on external fixator stiffness?

(a) Pin diameter.
(b) Pin spread.
(c) Bone quality.
(d) Stacking a second fixator bar.
(e) Distance from bone to fixator bar.

(8) A starting point entry portal that is too lateral on a trochanteric femoral nail will result in what deforming force?

(a) Varus.
(b) Valgus.
(c) Flexion.
(d) Extension.
(e) Excessive hoop stress.

(9) A 26-year-old man is involved in a high-speed motorcycle accident. He sustains a grade IIIB open tibia fracture. Examination shows a large soft-tissue defect and an insensate foot. What is the expected outcome in this scenario?

(a) Equal functional outcome when limb salvage is compared with amputation.
(b) Worse functional outcome with limb salvage than with primary amputation.
(c) Better functional outcome when amputation is compared with limb salvage.
(d) Amputation within 6 months of injury.
(e) Permanent loss of plantar sensation.

(10) Which of the following clinical scenarios represents the strongest indication for the locked plating technique in a 70-year-old woman?



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(a) Segmentally comminuted ulnar fracture.
(b) Simple diaphyseal fracture of the humerus.
(c) Transverse midshaft displaced clavicle fracture.
(d) Periprosthetic femur fracture distal to a well-fixed total hip arthroplasty.
(e) Schatzker 2 fracture of the tibia with severe joint depression and comminution.

(11) A fracture of what portion of the coronoid is most often associated with a terrible triad injury?

(a) Tip.
(b) Rim.
(c) Base.
(d) Anterolateral facet.
(e) Anteromedial facet.

(12) Which set of patient characteristics has the highest risk of developing osteonecrosis after an intracapsular femoral neck fracture?

(a) A 45-year-old woman with a displaced fracture.
(b) A 55-year-old man with a nondisplaced fracture.
(c) A 70-year-old woman with a nondisplaced fracture.
(d) A 70-year-old man with a displaced fracture.
(e) An 85-year-old woman with a displaced fracture.

(13) In the evaluation of somatosensory-evoked potential waveforms for intraoperative neuromonitoring for spinal surgery, the minimum criteria for determining potentially significant changes include

(a) 10% decrease in amplitude, 50% decrease in latency.
(b) 10% decrease in amplitude, 50% increase in latency.
(c) 0% loss of amplitude, transient increase in latency.
(d) 50% decrease in amplitude, 10% increase in latency.
(e) 50% decrease in amplitude, 10% decrease in latency.

(14) A 44-year-old man was involved in a low-speed rear-end motor vehicle accident 4 weeks ago. He predominantly reports pain in the back of the neck, with occasional radiation into the trapezius region bilaterally. He denies any extremity pain. The pain has not changed in intensity, but is worse with neck range of motion. Cervical spine radiographs were negative for acute osseous trauma or instability. What is the next most appropriate step in management?

(a) Continued observation.
(b) Cervical epidural injections.
(c) NSAIDs, activity modification, and physical therapy.
(d) Cervical facet blocks.
(e) Cervical MRI.

(15) A patient with a grade 2 L5–S1 isthmic spondylolisthesis reports low back pain and bilateral lower extremity pain. Nonsurgical management has failed to provide relief, and the patient is now a candidate for surgical intervention. The surgeon elects to proceed with L5–S1 laminectomy and posterior instrumented fusion after reduction of the spondylolisthesis. If a postoperative neurologic deficit develops, what structure has most likely been affected?

(a) L4 nerve root.
(b) L5 nerve root.
(c) SI nerve root.
(d) Genitofemoral nerve.
(e) Cauda equine.

(16) A 63-year-old man has a feeling of generalized clumsiness in his arms and hands, difficulty buttoning his shirt, and gradually worsening gait instability. During examination, his neck is gently passively flexed to end range while he is seated. The patient describes an electric shock-like sensation that radiates down the spine and into the extremities. This describes which of the following?

(a) A positive Lhermitte sign.
(b) A positive Spurling sign.
(c) A positive Jackson sign.
(d) A positive Lasegue sign.
(e) A positive Hoffmann sign.

(17) A 46-year-old man has a recurrent disk herniation on the left side at L4–L5 and has had persistent radicular symptoms for 3 months without neurologic deficit. His previous surgery was performed 13 months ago. What is the best method of surgical treatment?

(a) Posterior lumbar interbody fusion.
(b) Anterior lumbar interbody fusion.
(c) Revision diskectomy.
(d) Artificial disk replacement.
(e) Interspinous process spacer.

(18) Of the following, what is the most reliable method of assessing spinal fusion?

(a) Radiographs.
(b) MRI.
(c) Flexion/extension radiographs.
(d) CT.
(e) CT myelography.

(19) An 80-year-old man with a history of chronic obstructive pulmonary disease (COPD) and dementia is involved in a fall from standing height, striking his forehead. He is seen in the emergency department with predominantly mechanical neck pain but no obvious neurologic deficits. Radiographs indicate a nondisplaced type II odontoid fracture. What is the most appropriate treatment?

(a) Immobilization in a rigid cervical orthosis for 6–8 weeks.
(b) Posterior occipital–cervical fusion with an iliac crest bone graft.
(c) Open reduction and internal fixation of the odontoid process with an anterior odontoid screw.
(d) Resection of the odontoid process through a transoral approach.
(e) Halo skeletal fixation.

(20) A 42-year-old woman has a 3-week history of acute lower back pain with radiation into the left lower extremity. There is no history of trauma and no systemic symptoms are noted. Examination indicates a positive straight leg test at 25° on the left side. Motor testing shows mild weakness of the gluteus maximus and weakness of the gastrocnemius at 3/5. Sensory examination indicates decreased sensation along the lateral aspect of the foot. Knee reflex is intact; however, the ankle reflex is absent. MRI scans show a posterolateral disk herniation. The diagnosis at this time is consistent with a herniated nucleus pulposus at what level?

(a) Ll–L2.
(b) L2–L3.
(c) L3–L4.
(d) L4–L5.
(e) L5–S1.

## Answers

(1) Preferred response: 1

Discussion: In patients with femoral fractures and associated closed head injuries, there have been conflicting studies on the timing of fracture care and eventual neurologic outcome. It is known that an episode of hypotension and elevated intracranial pressure will lower the cerebral perfusion pressure, which is known to be detrimental to the neurologic outcome. Intraoperative hypoxia may also worsen the neurologic outcome and increased fluid administration may elevate the intracranial pressure. If early fracture fixation is necessary, the intracranial pressure should be monitored and the cerebral perfusion pressure maintained during the procedure. Immediate reamed intramedullary nailing is appropriate if the patient is hemodynamically stable and the cerebral perfusion pressure is maintained. If not, external fixation would be appropriate treatment. Temporary skeletal traction may be appropriate if the intracranial pressure is labile and precludes the patient from going to the operating room.
References: Anglen JO, Luber K, Park T. The effect of femoral nailing on cerebral perfusion pressure in head-injured patients. *J Trauma* 2003; **54**:l166–1170.
Pietropaoli JA, Rogers FB, Shackford SR, Wald SL, Schmoker JD, Zhuang J. The deleterious effects of intraoperative hypotension on outcome in patients with severe head injuries. *J Trauma* 1992; **33**:403–407.
McKee MD, Schemitsch EH, Vincent LO, Sullivan I, Yoo D. The effect of a femoral fracture on concomitant closed head injury in patients with multiple injuries. *J Trauma* 1997; **42**:1041–1045.

(2) Preferred response: 3

Discussion: The lateral femoral cutaneous nerve most commonly originates from the lumbar plexus and runs on the surface of the iliacus muscle and enters the thigh by passing under the inguinal ligament before piercing the fascia lata. Its path can be variable.
References: Hoppenfeld S, deBoer P, Buckley R, editors. *Surgical exposures in orthopaedics: the anatomic approach.* 4th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2009. pp. 440–441.
Anderson JE, editor. *Grant's atlas of anatomy.* 8th ed. Baltimore/London: Williams and Wilkins; 1983:fig 4–7, 4–18, 4–20.
Masquelet AC, McCullough CJ, Tubiana R. *An atlas of surgical exposures of the lower extremity.* Philadelphia, PA: JB Lippincott; 1993. pp. 7, 10.

(3) Preferred response: 3

Discussion: Karunakar and colleagues showed in a canine model that there is no significant difference in the heat generated during reaming with and without a tourniquet. The factor that made the most difference was related to the size of the reamer used compared with the diameter of the isthmus. Giannoudis and colleagues conducted a prospective randomized trial on 34 patients that evaluated the same topic as the first study with the same methodology, and the conclusions were again the same. The factor that generated the most heat was using large reamers (11–12 mm) in a patient with a small isthmus (8–9 mm). Systemic lupus erythematosus, steroid use, and knee flexion during reaming have not been shown to be associated with diaphyseal necrosis after reamed tibial nailing.
References: Giannoudis PV, Snowden S, Matthews SJ, Smye SW, Smith RM. Friction burns within the tibia during reaming. Are they affected by the use of a tourniquet? *J Bone Joint Surg Br* 2002; **84**:492–496.
Karunakar MA, Frankenburg EP, Le TT, Hall J. The thermal effects of intramedullary reaming. *J Orthop Trauma* 2004; **18**:674–679.

(4) Preferred response: 2

Discussion: There are relatively few comparative studies of the treatment of diaphyseal fractures of the humerus in the literature. In a meta-analysis of three prospective randomized trials comparing ORIF with IMN, open reduction and internal fixation showed a 90% risk reduction of shoulder impingement symptoms and a 75% risk reduction of

reoperation. There was no difference in the infection rate, nonunion rate, and radial nerve issues.

References: Bhandari M, Devereaux PJ, McKee MD, Schemitsch EH. Compression plating versus intramedullary nailing of humeral shaft fractures – a meta-analysis. *Acta Orthop* 2006; **77**:279–284.

Green A, Reid JS, Carlson DA. Fractures of the humerus. In: Baumgaertner MR, Tornetta P III, editors. *Orthopaedic knowledge update: trauma 3*. Rosemont, IL: American Academy of Orthopaedic Surgeons; 2005. pp. 163–180.

(5) Preferred response: 2

Discussion: Significant basic science research has been carried out on identifying inflammatory markers associated with systemic inflammatory response following trauma and musculoskeletal injury. Although not yet clinically applicable, IL-6 has been identified as a marker that correlates well with musculoskeletal injury (i.e. femur fracture) and treatment of these injuries (i.e. intramedullary nailing). IL-1 and IL-10 do not correlate with the treatment of musculoskeletal injury. Tumor necrosis factor-$\alpha$ and D-dimer, although often elevated following trauma, do not correlate with musculoskeletal treatment.

References: Sears BW, Stover MD, Callaci J. Pathoanatomy and clinical correlates of the immunoinflammatory response following orthopaedic trauma. *J Am Acad Orthop Surg* 2009; **17**:255–265.

Pape HC, Griensven MV, Hildebrand FF, Tzioupis CT, Sommer KL, Krettek CC, Giannoudis PV; Epoff Study Group. Systemic inflammatory response after extremity or truncal fracture operations. *J Trauma* 2008; **65**:1379–1384.

Pape HC, Schmidt RE, Rice J, van Griensven M, das Gupta R, Krettek C, Tscherne H. Biochemical changes after trauma and skeletal surgery of the lower extremity: quantification of the operative burden. *Crit Care Med* 2000; **28**:3441–3448.

(6) Preferred response: 4

Discussion: Fractures of the proximal metadiaphysis of the tibia can be treated successfully with intramedullary nails but historic rates of malalignment are up to 84%. The typical deformity is valgus and procurvatum because of the metaphyseal bony anatomy, eccentric start point, deforming force of the patellar tendon, and implant factors such as the Herzog curve of the nail. An ideal starting point is mandatory and should be at the medial border of the lateral tibial eminence on a true AP view and very proximal and anterior on a true lateral view with appropriate coronal and sagittal trajectory of the entry reamer. A reduction should be obtained and maintained during reaming, implant insertion, and interlocking. This can be facilitated by a variety of techniques including intraoperative external fixation, percutaneous reduction clamps or joysticks, semi-extended positioning, blocking screws, and ancillary plate fixation.

References: Higgins T, Templeman D. Fractures of the tibial diaphysis. In: Baumgaertner MR, Tornetta P III, editors. *Orthopaedic knowledge update: trauma 3.* Rosemont, IL: American Academy of Orthopaedic Surgeons; 2005. pp. 431–439.

Lang GJ, Cohen BE, Bosse MJ, Kellam JF. Proximal third tibial shaft fractures. Should they be nailed? *Clin Orthop Relat Res* 1995; (315):64–74.

(7) Preferred response: 1

Discussion: Whereas all of the factors will have an impact on frame rigidity and stability, the single biggest factor is the pin diameter because it has an exponential effect.

References: Ruedi TR, Buckley RE, Moran CG, editors. *AO principles of fracture management.* 2nd ed. New York, NY: Thieme; 2007.

Hipp JA, Hayes WC. Biomechanics of fractures. In: Browner BD, Jupiter JB, Levine AM, Trafton P, Krettek C, editors. *Skeletal trauma: basic science, management, and reconstruction.* 3rd ed. Philadelphia, PA: Saunders Elsevier; 2003. pp. 51–82.

(8) Preferred response: 1

Discussion: The trochanteric entry portal for femoral nail insertion is increasingly being used by orthopedic surgeons both for cephalomedullary implants and standard femoral nailing. In contradistinction to the piriformis fossa, the tip of the trochanter is not colinear to the diaphyseal isthmus and an errant start can lead to the introduction of malalignment and/or iatrogenic comminution at the fracture site. The desired starting point should be at the tip or slightly medial to the tip of the greater trochanter to avoid varus malalignment and blowout of the lateral wall.

References: Ruedi TR, Buckley RE, Moran CG, editors. *AO principles of fracture management.* 2nd ed. New York, NY: Thieme; 2007.

Ostrum RF, Marcantonio A, Marburger R. A critical analysis of the eccentric starting point for trochanteric intramedullary femoral nailing. *J Orthop Trauma* 2005; **19**:681–686.

(9) Preferred response: 1

Discussion: The Lower Extremity Assessment Project data have shown that absent plantar sensation is not an indication for primary amputation. When looking at a comparison between an insensate salvage group and a sensate salvage group at 2 years' follow-up, both groups had an equal proportion (55%) of normal plantar sensation and functionally both groups were equivalent. Absent plantar sensation at the initial evaluation is not prognostic for long-term plantar sensory status or functional outcome.

References: Bosse MJ, McCarthy ML, Jones AL, Webb LX, Sims SH, Sanders RW, MacKenzie EJ; Lower Extremity Assessment Project (LEAP) Study Group. The insensate foot following severe lower extremity trauma: an indication for amputation? *J Bone Joint Surg Am* 2005; **87**:2601–2608.
MacKenzie EJ, Bosse MJ. Factors influencing outcome following limb-threatening lower limb trauma: lessons learned from the Lower Extremity Assessment Project (LEAP). *J Am Acad Orthop Surg* 2006; **14**:S205–S210.

(10) Preferred response: 4

Discussion: Locking screw fixation is a relatively new option in the armamentarium of orthopedic surgeons treating fractures. The understanding of the biomechanics, implications to healing, and optimal indications and surgical techniques is still in evolution. A periprosthetic proximal femur fracture with a stable prosthesis is best treated with open reduction and internal fixation with locking proximal fixation with or without cerclage cables. Diaphyseal fractures treated with compression plating or bridge plating can be treated well with conventional implants unless osteoporosis is severe. An AO/OTA B-type partial articular fracture is also better suited to standard buttress plating with periarticular rafting lag screws. Locking fixation is not always required for a transverse displaced midshaft clavicle fracture.

References: Anglen J, Kyle RF, Marsh JL, Virkus WW, Watters WC III, Keith MW, *et al.* Locking plates for extremity fractures. *J Am Acad Orthop Surg* 2009; **17**:465–472.
Cantu RV, Koval KJ. The use of locking plates in fracture care. *J Am Acad Orthop Surg* 2006; **14**:183–190.

(11) Preferred response: 1

Discussion: The most common pattern of coronoid fracture with a terrible triad injury is a transverse fracture of 2–3 mm of the tip. The mechanism of injury of a terrible triad injury is typically valgus and supination. These forces force the radial head against and then under the capitellum, resulting in a fracture of the radial head. The coronoid is then driven under the trochlea and sheared off as the valgus force continues. The lateral collateral ligament typically tears next.

References: Steinmann SP. Coronoid process fracture. *J Am Acad Orthop Surg* 2008; **16**:519–529.
Doornberg JN, Ring D. Coronoid fracture patterns. *J Hand Surg Am* 2006; **31**:45–52.
Doornberg JN, Ring DC. Fracture of the anteromedial facet of the coronoid process. *J Bone Joint Surg Am* 2006; **88**:2216–2224.

(12) Preferred response: 1

Discussion: Loizou and colleagues prospectively studied 1023 patients who sustained an intracapsular hip fracture that was treated with internal fixation using contemporary methods. The overall incidence of osteonecrosis was 6.6%. Osteonecrosis was less common for undisplaced (4.0%) than for displaced fractures (9.5%) and in men (4.9%) than women (11.4%) who had a displaced fracture. The incidence of osteonecrosis for those patients younger than 60 years and who sustained a displaced fracture was 20.6% compared with 12.5% for those aged 60–80 years and 2.5% for those older than 80 years of age. Barnes and colleagues reported that late segmental collapse was more common in displaced fractures in women younger than 75 years than in those older than 75 years.

References: Loizou CL, Parker MJ. Avascular necrosis after internal fixation of intracapsular hip fractures; a study of the outcome for 1023 patients. *Injury* 2009; **40**:1143–1146.
Barnes R, Brown JT, Garden RS, Nicoll EA. Subcapital fractures of the femur. A prospective review. *J Bone Joint Surg Br* 1976; **58**:2–24.

(13) Preferred response: 4

Discussion: The established criteria for interpreting a significant change are 50% decrease in signal amplitude, 10% latency increase, and/or a complete loss of potential. Intraoperative spinal cord monitoring during spinal surgery generally consists of a combination of monitoring modalities.
Somatosensory-evoked potentials in combination with intraoperative electromyography can provide adequate coverage of sensory and motor components of spinal cord and nerve root function. Significant changes in evoked potential waveform characteristics can reflect dysfunction of the ascending somatosensory system.

References: Devlin VJ, Schwartz DM. Intraoperative neurophysiologic monitoring during spinal surgery. *J Am Acad Orthop Surg* 2007; **15**:549–560.
Weiss DS. Spinal cord and nerve root monitoring during surgical treatment of lumbar stenosis. *Clin Orthop Relat Res* 2001; (384):82–100.

(14) Preferred response: 3

Discussion: The patient was involved in a low-speed rear-end collision and sustained a whiplash-type injury, with management most often being nonsurgical. After 4 weeks of persistent pain, continued observation is not reasonable. Studies have shown that treatment including NSAIDs, activity modification, and a brief duration of physical therapy allows for improved outcomes after whiplash-type injuries when compared with observation alone. An MRI scan of the cervical spine is not indicated at this time and represents an unnecessary expense. Cervical epidural and facet injections are not indicated in the treatment of patients with whiplash injuries.

References: Rao RD, Currier BL, Albert TJ, Bono CM, Marawar SV, Poelstra KA, Eck JC. Degenerative cervical spondylosis: clinical syndromes, pathogenesis, and management. *J Bone Joint Surg Am* 2007; **89**:1360–1378.

Philadelphia Panel. Philadelphia Panel evidence-based clinical practice guidelines on selected rehabilitation interventions for neck pain. *Phys Ther* 2001; **81**:1701–1717.

(15) Preferred response: 2

Discussion: The L5 nerve root is especially vulnerable and prone to injury after the reduction of spondylolisthesis in patients with mid-grade and high-grade isthmic spondylolisthesis. The genitofemoral nerve is more commonly injured during anterior retroperitoneal approaches to the lumbar spine. Injury to the cauda equina often leads to bowel and bladder dysfunction and lower extremity weakness and is uncommon after reduction maneuvers.

References: Jones TR, Rao RD. Adult isthmic spondylolisthesis. *J Am Acad Orthop Surg* 2009; **17**:609–617.
Petraco DM, Spivak JM, Cappadona JG, Kummer FJ, Neuwirth MG. An anatomic evaluation of L5 nerve stretch in spondylolisthesis reduction. *Spine (Phila Pa 1976)* 1996; **21**:1133–1138; discussion 1139.

(16) Preferred response: 1

Discussion: What is now referred to as Lhermitte sign was first described by Marie and Chatelin in 1917 to describe 'transient "pins and needles" sensations traveling the spine and limbs on flexion of the head' in some patients with head injuries. A positive test is indicated by the presence of electric-like sensation down the spine or extremities. It is associated with cervical spinal cord pathology from a wide variety of etiologies, including multiple sclerosis. Recent studies suggest that it has a low sensitivity and high specificity. Spurling's sign is elicited by axial compression of the tilted head. Jackson's sign is elicited by hyperextension of the cervical spine. Lasegue sign refers to the straight leg raise with dorsiflexion of the ankle for lumbar radiculopathy. Hoffmann sign is a pathologic reflex of the upper extremity that is considered to be an indicator of cervical myelopathy.

References: Landes P, Malanga GA, Nadler SF. Physical examination of the cervical spine. In: Malanga GA, Nadler SF, editors. *Musculoskeletal physical examination: an evidence-based approach.* Philadelphia, PA: Elsevier; 2006. pp. 33–58.
Rhee JM, Riew KD. Cervical spondylotic myelopathy: including ossification of the posterior longitudinal ligament. In: Spivak JM, Connolly PJ, editors. *Orthopaedic knowledge update: spine 3.* Rosemont, IL: American Academy of Orthopaedic Surgeons; 2006. pp. 235–249.
Uchihara T, Furukawa T, Tsukagoshi H. Compression of brachial plexus as a diagnostic test of cervical cord lesion. *Spine (Phila Pa 1976)* 1994; **19**:2170–2173.

(17) Preferred response: 3

Discussion: The patient is a candidate for a revision diskectomy. Outcomes of revision diskectomy are almost as good as those reported for primary diskectomy. Reduction in leg pain is expected. An indication for fusion would be a concomitant instability at the planned surgical level. Although controversial, artificial disk replacement might be considered if there is a significant component of diskogenic pain without instability. However, disk replacement is not the first choice of treatment in this case. Interspinous process spacers are not currently indicated in this situation.

References: Stambough J. An algorithmic approach to recurrent lumbar disc herniation: evaluation and management. *Semin Spine Surg* 2008; **20**:2–13.
Bendo JA, Awad IN. Lumbar disk herniation. In: Spivak JM, Connolly PJ, editors. *Orthopaedic knowledge update: spine 3.* Rosemont, IL: American Academy of Orthopaedic Surgeons; 2006. pp. 289–297.

(18) Preferred response: 4

Discussion: Despite the ease of attainment, radiographs only accurately diagnose failed arthrodesis in 60–80% of uninstrumented cases and these numbers are even lower in cases with posterior instrumentation. The role of dynamic radiographs remains unclear because of the paucity of normative data values after lumbar spine fusion. CT scans provide excellent bony detail and their images are not affected by metal components as in MRI. Postmyelogram CT is useful for identifying neurologic compression.

References: Patel AA, Spiker WR. Update on the diagnosis and treatment of lumbar nonunions. *Semin Spine Surg* 2008; **20**:20–26.
Shen FH, Shaffrey CI, editors. *Arthritis and arthroplasty: the spine.* Philadelphia, PA: Saunders; 2010. pp. 274.

(19) Preferred response: 1

Discussion: The treatment options for a type II odontoid fracture include halo immobilization, odontoid screw fixation, and posterior atlantoaxial arthrodesis. However, surgical care at this time without attempting nonsurgical management is not warranted; therefore, the most appropriate management at this time is immobilization in a rigid cervical orthosis for 6–8 weeks. Halo vest fixation can lead to high healing rates but is generally contraindicated in elderly patients, especially one with COPD and dementia. Posterior surgical fusion techniques provide high fusion rates, but do so at the expense of loss of cervical rotation and surgical complications. Resection of a nondisplaced odontoid fracture without cord compression by a transoral approach is not necessary.

References: Koech F, Ackland HM, Varma DK, Williamson OD, Malham GM. Nonoperative management of type II odontoid fractures in the elderly. *Spine (Phila Pa 1976)* 2008; **33**:2881–2886.
Majercik S, Tashjian RZ, Biffl WL, Harrington DT, Cioffi WG. Halo vest immobilization in the elderly: a death sentence? *J Trauma* 2005; **59**:350–356; discussion 356–358.

(20) Preferred response: 5

Discussion: The patient's history and examination findings are consistent with a lumbar disk herniation at the L5–S1 level. Weakness of the gastrocnemius and gluteus maximus is consistent with an S1 lumbar radiculopathy. Nerve root tension signs are also consistent with a disk herniation at L5–S1, which typically affects the traversing S1 nerve root.

References: Hoppenfeld S. *Orthopaedic neurology: a diagnostic guide to neurologic levels*. Philadelphia, PA: JB Lippincott; 1977. pp. 45–74.
Haak MH. History and physical examination. In: Spivak JM, Connolly PJ, editors. *Orthopaedic knowledge update: spine 3.* Rosemont, IL: American Academy of Orthopaedic Surgeons; 2006. pp. 43–55.