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2024 HealthHelp Spine Procedures

Musculoskeletal Procedures

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Contraindications and Exclusions for Spine Surgery

Spinal surgery may be contraindicated or excluded due to ANY of the following conditions:

- Medical comorbid conditions that increase surgical risks (eg, systemic infection, infection around operative area of spine, severe cardiovascular or pulmonary diseases, malnutrition, anemia) [169] [43]
- Morbid obesity (body mass index [BMI] is 40 or higher) [135]
- Nicotine use *in the 6 weeks before surgery*. [169] [26]
- Psychological and behavioral health conditions that modify pain presentation (eg, depression, hyperchondriosis) or mimic radiculopathy or instability (eg, peripheral neuropathy, piriformis syndrome, myofascial pain, sacroiliac dysfunction) have **NOT** been ruled-out. [45]

Cervical Spine Procedures

Cervical Spine Disc Arthroplasty Guideline

Cervical artificial disc replacement (arthroplasty) is considered medically appropriate when the documentation demonstrates **ALL** of the following: [44] [83]

1. Conservative therapy attempted including **ALL** of the following:
 - a. Physical therapy (PT) program that is supervised by a licensed physical therapist or chiropractor for *at least 6 weeks in the past 6 months* with **NO** improvement in symptoms or functional ability.¹ ***NOTE:** *If PT notes demonstrate improvement in pain or functional ability, additional conservative therapy (non-surgical) is required, with a reevaluation of pain and functional status prior to considering surgical intervention.*
 - b. Pain management plan includes **EITHER** of the following:
 - i. Medication with non-steroidal anti-inflammatory drugs (NSAIDS) for *at least 4 weeks*.
 - ii. Non-medication pain management interventions attempted (eg, ice/heat, exercises, weight-limits, rest periods, splints)
2. Imaging studies (CT, MRI) demonstrate compression at levels corresponding to clinical findings.

¹A home exercise program that is self-managed or is **NOT** supervised by PT or a chiropractor is insufficient to meet this indication.

3. Radiculopathy is intractable due to 1 or 2 level disc disease at C3 to C7, resulting in central, lateral recess, or foraminal compression (herniated or spondylolytic osteophyte)

Anterior Cervical Spine Disc Arthroplasty Contraindications

Contraindications or exclusions to an anterior cervical artificial disc replacement include prior surgery at the level to be treated.

Cervical Spine Disc Arthroplasty Contraindications

Contraindications or exclusions to a cervical artificial disc replacement include **ANY** of the following: [44] [147]

1. More than 3 vertebral levels requiring treatment
2. Cervical instability (translation more than 3 mm and/or more than 11-degree rotational difference to that or either adjacent level)
3. Known allergy to implant materials (titanium, polyethylene, cobalt, chromium, and molybdenum)
4. Posttraumatic vertebral body deficiency/deformity
5. Facet joint degeneration
6. Neck or arm pain of unknown etiology
7. Axial neck pain as the solitary presenting symptom
8. Severe spondylosis (bridging osteophytes, disc height loss more than 50%, and absence of motion less than 2 degrees)
9. Osteoporosis/osteopenia
10. Active malignancy; history of invasive malignancy, unless treated and asymptomatic for at least 5 years
11. Systemic disease (acquired immune deficiency syndrome, human immunodeficiency virus, hepatitis B or C, and insulin-dependent diabetes)
12. Other metabolic bone disease (eg, Paget disease and osteomalacia)
13. Morbid obesity (body mass index [BMI] more than 40 or weight more than 100 lb over ideal body weight)
14. Active local/systemic infection
15. Presently on medications that can interfere with bone/soft-tissue healing (eg, corticosteroids)
16. Autoimmune spondyloarthropathies (rheumatoid arthritis)

Cervical Spine Decompression: Anterior With Fusion (ACDF) • Posterior With or Without Fusion Guideline

Laminectomy • Laminoplasty • Laminoforaminotomy

An anterior cervical decompression with fusion (ACDF) or posterior cervical decompression with or without fusion (ie, laminectomy, laminoplasty, laminoforaminotomy) is considered medically appropriate when the documentation demonstrates **ANY** of the following: [77] [186]

1. Cervical myelopathy or radiculopathy from deformity, ruptured disc, spinal instability or spondylosis **AND ANY** of the following:[39] [11]²
 - a. Conservative therapy attempted including **ALL** of the following:
 - i. Physical therapy (PT) program that is supervised by a licensed physical therapist or chiropractor for *at least 6 weeks in the past 6 months* with **NO** improvement in symptoms or functional ability.³ ***NOTE:** *If PT notes demonstrate improvement in pain or functional ability, additional conservative therapy (non-surgical) is required, with a reevaluation of pain and functional status prior to considering surgical intervention.*
 - ii. Pain management plan includes **EITHER** of the following:
 - A. Medication with non-steroidal anti-inflammatory drugs (NSAIDS) for *at least 4 weeks*.
 - B. Non-medication pain management interventions attempted (eg, ice/heat, exercises, weight-limits, rest periods, splints)
 - b. Imaging (CT, MRI) demonstrate spinal cord or nerve root decompression at the levels corresponding to clinical findings.
2. Decompression with fusion as first-line treatment *without conservative care* when **ALL** of the following are true: [173]
 - a. Spinal cord or nerve decompression is significant and due to infection, trauma or tumor.
 - b. X-rays demonstrate fracture or instability measure of **EITHER**:
 - i. C1 level subluxation of the atlantodental interval of more than 3 mm in adult or 5 mm in a child

²Myelopathy with spinal cord compression symptoms (eg, progressive neurological deficits including extremity weakness, gait/coordination disturbance, hyperreflexia, clonus, positive Babinski or Hoffman sign) require immediate surgical evaluation.

³A home exercise program that is self-managed or is **NOT** supervised by PT or a chiropractor is insufficient to meet this indication.

- ii. Sagittal plane angle is more than 11 degrees for one interspace or more than 3.5 mm anterior subluxation associated with cord/radicular dysfunction.
3. Decompression without fusion as first-line treatment without conservative care when spinal cord or nerve decompression is significant and due to infection, trauma or tumor. [55]

Cervical Spine Decompression: Anterior Without Fusion

• Cervical Spine Fusion: Anterior Without Decompression Guideline

Anterior cervical decompression without a fusion, or a fusion without a decompression:

- The role of this therapy is uncertain/unclear in the current evidence. Requests for this therapy require review by a physician reviewer, medical director and/or the individual's health-plan.

Cervical Spine Decompression: Posterior With Fusion Guideline

Posterior cervical spine fusion is considered medically appropriate when the documentation demonstrates **ALL** of the following: [68] [153]

1. Axial neck pain is non-radicular and pain generators are defined and treated.
2. Comorbidities confounding condition are managed (eg, comorbid behavioral health diagnosis is addressed).
3. Conservative therapy attempted including **ALL** of the following:
 - a. Physical therapy (PT) program that is supervised by a licensed physical therapist or chiropractor for *at least 6 weeks in the past 6 months* with **NO** improvement in symptoms or functional ability.⁴ ***NOTE:** *If PT notes demonstrate improvement in pain or functional ability, additional conservative therapy (non-surgical) is required, with a reevaluation of pain and functional status prior to considering surgical intervention.*
 - b. Pain management plan includes **EITHER** of the following:
 - i. Medication with non-steroidal anti-inflammatory drugs (NSAIDS) for *at least 4 weeks*.
 - ii. Non-medication pain management interventions attempted (eg, ice/heat, exercises, weight-limits, rest periods, splints)

⁴A home exercise program that is self-managed or is **NOT** supervised by PT or a chiropractor is insufficient to meet this indication.

4. Imaging (x-ray, CT, MRI) demonstrates disc pathology or spinal instability.
5. Spine pathology affects 2 levels or less.

Cervical Spine Decompression or Fusion Contraindications or Exclusions

Contraindications or exclusions for a cervical spine decompression or fusion include **ANY** of the following: [171] [77]

- Asymptomatic or mildly symptomatic
- Neck pain with **NO** neurological defects and **NO** spinal nerve root or cord compression on imaging
- Decompression alone with diagnosis of kyphosis or postoperative high risk for kyphosis.

Cervical Spine Procedures Associated LCDs



LCD 34228

See also, **LCD 34228**: Percutaneous Vertebral Augmentation (PVA) for Osteoporotic Vertebral Compression Fracture (VCF) at <https://www.cms.gov/medicare-coverage-database/search.aspx> if applicable to individual's healthplan membership.



LCD 38737

See also, **LCD 38737**: [Percutaneous Vertebral Augmentation (PVA) for Vertebral Compression Fracture (VCF)] at <https://www.cms.gov/medicare-coverage-database/search.aspx> if applicable to individual's healthplan membership.



LCD 38033

See also, **LCD 38033**: Cervical Disc Replacement at <https://www.cms.gov/medicare-coverage-database/search.aspx> if applicable to individual's healthplan membership.



LCD 33569

See also, **LCD 33569**: Percutaneous Vertebral Augmentation (PVA) for Osteoporotic Vertebral Compression Fracture (VCF) at <https://www.cms.gov/medicare-coverage-database/search.aspx> if applicable to individual's healthplan membership.



LCD 38201

See also, **LCD 38201**: Percutaneous Vertebral Augmentation (PVA) for Vertebral Compression Fracture (VCF) at <https://www.cms.gov/medicare-coverage-database/search.aspx> if applicable to individual's healthplan membership.



LCD 34976

See also, **LCD 34976**: Percutaneous Vertebral Augmentation (PVA) for Vertebral Compression Fracture (VCF) at <https://www.cms.gov/medicare-coverage-database/search.aspx> if applicable to individual's healthplan membership.



LCD 35130

See also, **LCD 35130**: Percutaneous Vertebral Augmentation (PVA) for Vertebral Compression Fracture (VCF) at <https://www.cms.gov/medicare-coverage-database/search.aspx> if applicable to individual's healthplan membership.



LCD 34106

See also, **LCD 34106**: Percutaneous Vertebral Augmentation (PVA) for Osteoporotic Vertebral Compression Fracture (VCF) at <https://www.cms.gov/medicare-coverage-database/search.aspx> if applicable to individual's healthplan membership.

Cervical Spine Surgery Procedure Codes

Table 1. Cervical Spine Surgery Associated Procedure Codes

CODE	DESCRIPTION
22210	Osteotomy of spine, posterior or posterolateral approach, 1 vertebral segment; cervical

CODE	DESCRIPTION
22220	Osteotomy of spine, including discectomy, anterior approach, single vertebral segment; cervical
22510	Percutaneous vertebroplasty (bone biopsy included when performed), 1 vertebral body, unilateral or bilateral injection, inclusive of all imaging guidance; cervicothoracic
22526	Percutaneous intradiscal electrothermal annuloplasty, unilateral or bilateral including fluoroscopic guidance; single level
22548	Arthrodesis, anterior transoral or extraoral technique, clivus-C1-C2 (atlas-axis), with or without excision of odontoid process
22551	Arthrodesis, anterior interbody, including disc space preparation, discectomy, osteophyctectomy and decompression of spinal cord and/or nerve roots; cervical below C2
22552	Arthrodesis, anterior interbody, including disc space preparation, discectomy, osteophyctectomy and decompression of spinal cord and/or nerve roots; cervical below C2, each additional interspace (List separately in addition to code for separate procedure)
22554	Arthrodesis, anterior interbody technique, including minimal discectomy to prepare interspace (other than for decompression); cervical below C2
22590	Arthrodesis, posterior technique, craniocervical (occiput-C2)
22595	Arthrodesis, posterior technique, atlas-axis (C1-C2)
22600	Arthrodesis, posterior or posterolateral technique, single interspace; cervical below C2 segment
22800	Arthrodesis, posterior, for spinal deformity, with or without cast; up to 6 vertebral segments
22802	Arthrodesis, posterior, for spinal deformity, with or without cast; 7 to 12 vertebral segments
22804	Arthrodesis, posterior, for spinal deformity, with or without cast; 13 or more vertebral segments
22808	Arthrodesis, anterior, for spinal deformity, with or without cast; 2 to 3 vertebral segments
22810	Arthrodesis, anterior, for spinal deformity, with or without cast; 4 to 7 vertebral segments
22812	Arthrodesis, anterior, for spinal deformity, with or without cast; 8 or more vertebral segments
22818	Kyphectomy, circumferential exposure of spine and resection of vertebral segment(s) (including body and posterior elements); single or 2 segments
22819	Kyphectomy, circumferential exposure of spine and resection of vertebral segment(s) (including body and posterior elements); 3 or more segments
22849	Reinsertion of spinal fixation device
22850	Removal of posterior nonsegmental instrumentation (eg, Harrington rod)
22852	Removal of posterior segmental instrumentation
22855	Removal of anterior instrumentation
22856	Total disc arthroplasty (artificial disc), anterior approach, including discectomy with end plate preparation (includes osteophyctectomy for nerve root or spinal cord decompression and microdissection); single interspace, cervical
22858	Total disc arthroplasty (artificial disc), anterior approach, including discectomy with end plate preparation (includes osteophyctectomy for nerve root or spinal cord decompression and microdissection); second level, cervical (List separately in addition to code for primary procedure)
22861	Revision including replacement of total disc arthroplasty (artificial disc), anterior approach, single interspace; cervical
22864	Removal of total disc arthroplasty (artificial disc), anterior approach, single interspace; cervical

CODE	DESCRIPTION
63001	Laminectomy with exploration and/or decompression of spinal cord and/or cauda equina, without facetectomy, foraminotomy or discectomy (eg, spinal stenosis), 1 or 2 vertebral segments; cervical
63015	Laminectomy with exploration and/or decompression of spinal cord and/or cauda equina, without facetectomy, foraminotomy or discectomy (eg, spinal stenosis), more than 2 vertebral segments; cervical
63020	Laminotomy (hemilaminectomy), with decompression of nerve root(s), including partial facetectomy, foraminotomy and/or excision of herniated intervertebral disc; 1 interspace, cervical
63040	Laminotomy (hemilaminectomy), with decompression of nerve root (s), including partial facetectomy, foraminotomy and / ot excision or herniated intervertebral disc, reexploration, single interspace; cervical
63045	Laminectomy, facetectomy and foraminotomy (unilateral or bilateral with decompression of spinal cord, cauda equina and/or nerve root[s], [eg, spinal or lateral recess stenosis]), single vertebral segment; cervical
63050	Laminoplasty, cervical, with decompression of the spinal cord, 2 or more vertebral segments;
63051	Laminoplasty, cervical, with decompression of the spinal cord, 2 or more vertebral segments; with reconstruction of the posterior bony elements (including the application of bridging bone graft and non-segmental fixation devices [eg, wire, suture, mini-plates], when performed)
63075	Discectomy, anterior, with decompression of spinal cord and/or nerve root(s), including osteophylectomy; cervical, single interspace
63081	Vertebral corpectomy (vertebral body resection), partial or complete, anterior approach with decompression of spinal cord and/or nerve root(s); cervical, single segment
63185	Laminectomy with rhizotomy; 1 or 2 segments
63190	Laminectomy with rhizotomy; more than 2 segments
63191	Laminectomy with section of spinal accessory nerve
63250	Laminectomy for excision or occlusion of arteriovenous malformation of spinal cord; cervical
63300	Vertebral corpectomy (vertebral body resection), partial or complete, for excision of intraspinal lesion, single segment; extradural, cervical
63304	Vertebral corpectomy (vertebral body resection), partial or complete, for excision of intraspinal lesion, single segment; intradural, cervical
0219T	Placement of a posterior intrafacet implant(s), unilateral or bilateral, including imaging and placement of bone graft(s) or synthetic device(s), single level; cervical
0274T	Percutaneous laminotomy/laminectomy (interlaminar approach) for decompression of neural elements, (with or without ligamentous resection, discectomy, facetectomy and/or foraminotomy), any method, under indirect image guidance (eg, fluoroscopic, CT), with or without the use of an endoscope, single or multiple levels, unilateral or bilateral; cervical or thoracic

Lumbar-Sacral Spine Procedures

Lumbar Spine Decompression Guideline

Laminectomy • Laminotomy • Facetectomy • Foraminotomy

Lumbar decompression (laminectomy, laminotomy, facetectomy, foraminotomy) is considered medically appropriate when the documentation demonstrates **ALL** of the following: [89] [159]

1. Activities of daily living (ADLs) (eg, bathing, dressing, eating) are impaired due to neurogenic claudication and/or radicular leg pain.
2. Conservative therapy attempted including **ALL** of the following:
 - a. Physical therapy (PT) program that is supervised by a licensed physical therapist or chiropractor for *at least 6 weeks in the past 6 months* with **NO** improvement in symptoms or functional ability.⁵ ***NOTE:** *If PT notes demonstrate improvement in pain or functional ability, additional conservative therapy (non-surgical) is required, with a reevaluation of pain and functional status prior to considering surgical intervention.*
 - b. Pain management plan includes **EITHER** of the following:
 - i. Medication with non-steroidal anti-inflammatory drugs (NSAIDS) for *at least 4 weeks*.
 - ii. Non-medication pain management interventions attempted (eg, ice/heat, exercises, weight-limits, rest periods, splints)
3. Imaging demonstrates moderate to severe stenosis that is consistent with clinical findings.
4. Lumbar spinal stenosis

Lumbar Fusion Guideline

Lumbar Fusion: Single Level With or Without Decompression

Lumbar fusion at a single level, with or without decompression (laminectomy, laminotomy, facetectomy, foraminotomy) is considered medically appropriate when for **ALL** of the following exist: [9] [136]

1. Imaging studies align with clinical findings
2. Lumbar back pain, neurogenic claudication, and/or radicular leg pain without sensory or motor deficit that impairs activities of daily living (ADLs) for at least 6 months
3. **ONE** of the following:
 - A. Cauda equina syndrome (loss of bladder and bowel control)
 - B. Chronic low back pain or degenerative disc disease (disc degeneration without significant neurological compression presenting with low back pain) with **ALL** of the following:

⁵A home exercise program that is self-managed or is **NOT** supervised by PT or a chiropractor is insufficient to meet this indication.

- I. Cognitive behavioral rehabilitation program evaluation (eg: to identify underlying non-medical issue)
 - II. Conservative therapy attempted including **ALL** of the following:
 - 1. Physical therapy (PT) program that is supervised by a licensed physical therapist or chiropractor for *at least 6 weeks in the past 6 months* with **NO** improvement in symptoms or functional ability.⁶
**NOTE: If PT notes demonstrate improvement in pain or functional ability, additional conservative therapy (non-surgical) is required, with a reevaluation of pain and functional status prior to considering surgical intervention.*
 - 2. Pain management plan includes **EITHER** of the following:
 - a. Medication with non-steroidal anti-inflammatory drugs (NSAIDS) for *at least 4 weeks*.
 - b. Non-medication pain management interventions attempted (eg, ice/heat, exercises, weight-limits, rest periods, splints)
 - C. Neurological deficit(s) are acute, progressive and significant (motor function 5-point scale for L5 or S1 roots is 0 to 2, or for L3 and L4 roots is 0 to 3).
4. Condition includes **ANY** of the following:
- a. **ANY** of the following:
 - i. Prior procedure was for pseudoarthrosis at the same level.
 - ii. Repeat disk herniations
 - b. Fusion for the treatment of spinal tumor, cancer, or infection
 - c. Revision surgery due to failed previous procedure(s) when **ALL** of the following are true: (Note: Many recurrent disc herniations can be treated with discectomy alone, so specific indications for the addition of fusion will be required)
 - i. 6 months at minimum from prior surgery
 - ii. Significant functional gains are anticipated from this revision.
 - d. Segmental instability/excessive motion (eg, degenerative spondylolisthesis, segmental instability, surgically induced segmental instability)
 - e. Spondylolisthesis (eg, congenital unilateral neural arch hypoplasia, degenerative spondylolisthesis, neural arch defect)

⁶A home exercise program that is self-managed or is **NOT** supervised by PT or a chiropractor is insufficient to meet this indication.

Lumbar Fusion: Repeat or Multi-Level With or Without Decompression

Repeat lumbar fusions or multi-level lumbar fusions (with or without decompression):

- The role of this therapy is uncertain/unclear in the current evidence. Requests for this therapy require review by a physician reviewer, medical director and/or the individual's health-plan.

Lumbar Discectomy, Percutaneous • Disc Decompression, Radiofrequency Guideline

Percutaneous lumbar discectomy and radiofrequency disc decompression:

- The role of this therapy is uncertain/unclear in the current evidence. Requests for this therapy require review by a physician reviewer, medical director and/or the individual's health-plan.

Lumbar Spine Discectomy/Microdiscectomy Guideline

A lumbar discectomy/microdiscectomy is considered medically appropriate when the documentation demonstrates **ANY** of the following: [23] [182] [27]

1. Herniation, inter-vertebral disc demonstrated on imaging that exactly correlates to clinical findings and **ALL** of the following:
 - a. Conservative therapy attempted including **ALL** of the following:
 - i. Physical therapy (PT) program that is supervised by a licensed physical therapist or chiropractor for *at least 6 weeks in the past 6 months* with **NO** improvement in symptoms or functional ability.⁷ ***NOTE:** *If PT notes demonstrate improvement in pain or functional ability, additional conservative therapy (non-surgical) is required, with a reevaluation of pain and functional status prior to considering surgical intervention.*
 - ii. Pain management plan includes **EITHER** of the following:
 - A. Medication with non-steroidal anti-inflammatory drugs (NSAIDS) for *at least 4 weeks*.
 - B. Non-medication pain management interventions attempted (eg, ice/heat, exercises, weight-limits, rest periods, splints)

⁷A home exercise program that is self-managed or is **NOT** supervised by PT or a chiropractor is insufficient to meet this indication.

- b. Radicular symptoms hinder activities of daily living (eg, bathing, dressing, eating)
- 2. Microdiscectomy is a first line treatment *without conservative therapy* for **ANY** of the following:
 - a. Cauda equina syndrome (bladder/bowel control is lost)
 - b. Neurological deficit that is significant (motor function scale for L3 or L4 roots 0 to 3 out of 5 or for L5 or S1 roots is 0 to 2 out of 5).

Lumbar Spine Procedures LCDs



LCD 34228

See also, **LCD 34228**: Percutaneous Vertebral Augmentation (PVA) for Osteoporotic Vertebral Compression Fracture (VCF) at <https://www.cms.gov/medicare-coverage-database/search.aspx> if applicable to individual's healthplan membership.



LCD 38737

See also, **LCD 38737**: [Percutaneous Vertebral Augmentation (PVA) for Vertebral Compression Fracture (VCF)] at <https://www.cms.gov/medicare-coverage-database/search.aspx> if applicable to individual's healthplan membership.



LCD 33569

See also, **LCD 33569**: Percutaneous Vertebral Augmentation (PVA) for Osteoporotic Vertebral Compression Fracture (VCF) at <https://www.cms.gov/medicare-coverage-database/search.aspx> if applicable to individual's healthplan membership.



LCD 38201

See also, **LCD 38201**: Percutaneous Vertebral Augmentation (PVA) for Vertebral Compression Fracture (VCF) at <https://www.cms.gov/medicare-coverage-database/search.aspx> if applicable to individual's healthplan membership.



LCD 34976

See also, **LCD 34976**: Percutaneous Vertebral Augmentation (PVA) for Vertebral Compression Fracture (VCF) at <https://www.cms.gov/medicare-coverage-data-base/search.aspx> if applicable to individual's healthplan membership.



LCD 35130

See also, **LCD 35130**: Percutaneous Vertebral Augmentation (PVA) for Vertebral Compression Fracture (VCF) at <https://www.cms.gov/medicare-coverage-data-base/search.aspx> if applicable to individual's healthplan membership.



LCD 34106

See also, **LCD 34106**: Percutaneous Vertebral Augmentation (PVA) for Osteoporotic Vertebral Compression Fracture (VCF) at <https://www.cms.gov/medicare-coverage-database/search.aspx> if applicable to individual's healthplan membership.



LCD 37826

See also, **LCD 37826**: Lumbar Artificial Disc Replacement at <https://www.cms.gov/medicare-coverage-database/search.aspx> if applicable to individual's healthplan membership.

As of 4/12/2024, Palmetto has non-coverage indications in L37826.

Lumbar Spine Surgery Procedure Codes

Table 1. Lumbar Spine Surgery Associated Procedure Codes

CODE	DESCRIPTION
22207	Osteotomy of spine, posterior or posterolateral approach, 3 columns, 1 vertebral segment (eg, pedicle/vertebral body subtraction); lumbar
22214	Osteotomy of spine, posterior or posterolateral approach, 1 vertebral segment; lumbar
22224	Osteotomy of spine, including discectomy, anterior approach, single vertebral segment; lumbar
22511	Percutaneous vertebroplasty (bone biopsy included when performed), 1 vertebral body, unilateral or bilateral injection, inclusive of all imaging guidance; lumbosacral

CODE	DESCRIPTION
22514	Percutaneous vertebral augmentation, including cavity creation (fracture reduction and bone biopsy included when performed) using mechanical device (eg, kyphoplasty), 1 vertebral body, unilateral or bilateral cannulation, inclusive of all imaging guidance; lumbar
22526	Percutaneous intradiscal electrothermal annuloplasty, unilateral or bilateral including fluoroscopic guidance; single level
22533	Arthrodesis, lateral extracavitary technique, including minimal discectomy to prepare interspace (other than for decompression); lumbar
22558	Arthrodesis, anterior interbody technique, including minimal discectomy to prepare interspace (other than for decompression); lumbar
22586	Arthrodesis, pre-sacral interbody technique, including disc space preparation, discectomy, with posterior instrumentation, with image guidance, includes bone graft when performed, L5-S1 interspace
22612	Arthrodesis, posterior or posterolateral technique, single level; lumbar (with lateral transverse technique, when performed)
22614	Arthrodesis, posterior or posterolateral technique, single interspace; each additional interspace (List separately in addition to code for primary procedure)
22630	Arthrodesis, posterior interbody technique, including laminectomy and/or discectomy to prepare interspace (other than for decompression), single interspace; lumbar
22633	Arthrodesis, combined posterior or posterolateral technique with posterior interbody technique including laminectomy and/or discectomy sufficient to prepare interspace (other than for decompression), single interspace and segment; lumbar
22800	Arthrodesis, posterior, for spinal deformity, with or without cast; up to 6 vertebral segments
22802	Arthrodesis, posterior, for spinal deformity, with or without cast; 7 to 12 vertebral segments
22804	Arthrodesis, posterior, for spinal deformity, with or without cast; 13 or more vertebral segments
22808	Arthrodesis, anterior, for spinal deformity, with or without cast; 2 to 3 vertebral segments
22810	Arthrodesis, anterior, for spinal deformity, with or without cast; 4 to 7 vertebral segments
22812	Arthrodesis, anterior, for spinal deformity, with or without cast; 8 or more vertebral segments
22818	Kyphectomy, circumferential exposure of spine and resection of vertebral segment(s) (including body and posterior elements); single or 2 segments
22819	Kyphectomy, circumferential exposure of spine and resection of vertebral segment(s) (including body and posterior elements); 3 or more segments
22849	Reinsertion of spinal fixation device
22850	Removal of posterior nonsegmental instrumentation (eg, Harrington rod)
22852	Removal of posterior segmental instrumentation
22855	Removal of anterior instrumentation
22857	Total disc arthroplasty (artificial disc), anterior approach, including discectomy to prepare interspace (other than for decompression), single interspace, lumbar
22862	Revision including replacement of total disc arthroplasty (artificial disc), anterior approach, single interspace; lumbar
22865	Removal of total disc arthroplasty (artificial disc), anterior approach, single interspace; lumbar
22867	Insertion of interlaminar/interspinous process stabilization/distraction device, without fusion, including image guidance when performed, with open decompression, lumbar; single level

CODE	DESCRIPTION
22869	Insertion of interlaminar/interspinous process stabilization/distraction device, without open decompression or fusion, including image guidance when performed, lumbar; single level
62380	Endoscopic decompression of spinal cord, nerve root(s), including laminotomy, partial facetectomy, foraminotomy, discectomy and/or excision of herniated intervertebral disc, 1 interspace, lumbar
63005	Laminectomy with exploration and/or decompression of spinal cord and/or cauda equina, without facetectomy, foraminotomy or discectomy (eg, spinal stenosis), 1 or 2 vertebral segments; lumbar, except for spondylolisthesis
63011	Laminectomy with exploration and/or decompression of spinal cord and/or cauda equina, without facetectomy, foraminotomy or discectomy (eg, spinal stenosis), 1 or 2 vertebral segments; sacral
63012	Laminectomy with removal of abnormal facets and/or pars inter-articularis with decompression of cauda equina and nerve roots for spondylolisthesis, lumbar (Gill type procedure)
63017	Laminectomy with exploration and/or decompression of spinal cord and/or cauda equina, without facetectomy, foraminotomy or discectomy (eg, spinal stenosis), more than 2 vertebral segments; lumbar
63030	Laminotomy (hemilaminectomy), with decompression of nerve root(s), including partial facetectomy, foraminotomy and/or excision of herniated intervertebral disc; 1 interspace, lumbar
63042	Laminotomy (hemilaminectomy), with decompression of nerve root(s), including partial facetectomy, foraminotomy and/or excision of herniated intervertebral disc, reexploration, single interspace; lumbar
63047	Laminectomy, facetectomy and foraminotomy (unilateral or bilateral with decompression of spinal cord, cauda equina and/or nerve root[s], [eg, spinal or lateral recess stenosis]), single vertebral segment; lumbar
63056	Transpedicular approach with decompression of spinal cord, equina and/or nerve root(s) (eg, herniated intervertebral disc), single segment; lumbar (including transfacet, or lateral extraforaminal approach) (eg, far lateral herniated intervertebral disc)
63087	Vertebral corpectomy (vertebral body resection), partial or complete, combined thoracolumbar approach with decompression of spinal cord, cauda equina or nerve root(s), lower thoracic or lumbar; single segment
63090	Vertebral corpectomy (vertebral body resection), partial or complete, transperitoneal or retroperitoneal approach with decompression of spinal cord, cauda equina or nerve root(s), lower thoracic, lumbar, or sacral; single segment
63102	Vertebral corpectomy (vertebral body resection), partial or complete, lateral extracavitary approach with decompression of spinal cord and/or nerve root(s) (eg, for tumor or retropulsed bone fragments); lumbar, single segment
63185	Laminectomy with rhizotomy; 1 or 2 segments
63190	Laminectomy with rhizotomy; more than 2 segments
63191	Laminectomy with section of spinal accessory nerve
63200	Laminectomy, with release of tethered spinal cord, lumbar
63252	Laminectomy for excision or occlusion of arteriovenous malformation of spinal cord; thoracolumbar
63303	Vertebral corpectomy (vertebral body resection), partial or complete, for excision of intraspinal lesion, single segment; extradural, lumbar or sacral by transperitoneal or retroperitoneal approach
63307	Vertebral corpectomy (vertebral body resection), partial or complete, for excision of intraspinal lesion, single segment; intradural, lumbar or sacral by transperitoneal or retroperitoneal approach
0202T	Posterior vertebral joint(s) arthroplasty (eg, facet joint[s] replacement), including facetectomy, laminectomy, foraminotomy, and vertebral column fixation, injection of bone cement, when performed, including fluoroscopy, single level, lumbar spine

CODE	DESCRIPTION
0221T	Placement of a posterior intrafacet implant(s), unilateral or bilateral, including imaging and placement of bone graft(s) or synthetic device(s), single level; lumbar
0275T	Percutaneous laminotomy/laminectomy (interlaminar approach) for decompression of neural elements, (with or without ligamentous resection, discectomy, facetectomy and/or foraminotomy), any method, under indirect image guidance (eg, fluoroscopic, CT), with or without the use of an endoscope, single or multiple levels, unilateral or bilateral; lumbar
C9757	Laminotomy (hemilaminectomy), with decompression of nerve root(s), including partial facetectomy, foraminotomy and excision of herniated intervertebral disc, and repair of annular defect with implantation of bone anchored annular closure device, including annular defect measurement, alignment and sizing assessment, and image guidance; 1 interspace, lumbar
S2350	Discectomy, anterior, with decompression of spinal cord and/or nerve root(s), including osteophylectomy; lumbar, single interspace

Spine Procedures Summary of Changes

The spinal procedures guidelines from 2023 to 2024 had the following changes:

- Citation updates completed per latest evidence review.

Cervical Spine Procedures

- **Cervical Spine Decompression: Anterior With Fusion (ACDF) • Posterior With or Without Fusion** guideline:
 - Updated Conservative therapy to clarify type of therapy, pain management, timeframes for treatment and when therapy should continue.
- **Cervical Spine Decompression: Posterior with Fusion** guideline:
 - Updated Conservative therapy to clarify type of therapy, pain management, timeframes for treatment and when therapy should continue.

Lumbar Spine Procedures

- **Lumbar Spine Decompression** guideline:
 - Updated Conservative therapy to clarify type of therapy, pain management, timeframes for treatment and when therapy should continue.
- **Lumbar Spine Fusion** guideline: *Single level with or without decompression*
 - Updated Conservative therapy to clarify type of therapy, pain management, timeframes for treatment and when therapy should continue.

Spine Surgery Definitions

Achondroplasia is the most common cause of dwarfism, or significantly abnormal short stature.

Adjacent segment disease is a progressed form of adjacent segment degeneration, a condition that often occurs after a spinal fusion or other back surgery. Spinal fusion is surgery that is typically performed when vertebrae become so unstable that movement affects the nerves or causes pain.

Anastomosis is a connection made surgically between adjacent blood vessels, parts of the intestine or other channels of the body.

Aneurysmal cyst is a benign, blood-filled lesion in the bone that tends to expand or grow. While it is referred to as a cyst, it is a true benign bone tumor surrounded by a thin wall of bone.

Ankylosing spondylosis (spondylitis) is a chronic inflammatory disease that affects the spine, sacroiliac joints and often other joints (such as the shoulder), and is marked by pain and stiffness.

Ankylosis is stiffness or fixation of a joint by disease or surgery.

Annular refers to a ring-like part, structure, or marking of a body part.

Annuloplasty is surgical treatment of a ringlike anatomical part.

Arthrodesis is the surgical fusion of a joint.

Arthroplasty is the operative formation or restoration of a joint.

Bleeding diathesis (coagulopathy) is a disease or condition affecting the blood's ability to become viscous or thickened into a coherent mass.

Bone-disc-bone osteotomy is the surgical cutting of a bone or removal of a piece of bone that aims to resect the disc with its adjacent endplate(s).

Bone graft is a procedure where osseous matter is transplanted from a donor site to a recipient site, without anastomosis of nutrient vessels.

Burst fracture is an injury in which the vertebra, the primary bone of the spine, breaks in multiple directions.

Cauda equina is the sack of nerve roots (nerves that leave the spinal cord between spaces in the bones of the spine to connect to other parts of the body) at the lower end of the spinal cord. These nerve roots provide the ability to move and feel sensation in the legs and the bladder.

Cauda equina syndrome is a group of symptoms that are caused by compression of the cauda equina and include pain in the lower back and legs, weakness and numbness in the groin, buttocks and legs, and impaired functioning of the bladder and bowel.

Cervical decompression surgery is a procedure that removes any structures compressing the nerves in the neck. The cervical section of the spine begins at the base of the skull and supports the neck. During surgery, a small section of the bone that is compressing the nerve root is removed to alleviate pressure and allow the nerve root to heal. Sometimes fragments of material from the spine are lodged under the nerve root as well, and are removed during cervical decompression surgery.

Cervical spine is the neck region of the spinal column or backbone. It consists of the first seven bones (C1-C7).

Cervical spondylotic myelopathy (CSM) is a neck condition that arises when the spinal cord becomes compressed due to the wear-and-tear changes that occur in the spine with age.

Chin-on-chest deformity is a specific type of hyperkyphosis (a spinal deformity in which the upper back curves forward more than normal, creating the appearance of a hump in the back) which typically exceeds 50 degrees.

Chordoma is a type of bone cancer that usually starts in the lower spinal column or at the base of the skull.

Closing wedge osteotomy is the surgical cutting of a bone or removal of a piece of bone to correct kyphosis.

Compression fracture is a break in the vertebrae and can cause the vertebrae to collapse, making them shorter.

Coronal alignment defect is a type of spinal deformity with deviation from midline in the coronal plane (a vertical plane running from side to side; divides the body or any of its parts into anterior and posterior portions).

Degenerative disc disease refers to symptoms of back or neck pain caused by wear-and-tear on a spinal disc.

Delayed union fracture is healing of a fracture that takes longer than expected, usually 4 to 6 months, that is demonstrated between 2 sets of X-rays.

Disc herniation refers to a problem with one of the rubbery cushions (discs) that sit between the bones (vertebrae) that stack to make the spine.

Discectomy is the surgical removal of the damaged portion of a herniated disc in the spine.

Discitis is an infection of the discs between the vertebra of the spine.

Discogenic means originating in an intervertebral disc, produced by factors (such as herniation or deterioration) occurring in an intervertebral disc.

Discography is a diagnostic imaging test used to help identify the source of back pain and to guide the treatment of abnormal discs. Using X-ray guidance, contrast dye is injected into the center of one or more spinal discs, which can temporarily reproduce back pain symptoms and help diagnose if a particular disc is causing back pain. Discography may also be used before back surgery to identify discs that may need to be removed.

Dural arterio-venous spinal fistula (dAVF) is an abnormal connection between an artery and a vein in the tough covering (dura mater) over the brain or spinal cord. In this rare condition, abnormal passageways between arteries and veins (arteriovenous fistulas) may occur in the brain, spinal cord or other areas of the body.

Dysphagia is difficulty in swallowing.

Effacement is the thinning or obliteration of tissue or narrowing of an internal anatomical space.

Fistula is an abnormal connection that leads from an abscess, hollow organ or part to the body surface, or from one hollow organ or part to another, and may be surgically created to permit passage of fluids or secretions.

Giant cell tumor is a rare tumor that usually forms in bone, but may also form in cartilage, muscle, fat, blood vessels or other supportive tissue in the body. Most giant cell tumors occur at the ends of the long bones of the arms and legs near a joint (such as the knee, wrist, hip or shoulder). Most are benign (not cancer) but some are malignant (cancer). Giant cell tumors usually occur in young and middle-aged adults.

Hemangioma is usually a benign tumor made up of blood vessels that typically occurs as a purplish or reddish slightly elevated area of skin.

Hypertrophy is the excessive development of an organ or part, specifically an increase in bulk (as by thickening of muscle fibers) without multiplication of parts.

Intradermal epidural cyst is a benign growth that occurs under the skin, outside of the dura mater (the most fibrous of the three membranes [meninges] covering the brain and the spinal cord).

Kummel disease is a condition where avascular necrosis of the vertebral body develops following a vertebral compression fracture.

Kyphectomy is a wedge resection of vertebral bodies.

Kyphoscoliosis is a deviation of the normal curvature of the spine in the sagittal and coronal planes and can include a rotation of the spinal axis.

Kyphosis is the exaggerated outward curvature of the thoracic region of the spine resulting in a rounded upper back.

Laminectomy is a type of surgery in which a surgeon removes part or all of the vertebral bone (lamina). This helps ease pressure on the spinal cord or the nerve roots that may be caused by injury, herniated disc, narrowing of the canal (spinal stenosis) or tumors.

Laminoplasty is a surgical procedure performed on the cervical vertebrae (neck bones) to increase the space within the spinal canal by creating a hinge on the lamina (the back part of the spinal bone). Metal hardware bridges the gap in the opened section of the spine.

Laminotomy is a procedure performed by spine surgeons to decompress the spinal canal in either the cervical (neck) or lumbar (low back) spine.

Langerhan's cell histiocytosis is a rare disorder in which the body makes too many dendritic cells (a form of histiocyte, or white blood cell) which plays a role in the body's immune system. They can be found in the skin, lungs, stomach, bone, eyes and intestines.

Ligamenta flavum is a short but thick ligament that connects the laminae of adjacent vertebrae from C2 to S1 and is considered a medial ward continuation of the facet joint.

Lumbar decompression most commonly involves a laminectomy, but may also be used to describe laminotomy, facetectomy, foraminotomy. Laminectomy involves the removal of the posterior part of a vertebra, the lamina or reopening of the foramina with the goal of creating additional

space for the spinal cord and nerves. Spinal stenosis, spondylolisthesis, herniated disc or bone spurs are the common indications.

Lumbar Spine is the lower back region of the spinal column or backbone. It consists of five bones (L1-L5).

Metalloma is an inflammatory pseudotumor.

Metastasis is the spread of a disease-producing agency (such as cancer cells) from the initial or primary site of disease to another part of the body.

Multiple myeloma is a blood cancer that develops in plasma cells in the bone marrow. Plasma cells are white blood cells that produce antibodies to protect the body from infection. In multiple myeloma, the plasma cells grow too much, crowding out normal bone marrow cells.

Myelogram is a radiographic visualization of the spinal cord after injection of a contrast medium into the spinal subarachnoid space.

Myelomalacia is a medical condition that occurs when the spinal cord begins to soften, which can lead to a loss of spinal cord volume and can cause problems throughout the body.

Myelomeningocele is a congenital cleft of the spinal column with hernial protrusion of the meninges and sometimes the spinal cord (spina bifida) in which neural tissue of the spinal cord and the investing meninges protrude from the spinal column, forming a sac under the skin.

Myelopathy is a disease or disorder of the spinal cord or bone marrow.

Myotonic dystrophy is a form of muscular dystrophy that affects muscles and many other organs in the body.

Neurinoma is a benign and slow-growing tumors that occur in the peripheral nervous system including the spinal nerves, which proceed from the spinal cord in the spine, and cranial nerves. Neurinomas originate from the Schwann cells (a type of glial cell of the peripheral nervous system that helps separate and insulate nerve cells) that surround the nerve cells.

Neurofibromatosis is a rare genetic disorder that causes benign tumors to grow on nerves and other parts of the body. There are three types of neurofibromatosis: neurofibromatosis 1 (NF1), neurofibromatosis 2 (NF2) and schwannomatosis.

Nonunion fracture occurs when a broken bone fails to heal.

Open reduction internal fixation (ORIF) is a type of surgery used to stabilize and heal a broken bone.

Ossification is the process in which cartilage is transformed into bone.

Ossification of the posterior longitudinal ligament (OPLL) is a spinal condition where the posterior longitudinal ligament becomes calcified and less flexible.

Osteoblastoma is a rare benign bone tumor that accounts for about 1 percent of all primary bone tumors in the United States.

Osteogenesis imperfecta is a hereditary disease caused by defective or deficient collagen production and marked by extreme brittleness of the long bones and a bluish color of the whites of the eyes.

Osteoid osteoma is a type of benign bone tumor that is usually found in the legs but may occur also at other bones in nearly any part of the body, and occurs most often in people under the age of 50.

Osteolytic refers to a progressive condition where bone tissue is destroyed. In this process, bones lose minerals (mostly calcium), softens, degenerates and become weaker.

Osteopenia is the reduction in bone volume to below normal levels especially due to inadequate replacement of bone lost to normal lysis.

Osteoporosis is a condition that is characterized by a decrease in bone mass, with decreased density and enlargement of bone spaces, producing porosity and fragility.

Osteotomy is the incision or transection of a bone.

Paresis describes slight or partial paralysis.

Pedicle subtraction osteotomy, also called a Ponte osteotomy, is the surgical cutting of a bone or removal of a piece of bone used to reverse spinal deformities.

Percussion is a method of tapping body parts with fingers, hands or small instruments as part of a physical examination.

Percutaneous vertebral augmentation is a minimally invasive procedure for the treatment of compression fractures of the vertebral body.

Pseudoarthrosis is a term used to describe what happens when a spinal fusion is unsuccessful. This condition may cause no symptoms or may cause pain in the neck, back, arms or legs.

Radiculopathy describes a range of symptoms, including pain, numbness and weakness, produced by the pinching of a nerve root in the spinal column.

Renal osteodystrophy is a form of metabolic bone disease seen in patients with chronic renal insufficiency characterized by bone mineralization deficiency due to electrolyte and endocrine abnormalities. Patients present with osteomalacia, osteonecrosis and pathologic fractures.

Resection is a surgical procedure done to remove tissue, or part or all of an organ.

Retropulsion is a disorder of locomotion commonly associated with Parkinson's disease that is marked by a tendency to walk backwards.

Rhizotomy is a surgical procedure to sever nerve roots in the spinal cord, which effectively relieves chronic back pain and muscle spasms.

Sagittal alignment defect is the loss of normal lumbar lordosis. This deformity is usually iatrogenic and often follows lumbar fusion, thoracolumbar fusion and (in some cases) lumbar decompressive procedures.

Scoliosis is a sideways curvature of the spine.

Smith-Peterson osteotomy is the surgical cutting of a bone or removal of a piece of bone and involves the resection of posterior elements, including bilateral facet joints, part of the lamina and the posterior ligaments at the osteotomy site.

Spinal fusion is surgery to permanently connect two or more vertebrae in the spine, eliminating motion between them.

Spinal instrumentation is a method of straightening and stabilizing the spine after spinal fusion, by surgically attaching hooks, rods and wire to the spine in a way that redistributes stress on the bones and keeps them in proper alignment.

Spinal spondylosis is an umbrella term used to describe pain from degenerative conditions of the spine. Most often, the term spondylosis is used to describe osteoarthritis of the spine, but it is also commonly used to describe any manner of spinal degeneration.

Spondylodiscitis is a primary infection (accompanied by destruction) of the intervertebral disc (discitis), with secondary infections of the vertebrae (spondylitis), starting at the endplates. It can lead to osteomyelitis of the spinal column.

Spondylolisthesis is the forward displacement of a vertebra on the one below it and especially of the fifth lumbar vertebra on the sacrum producing pain by compression of nerve roots.

Stenosis is a narrowing or constriction of the diameter of a bodily passage or orifice.

Subchondral defect is a focal area of damage to the bone that sits underneath cartilage in a joint.

Syringomyelia is a chronic progressive disease of the spinal cord associated with sensory disturbances, muscle atrophy and spasticity.

Syrinx is a cerebrospinal fluid-filled cyst which collects inside of the spinal cord or brain stem. A syrinx in the spinal cord is called syringomyelia, and a syrinx in the brain stem is called syringobulbia.

Tethered cord syndrome is a neurologic disorder caused by tissue attachments that limit the movement of the spinal cord within the spinal column.

Traumatic central cord syndrome is an incomplete traumatic injury to the cervical spinal cord – the portion of the spinal cord that runs through the bones of the neck. This injury results in weakness in the arms more so than the legs.

Vertebral column osteotomy is the surgical cutting of a bone or removal of a piece of bone from the bones of the spinal column.

Vertebral compression fractures (VCFs) occur when the bony block or vertebral body in the spine collapses, which can lead to severe pain, deformity and loss of height. These fractures more commonly occur in the thoracic spine (the middle portion of the spine), especially in the lower part.

Vertebral corpectomy is a procedure that removes damaged vertebrae and intervertebral discs that are compressing the spinal cord and spinal nerves.

Vertebroplasty is a medical procedure for reducing pain caused by a vertebral compression fracture (as that associated with osteoporosis) that involves injection of an acrylic cement (as methyl methacrylate) into the body of the fractured vertebra for stabilization.

Wedge compression fracture is a type of fracture usually occurs in the front of the vertebra, collapsing the bone in the front of the spine and leaving the back of the same bone unchanged, which results in the vertebra taking on a wedge shape.

Spine Surgery References

- [1] (2020). Low back pain and sciatica in over 16s: assessment and management. *NICE (National Institute for Health and Care Excellence)*. Retrieved: February 2023. <https://www.nice.org.uk/guidance/ng59/resources/low-back-pain-and-sciatica-in-over-16s-assessment-and-management-pdf-1837521693637>
- [2] Afewerki, S., Bassous, N., . . . Lobo, A. O. (2019). Advances in dual functional antimicrobial and osteoinductive biomaterials for orthopaedic applications. *Nanomedicine: Nanotechnology, Biology, and Medicine*, 24, 102143. Retrieved: May 2022. <https://doi.org/10.1016/>
- [3] Akgun, M. Y., Kemerdere, R., . . . Hanci, M. (2019). Spinal Vascular Malformations: Treatment and Outcome. *World Neurosurgery*, 130, e953-e960.
- [4] Albanese, J. & Daubs, M. D. (2022). Appropriate Use Criteria in Spine Surgery. M. P. Steinmetz & S. H. Berven (Eds.). *Benzel's Spine Surgery* (5), (pp. 1555-1560.e1). Philadelphia: Elsevier, Inc.
- [5] Alvi, M. A., Zreik, J., . . . Bydon, M. (2020). Comparison of Costs and Postoperative Outcomes between Vertebroplasty and Kyphoplasty for Osteoporotic Vertebral Compression Fractures: Analysis from a State-Level Outpatient Database. *World Neurosurgery*, 141, e801-e814.
- [6] Amin, T., Lin, H., . . . Mobbs, R. J. (2021). Revision of a Failed C5-7 Corpectomy Complicated by Esophageal Fistula Using a 3-Dimensional–Printed Zero-Profile Patient-Specific Implant: A Technical Case Report. *World Neurosurgery*, 151, 29-38.
- [7] Ammerman, J. M., Clifton, W. & Caputy, A. J. (2022). Video-Assisted Thoracoscopic Discectomy: Indications and Techniques. A. Quinones-Hinojosa (Ed.). *Schmidek and Sweet: Operative Neurosurgical Techniques* (7), (pp. 1691-1699.e1). Philadelphia: Elsevier, Inc.
- [8] Arora, M. & Leever, J. D. (2020). Thoracic epidural lipomatosis associated with syrinx: A case report. *Radiology Case Reports*, 15(5), 528-530.
- [9] Austevoll, I.M., Hermansen, E., . . . Algaard, K.R.H. (2021). Decompression with or without Fusion in Degenerative Lumbar Spondylolisthesis. *New England Journal of Medicine*, 385, 526-538.
- [10] Babatunde, O.O., Jordan, J.L., . . . Protheroe, J. (2017). Effective treatment options for musculoskeletal pain in primary care: A systematic overview of current evidence. *PLoS One*, 12(6), Article e0178621.
- [11] Badhiwala, J. H., A, A. M. & Fehlings, M. J. (2023). Evaluation and Treatment of Degenerative Cervical Myelopathy. H. Winn (Ed.). *Youmans and Winn Neurological Surgery* (8), (pp. 2517-2525.e4). Philadelphia: Elsevier, Inc.
- [12] Badrinath, R., Sullivan, T. B., . . . Allen, R. T. (2018). Posterolateral and Lateral Corpectomies. S. R. Garfin & F. J. Eismont (Eds.). *Rothman-Simeone and Herkowitz's The Spine* (7), (pp. 907-916). Philadelphia: Elsevier, Inc.

- [13] Bae, J. & Lee, S. (2022). Thoracic Discectomy. M. P. Steinmetz & S. H. Berven (Eds.). *Benzel's Spine Surgery* (5), (pp. 1194-1201.e2). Philadelphia: Elsevier, Inc.
- [14] Bailey, C. S., Rasoulinejad, P., . . . Urquhart, J. C. (2020). Surgery versus Conservative Care for Persistent Sciatica Lasting 4 to 12 Months. *The New England Journal of Medicine*, 382(12), 1093-1102.
- [15] Bartleson, J. D. & Barbano, R. L. (2020). Mechanical and Other Lesions of the Spine, Nerve Roots, and Spinal Cord. L. Goldman & A.I. Schafer (Eds.). *Goldman-Cecil Medicine* (26), (pp. 2329-2343.e2). Philadelphia: Elsevier, Inc.
- [16] Beh, S. R., Chandy, S., . . . Kamel, M. (2020). Repair of durotomy using a pedicled thymopericardial fat pad following excision of thoracic intervertebral disc prolapse: A case report. *Clinical Neurology and Neurosurgery*, 198, 106114. Retrieved: May 2022. <https://doi.org/10.1016/j.clineuro.2020.106114>
- [17] Beier, A. D., Akinduro, O. O., . . . Pang, D. (2022). Surgical Management of Spinal Dysraphism. A. Quinones-Hinojosa (Ed.). *Schmidek and Sweet: Operative Neurosurgical Techniques* (7), (pp. 872-901.e2). Philadelphia: Elsevier, Inc.
- [18] Bhalla, A., Bono, C. M., . . . Garfin, S. R. (2018). Lumbar Disc Herniations. S. R. Garfin & F. J. Eismont (Eds.). *Rothman-Simeone and Herkowitz's The Spine* (7), (pp. 839-868). Philadelphia: Elsevier, Inc.
- [19] Bonneville, P. & Sailha, F. (2020). Spinal and peripheral bone metastases: Time to structure medico-surgical management! *Orthopaedics & Traumatology: Surgery & Research*, 106(6), 995-996.
- [20] Brandt, R. J. & Eskey, C. J. (2022). Vertebroplasty and Kyphoplasty. A. Quinones-Hinojosa (Ed.). *Schmidek and Sweet: Operative Neurosurgical Techniques* (7), (pp. 1847-1858.e2). Philadelphia: Elsevier, Inc.
- [21] Buchholz, A. L., Quinn, J. C. & Shaffrey, C. I. (2019). Postoperative Spinal Deformities: Kyphosis, Nonunion, and Loss of Motion Segment. *Complications in Neurosurgery*, 55, 325-330.
- [22] Buell, T. J., Christiansen, P. A., . . . Smith, J. S. (2023). Evaluation and Treatment of Adult Scoliosis and Sagittal Plane Deformity. H. Winn (Ed.). *Youmans and Winn Neurological Surgery* (8), (pp. 2743-2757.e6). Philadelphia: Elsevier, Inc.
- [23] Butler, A.J., Munakomi, S. & Donnally III, C.J. (2023) . Discectomy. *StatPearls*, , 1-25. Retrieved: May 2023. <https://www.ncbi.nlm.nih.gov/books/NBK544281/>
- [24] Callanan, G. & Radcliff, K. E. (2021). Cervical Total Disc Replacement. *Neurosurgery Clinics of North America*, 32(4), 461-472.
- [25] Chang, C., Wu, J., . . . Mummaneni, P. V. (2023). Cervical Arthroplasty. H. Winn (Ed.). *Youmans and Winn Neurological Surgery* (8), (pp. 2785-2787.e1). Philadelphia: Elsevier, Inc.
- [26] Chang, L., Kimaz, S., . . . Hartl, R. (2023). Posterior Thoracic and Lumbar Instrumentation. H. R. Winn (Ed.). *Youmans and Winn Neurological Surgery* (8), (pp. 2830-2830.e14). Philadelphia: Elsevier, Inc.

- [27] Chen, K.-T., Kim, J.-S., . . . Chen, C.-M. (2023). Current Indications for Spinal Endoscopic Surgery and Potential for Future Expansion. *Neurospine*, 20(1), 33-42.
- [28] Chen, Y., Tang, T. & Erdek, M. A. (2019). Advanced Image-Guided Procedures for Painful Spine. *Neuroimaging Clinics of North America*, 29(4), 553-561.
- [29] Chieng, L. O. & Perez-Cruet, M. J. (2022). Spinal Augmentation for Vertebral Compression Fractures. M. P. Steinmetz & S. H. Berven (Eds.). *Benzel's Spine Surgery* (5), (pp. 1165-1172.e2). Philadelphia: Elsevier, Inc.
- [30] Christiansen, P. A. & Yen, C. (2023). Evaluation and Treatment of Thoracic Disk Herniation. H. Winn (Ed.). *Youmans and Winn Neurological Surgery* (8), (pp. 2486-2493.e2). Philadelphia: Elsevier, Inc.
- [31] Clerk-Lamallice, O., Beall, D. P., . . . Lorio, M. P. (2019). ISASS Policy 2018—Vertebral Augmentation: Coverage Indications, Limitations, and/or Medical Necessity. *International Journal of Spine Surgery*, 13(1), 1-10.
- [32] Corwell, B. & Davis, N. (2020). The Emergent Evaluation and Treatment of Neck and Back Pain. *Emergency Medicine Clinics of North America*, 38(1), 167-191.
- [33] Court, C., Briand, S., . . . Bouthors, C. (2021). Management of chordoma of the sacrum and mobile spine. *Orthopaedics & Traumatology: Surgery & Research*, 108(1), 103169. Retrieved: May 2022. <https://doi.org/10.1053/j.semss.2019.103169>
- [34] Dardis, R. M., Saxena, A., . . . Gullan, R. (2022). Disc Replacement Technologies in the Cervical and Lumbar Spine. A. Quinones-Hinojosa. *Schmidek and Sweet: Operative Neurosurgical Techniques* (7), (pp. 1638-1649.e1). Philadelphia: Elsevier, Inc.
- [35] Decker, S., Winkelmann, M.,... Knipp, B.S. (2020). Pelvic Ring Fractures. B.D. Browner, J.B. Jupiter, . . . P.A. Anderson (Eds.). *Skeletal Trauma: Basic Science, Management, and Reconstruction* (6), (pp. 1108-1195). Philadelphia, PA: Elsevier, Inc.
- [36] Derman, P. B., Zigler, J. E., . . . Lieberman, I. H. (2023). Lumbar Disk Arthroplasty. H. Winn (Ed.). *Youmans and Winn Neurological Surgery* (8), (pp. 2788-2793.e2). Philadelphia: Elsevier, Inc.
- [37] Derman, P. B., Rihn, J. & Albert, T. J. (2018). Surgical Management of Lumbar Spinal Stenosis. S. R. Garfin & F. J. Eismont (Eds.). *Rothman-Simeone and Herkowitz's The Spine* (7), (pp. 1039-1057). Philadelphia: Elsevier, Inc.
- [38] Dixit, R. (2021). Low Back Pain. G. S. Firestein & R. C. Budd (Eds.). *Firestein & Kelley's Textbook of Rheumatology* (11), (pp. 753-775). Philadelphia: Elsevier, Inc.
- [39] Donnally III, C.J., Hanna A. & Odom C.K. (2023) . Cervical Myelopathy. *StatPearls*, (Issue #), 1-5. Retrieved: May 2023. <https://www.ncbi.nlm.nih.gov/books/NBK482312/>
- [40] Falkowski, G. A., Labaran, L. & Hassanzadeh, H. (2019). Sagittal alignment and thoracolumbar osteotomies. *Seminars in Spine Surgery*, 31(2), 61-69.
- [41] Frassanito, P., D'Onofrio, G. F., . . . Caldarelli, M. (2019). Multimodal Management of Aggressive Recurrent Aneurysmal Bone Cyst of Spine: Case Report and Review of Literature. *World Neurosurgery*, 126, 423-427.

- [42] Gandham, S., Samy, D. & Annis, P. (2021). Indications and algorithm of treatments in adult spinal deformity. *Orthopaedics and Trauma*, 35(6), 358-368.
- [43] Gao, X., Yang, Y., . . . Hong, Y. (2018). A Comparison of Cervical Disc Arthroplasty and Anterior Cervical Discectomy and Fusion in Patients with Two-Level Cervical Degenerative Disc Disease: 5-Year Follow-Up Results. *World Neurosurgery*, 122, e1083-e1089.
- [44] Gardocki, R. J. & Park, A. L. (2021). Degenerative Disorders of the Cervical Spine. F. M. Azar & J. H. Beaty (Eds.). *Campbell's Operative Orthopaedics* (14), (pp. 1682-1718.e5). Philadelphia: Elsevier, Inc.
- [45] Gardocki, R.J. & Park, A.L. (2021). Degenerative Disorders of the Thoracic and Lumbar Spine. F.M. Azar & J.H. Beaty (Eds.). *Campbell's Operative Orthopaedics* (14), (pp. 1719-1801.e9). Philadelphia: Elsevier, Inc.
- [46] Geiger, C. D., Devereaux, M. W. & Hart, D. (2022). Disorders of Bones, Joints, Ligaments, and Meninges. J. Jankovic & J. C. Mazziotta (Eds.). *Bradley and Daroff's Neurology in Clinical Practice* (8), (pp. 1798-1828.e3). Philadelphia, PA: Elsevier, Inc.
- [47] Gelfand, Y., Benton, J. A., . . . Yassari, R. (2020). Comparison of 30-Day Outcomes in Patients with Cervical Spine Metastasis Undergoing Corpectomy Versus Posterior Cervical Laminectomy and Fusion: A 2006–2016 ACS-NSQIP Database Study. *World Neurosurgery*, 147, e78-e84.
- [48] Gerling, M. C., Hale, S. D. & White-Dzuro, C. E. (2019). Endoscopic Discectomy. *Operative Techniques in Orthopaedics*, 29(2), 100719. Retrieved: April 2022. <https://doi.org/10.1016/j.oto.2019.100719>
- [49] Goh B. C., Striano, B. M., . . . Hershman, S. H. (2020). Laminoplasty versus laminectomy and fusion for cervical spondylotic myelopathy: a cost analysis. *The Spine Journal*, 20(11), 1770-1775.
- [50] Gokcen, H. B. & Ozturk, C. (2019). Ossification of the Ligamentum Flavum at the Thoracic and Lumbar Region in an Achondroplastic Patient. *World Neurosurgery*, 126, 461-465.
- [51] Grabowski, G., Gilbert, T. M., . . . Cornett, C. A. (2020). Degenerative Conditions of the Cervical and Thoracolumbar Spine. M. D. Miller & S. B. Thompson (Eds.). *DeLee, Drez, & Miller's Orthopaedic Sports Medicine* (5), (pp. 1593-1604.e2). Philadelphia: Elsevier, Inc.
- [52] Gumusay, O., Huppert, L. A., . . . Rugo, H. S. (2022). The role of percutaneous vertebral augmentation in patients with metastatic breast cancer: Literature review including report of two cases. *The Breast*, 63, 149-156
- [53] Guo, C., Zhu, D., . . . Peng, Z. (2019). Transforaminal Percutaneous Endoscopic Decompression for Lower Thoracic Spinal Stenosis. *World Neurosurgery*, 128, e504-e512.
- [54] Gu, B. J., Blue, R., . . . Welch, W. C. (2021). Posterior Lumbar Facet Replacement and Arthroplasty. *Neurosurgery Clinics of North America*, 32(4), 521-526.
- [55] Hagan, M.J., Feler, J., . . . Fridley, J.S. (2022). Spinal cord injury in adult and pediatric populations. *Interdisciplinary Neurosurgery*, 29, Article 101594.

- [56] Hamilton, K. & Hurlbert, J. (2022). Anterior Cervical Discectomy and Corpectomy. M. P. Steinmetz & S. H. Berven (Eds.). *Benzel's Spine Surgery* (5), (pp. 969-979.e1). Philadelphia: Elsevier, Inc.
- [57] Heary, R.F. & Gillick, J.L. (2023). Evaluation, Indications, and Techniques of Revision Spine Surgery. H.R. Winn (Ed.). *Youmans & Winn Neurological Surgery* (8), (pp. 2853-2853.e27). Philadelphia: Elsevier, Inc.
- [58] Herenden, J. S., Meyer, S. A. & Knightly, J. J. (2023). Evaluation and Treatment of Cervical Disk Herniations. H. R. Winn (Ed.). *Youmans and Winn Neurological Surgery* (8), (pp. 2465-2476.e2). Philadelphia: Elsevier, Inc.
- [59] Hsieh, H., Bowles, D. R., . . . Vaccaro, A. R. (2020). Is Open Surgery for Metastatic Spinal Cord Compression Secondary to Lung Cancer Really Beneficial? A Systematic Review. *World Neurosurgery*, 144, e253-e263.
- [60] Ide, K., Hasegawa, T., . . . Matsuyama, Y. (2020). Spinal shortening osteotomy for adult tethered cord syndrome evaluated by intraoperative ultrasonography. *Journal of Orthopaedic Science*, 26(3), 363-368.
- [61] Jandial, R. (2020). Lateral Mass Fixation. R. Jandial (Ed.). *Core Techniques in Operative Neurosurgery* (2), (pp. 345-349). Philadelphia: Elsevier, Inc.
- [62] Jandial, R. (2020). Lumbar Disk Arthroplasty. R. Jandial (Ed.). *Core Techniques in Operative Neurosurgery* (2), (pp. 419-422). Philadelphia: Elsevier, Inc.
- [63] Joo, P. Y., Jayaram, R. H., . . . Grauer, J. N. (2022). Four-level anterior versus posterior cervical fusions: Perioperative outcomes and five-year reoperation rates. *North American Spine Society Journal (NASSJ)*, 10, 100115. Retrieved: May 2022. <https://doi.org/10.1016/j.xnsj.2022.100115>
- [64] Kato, S. (2020). Complications of thoracic spine surgery – Their avoidance and management. *Journal of Clinical Neuroscience*, 81, 12-17.
- [65] Kato S., Ganau, M. & Fehlings, M. G. (2018). Surgical decision-making in degenerative cervical myelopathy – Anterior versus posterior approach. *Journal of Clinical Neuroscience*, 58, 7-12.
- [66] Katsanos, K., Sabharwal, T., . . . Gangi, A. (2021). Skeletal Interventions. A. Adam & A. K. Dixon (Eds.). *Grainger & Allison's Diagnostic Radiology* (7), (pp. 2211-2237). Philadelphia: Elsevier, Inc.
- [67] Katz, J.N., Zimmerman, Z.E., . . . Makhni, M.C. (2022). Diagnosis and Management of Lumbar Spinal Stenosis: A Review. *JAMA*, 327(17), 1688-1699.
- [68] Kerolus, M. G., Molenda, J. E., . . . Fessler, R. G. (2022). Posterior Percutaneous and Minimally Invasive Approaches to Decompression and Arthrodesis of the Cervical Spine. M. P. Steinmetz & S. H. Berven (Eds.). *Benzel's Spine Surgery* (5), (pp. 949-956.e3). Philadelphia: Elsevier, Inc.

- [69] Kim, J. & Choi, D. (2018). Unilateral biportal endoscopic decompression by 30° endoscopy in lumbar spinal stenosis: Technical note and preliminary report. *Journal of Orthopaedics*, 15 (2), pp: 366-371.
- [70] Kolcun, J.P.G. & Levi, A. (2022). Nerve Sheath Tumors Involving the Spine. A. Quiñones-Hinojosa (Ed.). *Schmidek and Sweet: Operative Neurosurgical Techniques* (7), (pp. 2196-2204.e2). Philadelphia: Elsevier, Inc.
- [71] Kong, W., Ao, J., . . . Liao, W. (2018). Local Spinal Cord Decompression Through a Full Endoscopic Percutaneous Transcorporeal Approach for Cervicothoracic Ossification of the Posterior Longitudinal Ligament at the T1-T2 Level. *World Neurosurgery*, 112, 287-293.
- [72] Kuebler, K., Acure, J. & Oskouei, A. (2021). Diagnosing and Managing Spinal Stenosis in the Adult Patient. *Journal for Nurse Practitioners*, 17(9), 1068-1070.
- [73] Kumar, J. R. V. & Ray, D. K. (2023). Evaluation and Treatment of Fungal and Tubercular Infections of the Spine. H. R. Winn (Ed.). *Youmans and Winn Neurological Surgery* (8), (pp. 2537-2537.e20). Philadelphia: Elsevier, Inc.
- [74] Kumar, K. N. S., Visvanathan, K., . . . Krishnamurthy, G. (2022). Surgical management of spinal dural arteriovenous fistula – A single centre experience. *Interdisciplinary Neurosurgery*, 28, 101500. Retrieved: May 2022. <https://doi.org/10.1016/j.inat.2022.101500>
- [75] Kumar, R. & Tsirikos, A. I. (2021). Intraspinal anomalies: presentation, assessment, treatment and association with the development of scoliosis. *Orthopaedics and Trauma*, 35(6), 347-357.
- [76] Ladner, T. R., Weiss, N., . . . Post, K. D. (2023). Avoidance of Complications in Neurosurgery. H. Winn (Ed.). *Youmans and Winn Neurological Surgery* (8), (pp. 228-228.e29). Philadelphia: Elsevier, Inc.
- [77] Lee, B. S., Placide, R. J., . . . Steinmetz, M. P. (2022). Management of Cervical Spondylotic Myelopathy. A. Quiñones-Hinojosa (Ed.). *Schmidek and Sweet: Operative Neurosurgical Techniques* (7), (pp. 1650-1663.e3). Philadelphia: Elsevier, Inc.
- [78] Lee, J. J., Kim, H. C., . . . Ha, Y. (2021). Laminectomy with instrumented fusion vs. laminoplasty in the surgical treatment of cervical ossification of the posterior longitudinal ligament: A multicenter retrospective study. *Journal of Clinical Neuroscience*, 94, 271-280.
- [79] Li, X., Jin, L., . . . Shen, H. (2019). Endoscopic Ventral Decompression for Spinal Stenosis with Degenerative Spondylolisthesis by Partially Removing Posterosuperior Margin Underneath the Slipping Vertebral Body: Technical Note and Outcome Evaluation. *World Neurosurgery*, 126, e517-e525.
- [80] Li, Y. & Wang, M. Y. (2023). Minimally Invasive Spine Surgery for Adult Spinal Deformity: Principles and Applications. H. Winn (Ed.). *Youmans and Winn Neurological Surgery* (8), (pp. 2882-2895.e5). Philadelphia: Elsevier, Inc.
- [81] Li, Z., Ma, S., . . . Zhao, H. (2020). Percutaneous Isthmus Foraminoplasty and Full-Endoscopic Lumbar Discectomy for Very Highly Upmigrated Lumbar Disc Herniation: Technique Notes and 2 Years Follow-Up. *World Neurosurgery*, 141, e9-e17.

- [82] Librianto, D. & Aprilya, D. (2021). Cantilever method for severe kyphotic deformity correction in spondylitis tuberculosis: A technical note and literature review. *Annals of Medicine and Surgery*, 69, 102764. Retrieved: May 2022. <https://doi.org/10.1016/j.am-su.2021.102764>
- [83] Lin, B.H.-H., Joaquim, A.F. & Riew, K.D. (2023). Cervical arthroplasty for myelopathy—A systematic review. *Seminars in Spine Surgery*, 35(1), Article 101012.
- [84] Lopez, W.Y., Goh, B.C., . . . Hershman, S.H. (2020). Laminoplasty—an underutilized procedure for cervical spondylotic myelopathy. *The Spine Journal*, 21(4), 571-577.
- [85] Luo, R., Song, Y., . . . Yang, C. (2019). Severe Kyphoscoliosis Associated with Multiple Giant Intraspinal Epidural Cysts: A Case Report and Literature Review. *World Neurosurgery*, 125, 129-135.
- [86] Lyster, M. J., Bag, A. K. & Geldmacher, D. S. (2022). Spinal Cord Vascular Disease. J. Janakovic & J. C. Mazziotta (Eds.). *Bradley and Daroff's Neurology in Clinical Practice* (8), (pp. 1058-1065.e1). Philadelphia, PA: Elsevier, Inc.
- [87] Maas, A. I. R., Peul, W. & Thomé, C. (2021). Surgical decompression in acute spinal cord injury: earlier is better. *The Lancet Neurology*, 20(2), 84-86.
- [88] Margaryan, D., Renz, N., . . . Trampuz, A. (2020). Spinal implant-associated infections: a prospective multicentre cohort study. *International Journal of Antimicrobial Agents*, 56(4), 106116. Retrieved: May 2022. <https://doi.org/10.1016/j.ijantimicag.2020.106116>
- [89] Martirosyan, N.L., Wewel, J.T. & Uribe, J.S. (2023). Anterior and Lateral Lumbar Instrumentation. H.R. Winn (Eds.). *Youmans and Winn Neurological Surgery* (8), (pp. 2822-2829.e2). Philadelphia: Elsevier, Inc.
- [90] Mascarinas, A. Harrison, J., . . . Lutz, G.. (2016). Regenerative Treatments for Spinal Conditions. *Physical Medicine and Rehabilitation Clinics of North America*, 27(4), 1003-1017.
- [91] Massaad, M. & Shin, J. H. (2022). Thoracic and Lumbar Spine Construct Design. M. P. Steinmetz & S. H. Berven (Eds.). *Benzel's Spine Surgery* (5), (pp. 999-1007.e1). Philadelphia: Elsevier, Inc.
- [92] Matys, T., Sheikh-Bahaei, N. & Gillard, J. H. (2021). Postoperative Spine. A. Adam & A. K. Dixon (Eds.). *Grainger & Allison's Diagnostic Radiology* (7), (pp. 1319-1331). Philadelphia: Elsevier, Inc.
- [93] Mazur-Hart, D. J., Larson, E. W., . . . Yam, D. A. (2022). Neurological emergency from rare spinal metalloma: Case report and literature review. *Radiology Case Reports*, 17(5), 1540-1548.
- [94] McGrath, L. & Hofstetter, C. (2023). Endoscopic Approaches and Applications for Lumbar Spinal Procedures. H. Winn (Ed.). *Youmans and Winn Neurological Surgery* (8), (pp. 2872-2881.e1). Philadelphia: Elsevier, Inc.
- [95] Mo, A.Z., Bell, G.R. & Lebl, D.R. (2018). Degenerative Spondylolisthesis. S.R. Garfin & F.J. Eismont (Eds.). *Rothman-Simeone and Herkowitz's The Spine* (7), (pp. 1059-1074). Philadelphia: Elsevier, Inc.

- [96] Momin, A., Shao, S., . . . Steinmetz, M. P. (2022). Minimally Invasive Spinal Decompression and Stabilization Techniques I: Philosophy and Rationale. M. P. Steinmetz & S. H. Berven (Eds.). *Benzel's Spine Surgery* (5), (pp. 1099-1106.e3). Philadelphia: Elsevier, Inc.
- [97] Mongardi, L., Visani, J., . . . Lofrese, G. (2020). Ct guided reference markers for spinal dorsal lesions: A safe and valuable tool impacting intraoperative localization time. *Journal of Clinical Neuroscience*, 84, 97-101.
- [98] Nagashima, H., Tanishima, S. & Tanida, A. (2017). Diagnosis and management of spinal infections. *Journal of Orthopaedic Science*, 23(1), 8-13.
- [99] Naito, K., Yamagata, T., . . . Takami, T. (2019). Safety and Efficacy of Syringoperitoneal Shunting with a Programmable Shunt Valve for Syringomyelia Associated with Extensive Spinal Adhesive Arachnoiditis: Technical Note. *World Neurosurgery*, 132, 14-20.
- [100] Neifert, S. N., Martini, M. L., . . . Krishnaney, A. A. (2022). Postoperative Spinal Disorders—Cervical. M. P. Steinmetz & S. H. Berven (Eds.). *Benzel's Spine Surgery* (5), (pp. 545-550.e2). Philadelphia: Elsevier, Inc.
- [101] Nessim, A., Cho, W. & Sharan, A. D. (2022). Vascularized Bone Grafts in Spine Surgery. M. P. Steinmetz & S. H. Berven (Eds.). *Benzel's Spine Surgery* (5), (pp. 1501-1506.e1). Philadelphia: Elsevier, Inc.
- [102] Newton, P. O., Wu, K. W. & Yaszay, B. (2018). Thoracoscopic Approach for Spinal Conditions. S. R. Garfin & F. J. Eismont (Eds.). *Rothman-Simeone and Herkowitz's The Spine* (7), (pp. 509-523). Philadelphia: Elsevier, Inc.
- [103] Noureldine, M. H. A., Shimony, N., . . . Groves, M. L. (2023). Achondroplasia and Other Dwarfisms. H. R. Winn (Ed.). *Youmans and Winn Neurological Surgery* (8), (pp. 1973-1985.e3). Philadelphia: Elsevier, Inc.
- [104] Obo, T., Fujishiro, T., . . . Neo, M. (2022). Segmental cervical instability does not drive the loss of cervical lordosis after laminoplasty in patients with cervical spondylotic myelopathy. *The Spine Journal*, 22(11), 1837-1847.
- [105] Omran, K. & Abdel-Fattah, A. S. (2018). Posterior Extensive Circumferential Decompressive Reconstructive Technique in Surgical Treatment of Upper Thoracic Spine Compressive Lesions. *World Neurosurgery*, 123, e501-e508.
- [106] Orr, R. D. (2022). An Approach for Treatment of Complex Adult Spinal Deformity. M. P. Steinmetz & S. H. Berven (Eds.). *Benzel's Spine Surgery* (5), (pp. 1222-1228.e4). Philadelphia: Elsevier, Inc.
- [107] Pahlavan, S., Lee, Y. & Bhatia, N. N. (2018). Postoperative Spinal Infections. S. R. Garfin & F. J. Eismont (Eds.). *Rothman-Simeone and Herkowitz's The Spine* (7), (pp. 1807-1825). Philadelphia: Elsevier, Inc.
- [108] Park, H., Kim, S., . . . Kang, S. (2020). Dural Tears in Percutaneous Biportal Endoscopic Spine Surgery: Anatomical Location and Management. *World Neurosurgery*, 136, e578-e585.

- [109 Parmar, V. & Resnick, D. K. (2022). Posterior Thoracic and Lumbar Universal Spine Instrumentation. M. P. Steinmetz & S. H. Berven (Eds.). *Benzel's Spine Surgery* (5), (pp. 1045-1058.e4). Philadelphia: Elsevier, Inc.
- [110 Pastel, D. A., Eskey, C. J. & Hirsch, J. A. (2021). Vertebroplasty and Kyphoplasty. M. A. Mauro & K. P. Murphy (Eds.). *Image-Guided Interventions* (3), (pp. 891-897.e2). Philadelphia: Elsevier, Inc.
- [111 Patsch, J. M. & Krestan, C. R. (2021). Metabolic and Endocrine Skeletal Disease. A. Adam & A.K. Dixon (Eds.). *Grainger & Allison's Diagnostic Radiology* (7), (pp. 1087-1115).. Philadelphia, PA: Elsevier, Inc.
- [112 Penalosa, B. S., Ramos, O., . . . Danisa, O. A. (2021). Pedicle subtraction osteotomy in adult spinal deformity correction. *Journal of Clinical Neuroscience*, 94, 266-270.
- [113 Pennington, Z., Ahmed, A. K., . . . , Sciubba, D. M. (2019). The Use of Sacral Osteotomy in the Correction of Spinal Deformity: Technical Report and Systematic Review of the Literature. *World Neurosurgery*, 130, 285-292.
- [114 Pennington, Z., Schilling, A. T., . . . Sciubba, D. M. (2021). Minimally invasive circumferential decompression and stabilization for metastatic vertebral column disease. *Seminars in Spine Surgery*, 33(1), 100852. Retrieved: May 2022. <https://doi.org/10.1016/j.semss.2021.100852>
- [115 Perez, J. H. T., Voll, C. & Shararah S. (2020). Treatment of Spinal Myoclonus Due to Degenerative Compression Myelopathy with Cervical Spinal Cord Stimulation: A Report of 2 Cases. *World Neurosurgery*, 136, 44-48.
- [116 Perron, A.D. & Huff, J.S. (2018). Spinal Cord Disorders. R. M. Walls (Ed.). *Rosen's Emergency Medicine: Concepts and Clinical Practice* (9), (pp. 1298-1306). Philadelphia: Elsevier, Inc.
- [117 Peterson, K. A., Zehri, A. H., . . . Hsu, W. (2021). Current trends in incidence, characteristics, and surgical management of metastatic breast cancer to the spine: A National Inpatient Sample analysis from 2005 to 2014. *Journal of Clinical Neuroscience*, 91, 99-104.
- [118 Phillips, F. M., Kurd, M. F., . . . Kreitz, T. (2018). Osteoporosis: Surgical Strategies. S. R. Garfin & F. J. Eismont (Eds.). *Rothman-Simeone and Herkowitz's The Spine* (7), (pp. 1611-1623). Philadelphia: Elsevier, Inc.
- [119 Prolo, L. M., Edwards & M. S. B. (2023). Ependymomas. H. R. Winn (Ed.). *Youmans and Winn Neurological Surgery* (8), (pp. 1803-1803.e13). Philadelphia: Elsevier, Inc.
- [120 Qiu, Y., Xie, Y., . . . Chen, C. (2020). Adjacent two-level anterior cervical discectomy and fusion versus one-level corpectomy and fusion in cervical spondylotic myelopathy: Analysis of perioperative parameters and sagittal balance. *Clinical Neurology and Neurosurgery*, 194, 105919. Retrieved May 2022. <https://doi.org/10.1016/j.clineuro.2020.105919>
- [121 Raffa, S. J., Boddu, J. V. & Wang, M. Y. (2023). Spinal Osteotomies. H. R. Winn (Ed.). *Youmans and Winn Neurological Surgery* (8), (pp. 2848-2852.e1). Philadelphia: Elsevier, Inc.

- [122 Rainville, J. & Mahmood, U. (2019). Lumbar Spondylolysis and Spondylolisthesis. W. R. Frontera & J. K. Silver (Eds.). *Essentials of Physical Medicine and Rehabilitation* (4), (pp. 269-276). Philadelphia: Elsevier, Inc.
- [123 Rajasekaran, S., Viswanathan, V.K. & Shetty, A.P. (2022). Primary Infections of the Spine. M. P. Steinmetz & S. H. Berven (Eds.) *Benzel's Spine Surgery* (5). Philadelphia: Elsevier, Inc.
- [124 Ramos, R. D., Groves, M. L. & Yassari, R. (2022). Neurologic Problems of the Spine in Achondroplasia. A. Quiñones-Hinojosa (Ed.). *Schmidek and Sweet: Operative Neurosurgical Techniques* (7), (pp. 1973-1982.e2). Philadelphia: Elsevier, Inc.
- [125 Ravindra, V. M., Finn, M. A., . . . Dailey, A. T. (2023). Postoperative Infections of the Spine. H. R. Winn (Ed.). *Youmans and Winn Neurological Surgery* (8), (pp. 413-421.e5). Philadelphia: Elsevier, Inc.
- [126 Reid, D. B. C., Haglin, J. M., . . . Daniels, A. H. (2019). Operative Management of Spinal Infection Among Intravenous Drug Abusers. *World Neurosurgery*, 124, e552-e557.
- [127 Renehan, J., Zelenty, W., . . . Kalantar, S. B. (2020). Cervical laminoplasty. *Seminars in Spine Surgery*, 32(1), Article 100777.
- [128 Roguski, M. & Groves, M. L. (2023). Adult Syringomyelia. H. R. Winn (Ed.). *Youmans and Winn Neurological Surgery* (8), (pp. 2601-2606.e2). Philadelphia: Elsevier, Inc.
- [129 Roguski, M. & Groves, M. L. (2023). Adult Tethered Cord Syndrome. H. R. Winn (Ed.). *Youmans and Winn Neurological Surgery* (8), (pp. 2594-2600.e2). Philadelphia: Elsevier, Inc.
- [130 Romaniyanto, Mahyudin, F., . . . Rhatomy, S. (2022). An update of current therapeutic approach for Intervertebral Disc Degeneration: A review article. *Annals of Medicine and Surgery*, 77, 103619. Retrieved: August 2022. <https://doi.org/10.1016/j.amsu.2022.103619>
- [131 Rossdeutsch, A., Copley, P. & Khan, S. (2017). Degenerative spinal disc disease and its treatment. *Orthopaedics and Trauma*, 31(6), 378-387.
- [132 Rothrock, R. J., Haldeman, C., . . . Levi, A. D. (2021). Challenges in Diagnosis and Management of Previously Embolized Spinal Dural Arteriovenous Fistulae. *World Neurosurgery*, 154, e710-e717.
- [133 Rousing, R., Hansen, K. L., . . . Lauritsen, J. M. (2010). Twelve-Months Follow-up in Forty-Nine Patients With Acute/Semicute Osteoporotic Vertebral Fractures Treated Conservatively or With Percutaneous Vertebroplasty: A Clinical Randomized Study. *Spine*, 35(5), 478-482.
- [134 Ryabykh S. O., Pavlova, O. M., . . . Gubin, A. V. (2018). Surgical Management of Myelomeningocele-Related Spinal Deformities. *World Neurosurgery*, 112, e431-e441.
- [135 St. Onge, M. & France, J. (2017). Cervical Arthroplasty. *Operative Techniques in Orthopaedics*, 27(4), 283-289.
- [136 Saadeh, Y.S., Khalsa, S.S., . . . Park, P. (2023). Evaluation and Treatment of Degenerative Lumbar Spondylolisthesis. H.R. Winn (Ed.). *Youmans and Winn Neurological Surgery* (8), (pp. 2510-2516.e2). Philadelphia: Elsevier, Inc.

- [137 Samadian, M., Maroufi, S.F., . . . Jafari, A. (2022). Osteoblastoma of C2 vertebrae presented with lymphadenopathy and torticollis: Case report and review of literature. *Interdisciplinary Neurosurgery*, 72, 101557. Retrieved: May 2022. <https://doi.org/10.1016/j.inat.2022.101557>
- [138 San Miguel, J. E., Holton, K. J. & Polly, D. W. (2022). Anatomy and Physiology/Biology of Bone. R. F. Heary (Ed.). *Revision Lumbar Spine Surgery*, (pp. 1-16). Philadelphia: Elsevier, Inc.
- [139 Schmidt, M. H. & Kalra, R. R. (2022). Thoracoscopic Corpectomy and Reconstruction. M. P. Steinmetz & S. H. Berven (Eds.). *Benzel's Spine Surgery* (5), (pp. 1031-1039.e1). Philadelphia: Elsevier, Inc.
- [140 Sellin, J. N., Tatsui, C. E. & Rhines, L. D. (2023). Evaluation and Treatment of Benign Intradural Extramedullary Tumors. H.R. Winn (Ed.). *Youmans and Winn Neurological Surgery* (8), (pp. 2547-2554.e2). Philadelphia: Elsevier, Inc.
- [141 Shah, K. C., Gadia, A., . . . Nene, A. (2018). Buckling Collapse of Midcervical Spine Secondary to Neurofibromatosis. *World Neurosurgery*, 114, 228-229.
- [142 Shah, L. M., Jennings, J. W., . . . Bykowski, J. (2018). ACR Appropriateness Criteria[®] Management of Vertebral Compression Fractures. *Journal of the American College of Radiology*, 15(11), S347-S364. Retrieved: May 2022. <https://www.clinicalkey.com/#!/content/journal/1-s2.0-S154614401831161X>
- [143 Sharif, S. & Ali, M. Y. J. (2020). Outcome Prediction in Spinal Cord Injury: Myth or Reality. *World Neurosurgery*, 140, 574-590.
- [144 Shetty, G. S., Singh, V., . . . Behari, S. (2021). Spinal Epidural Fistulas—A Separate Entity to Dural Fistulas with Different Angioarchitecture and Treatment Approach. *World Neurosurgery*, 149, e600-e611.
- [145 Sielatycki, J. A., Devlin, C. J., . . . Hodges, S. (2021). A novel lumbar total joint replacement may be an improvement over fusion for degenerative lumbar conditions: a comparative analysis of patient-reported outcomes at one year. *The Spine Journal*, 21(5), 829-840.
- [146 Silva, A., Yurac, R., . . . Hem, S. (2021). Low Implant Failure Rate of Percutaneous Fixation for Spinal Metastases: A Multicenter Retrospective Study. *World Neurosurgery*, 148, e627-e634.
- [147 (2020). Simplify Cervical Artificial Disc - P200022. *U.S. Food and Drug Administration (FDA)*. May 2023. <https://www.fda.gov/medical-devices/recently-approved-devices/simplify-cervical-artificial-disc-p200022>
- [148 Sivakanthan, S., Hasan, S. & Hofstetter, C. (2019). Full-Endoscopic Lumbar Discectomy. *Neurosurgery Clinics of North America*, 31(1), 1-7.
- [149 Stiel, N., Özden, J., . . . Spiro, A. S. (2019). Pedicle screw instrumentation with or without pelvic fixation in neuromuscular scoliosis: Outcome and complications in a series of 37 patients with a minimum 2-year follow-up. *The Surgeon*, 18(5), e7-e12.

- [150] Trapana, J. E. & Gjolaj, J. P. (2022). Infections of the spine. *Seminars in Spine Surgery*, 34(1), 100922. Retrieved: May 2022. <https://doi.org/10.1016/j.semss.2022.100922>
- [151] Tunkel, A. R. (2020). Subdural Empyema, Epidural Abscess, and Suppurative Intracranial Thrombophlebitis. J. E. Bennett & R. Dolin (Eds.). *Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases* (9), (pp. 1262-1271.e2). Philadelphia: Elsevier, Inc.
- [152] Tyger, R. (2022). Spine. S. D. Rynders & J. A. Hart (Eds.). *Orthopaedics for Physician Assistants* (2), (pp. 1-38). Philadelphia: Elsevier, Inc.
- [153] Valero-Moreno, F. (2023). Radiculopathy from foraminal stenosis. K.L. Chaichana & Quiñones-Hinojosa, A. (Eds.). *Comparative Management of Spine Pathology*, (pp. 88-93). Philadelphia, PA: Elsevier, Inc.
- [154] Varshneya, K., Stienen M. N., . . . Veeravagu, A. (2020). Evaluating the Impact of Spinal Osteotomy on Surgical Outcomes of Thoracolumbar Deformity Correction. *World Neurosurgery*, 144, e774-e779.
- [155] Vázquez, R. G., Ferreiro Velasco, M. E., . . . de la Barrera, S. S. (2017). Update on traumatic acute spinal cord injury. Part 1. *Intensive Care Medicine (Medicina Intensiva, English Edition)*, 41(4), 237-247.
- [156] Vidalis, B. M., Ngwudike, S. I., . . . Chohan, M. O. (2021). Negative Pressure Wound Therapy in Facilitating Wound Healing After Surgical Decompression for Metastatic Spine Disease. *World Neurosurgery*, 159, e407-e415.
- [157] Vollmer, D. G. & Mizuno, J. (2023). Evaluation and Treatment of Ossification of the Posterior Longitudinal Ligament. H. Winn (Ed.). *Youmans and Winn Neurological Surgery* (8), (pp. 2477-2485.e3). Philadelphia: Elsevier, Inc.
- [158] Wagner, A., Haag, E., . . . Meyer, B. (2021). Cement-Augmented Carbon Fiber-Reinforced Pedicle Screw Instrumentation for Spinal Metastases: Safety and Efficacy. *World Neurosurgery*, 154, e536-e546.
- [159] Wagner, R. & Haefner, M. (2021). Indications and Contraindications of Full-Endoscopic Interlaminar Lumbar Decompression. *World Neurosurgery*, 145, 657-662.
- [160] Wainwright, J. V., Cooper, J. B. & Schmidt, M. H. (2022). Anterior and Lateral Approaches for Thoracic Discectomy: Endoscopic and Mini-Open Techniques. A. Quiñones-Hinojosa (Ed.). *Schmidek and Sweet: Operative Neurosurgical Techniques* (7), (pp. 1705-1716.e2). Philadelphia: Elsevier, Inc.
- [161] Waldman, S. D. (2021). Percutaneous Laser-Assisted Annuloplasty. S.D. Waldman (Ed.). *Atlas of Interventional Pain Management* (5), (pp. 1044). Philadelphia, PA: Elsevier, Inc.
- [162] Waldman, S.D. (2021). Percutaneous Sacroiliac Joint Fusion. S.D. Waldman (Ed.). *Atlas of Interventional Pain Management* (5), (pp. 1146-1146). Philadelphia, PA: Elsevier, Inc.
- [163] Wang, H., Yang, R., . . . Hong, Y. (2021). Comparison of Interventions for Cervical Ossification of Posterior Longitudinal Ligament: A Systematic Review and Network Meta-Analysis. *World Neurosurgery*, 155, 1-12.

- [164 Wang, J., Liu, C., . . . Wang, W. (2019). Early and Midterm Outcomes of Surgical Correction
] for Severe Dystrophic Cervical Kyphosis in Patients with Neurofibromatosis Type 1: A Retro-
spective Multicenter Study. *World Neurosurgery*, 127, e1190-e1200.
- [165 Wang, T. Y., Mehta, V. A., . . . Abd-El-Barr, M. M. (2021). Biomechanics, evaluation, and
] management of subaxial cervical spine injuries: A comprehensive review of the literature.
Journal of Clinical Neuroscience, 83, 131-139.
- [166 Wang, Z., Truong, V. T., . . . Boubetz, G. (2021). One-stage oblique lateral corridor antibiot-
] ic-cement reconstruction for Candida spondylodiscitis in patients with major comorbidities:
Preliminary experience. *Neurochirurgie*, 67(2), 157-164.
- [167 Warner, W. & Beaty, J. (2021). Paralytic Disorders. F. M. Azar & J. H. Beaty (Eds.). *Camp-
] bell's Operative Orthopaedics*, (14), (pp. 1369-1458.e10). Philadelphia: Elsevier, Inc.
- [168 Warner, W.C. & Sawyer, J.R. (2021). Neuromuscular Disorders. F.M. Azar & J.H. Beaty
] (Eds.). *Campbell's Operative Orthopaedics* (14), (pp. 1459-1490.e5). Philadelphia: Elsevier,
Inc.
- [169 Warner, W.C. & Sawyer, J.R. (2021). Scoliosis and Kyphosis. F.M. Azar & J.H. Beaty (Eds.).
] *Campbell's Operative Orthopaedics* (14), (pp. 1998-2196.e28). Philadelphia: Elsevier, Inc.
- [170 Watson, J. T. (2020). Biology and Enhancement of Skeletal Repair. B. D. Browner & J. B.
] Jupiter (Eds.). *Skeletal Trauma: Basic Science, Management, and Reconstruction* (6), (pp.
79-128). Philadelphia: Elsevier, Inc.
- [171 Weinberg, D.S. & Rhee, J.M. (2020). Cervical laminoplasty: indication, technique, complica-
] tions. *Journal of Spine Surgery*, 6(1), 290-301.
- [172 Wetzel, F. T., Munyon, C. N. & Saulino, M. (2018). Surgical Procedures for the Control of
] Chronic Pain. S. R. Garfin & F. J. Eismont (Eds.). *Rothman-Simeone and Herkowitz's The
Spine* (7), (pp. 2023-2040). Philadelphia: Elsevier, Inc.
- [173 Williams, K. D. (2021). Fractures, Dislocations, and Fracture-Dislocations of the Spine. F.
] M. Azar & J. H. Beaty (Eds.). *Campbell's Operative Orthopaedics* (14), (pp. 1832-1923).
Philadelphia: Elsevier, Inc.
- [174 Williams, K.D. (2021). Infections and Tumors of the Spine. F.M. Azar & J.H. Beaty (Eds.).
] *Campbell's Operative Orthopaedics* (14), (pp. 1924-1956.e7). Philadelphia: Elsevier, Inc.
- [175 Williams, L.A. & McDonald, C.M. (2021). Myopathic Disorders. D.X. Cifu (Ed.). *Braddom's
] Physical Medicine and Rehabilitation* (6), (pp. 875-915.e3). Philadelphia: Elsevier, Inc.
- [176 Wipplinger, C., Kirnaz, S., . . . Härtl, R. (2023). Minimally Invasive Decompression Techni-
] ques. H. R. Winn (Ed.). *Youmans and Winn Neurological Surgery* (8), (pp. 2854-2860.e1).
Philadelphia: Elsevier, Inc.
- [177 Witiw, C. D. & O'Toole, J. E. (2023). Cervical, Thoracic, and Lumbar Stenosis. H. R. Winn
] (Ed.). *Youmans and Winn Neurological Surgery* (8), (pp. 2498-2509.e5). Philadelphia:
Elsevier, Inc.

- [178] Wolfa, C.E. & Eckardt, G.W. (2023). Posterior Subaxial and Cervicothoracic Instrumentation. H.R. Winn (Ed.). *Youmans & Winn Neurological Surgery* (8), (pp. 2807-2814.e2). Philadelphia: Elsevier, Inc.
- [179] Woodard, E. J. (2022). Dorsal Semirigid Stabilization. M. P. Steinmetz & S. H. Berven (Eds.). *Benzel's Spine Surgery* (5), (pp. 1078-1087.e3). Philadelphia: Elsevier, Inc.
- [180] Wu, T., Liu, H., . . . Chen, H. (2017). Cervical disc arthroplasty for the treatment of adjacent segment disease: A systematic review of clinical evidence. *Clinical Neurology and Neurosurgery*, 162, 1-11.
- [181] Xi, L., Jin, L., . . . Shen, H. (2019). Endoscopic Ventral Decompression for Spinal Stenosis with Degenerative Spondylolisthesis by Partially Removing Posterosuperior Margin Underneath the Slipping Vertebral Body: Technical Note and Outcome Evaluation. *World Neurosurgery*, 126, e517-e525.
- [182] Yoon, W.W. & Koch, J. (2021). Herniated discs: when is surgery necessary? *EFORT Open Reviews*, 6(6), 526-530.
- [183] Younus, A. & Kelly, A. (2019). Innovative multi-cage long segment lumbar spine reconstruction for multilevel lumbar tuberculosis. *Interdisciplinary Neurosurgery*, 18, 100527. Retrieved: May 2022. <https://doi.org/10.1016/j.inat.2019.100527>
- [184] Yuan, W., Zhang, R., . . . Zhu, Y. (2020). Grade V Thoracic Spondylolisthesis in Neurofibromatosis Type 1: Case Report and Literature Review. *World Neurosurgery*, 138, 291-296.
- [185] Zavras, A. G., Sullivan, T. B., . . . Colman, M. W. (2021). Failure in cervical total disc arthroplasty: single institution experience, systematic review of the literature, and proposal of the RUSH TDA failure classification system. *The Spine Journal*, 22(3), 353-369.
- [186] Zhang, A.S., Myers, C., . . . Daniels, A.H. (2021). Cervical Myelopathy: Diagnosis, Contemporary Treatment, and Outcomes. *The American Journal of Medicine*, 135(4), 435-443.
- [187] Zhang, H., Deng, A., . . . Alonge, E. (2020). Posterior-Only Surgical Correction with Heavy Halo-Femoral Traction for the Treatment of Severe and Rigid Congenital Scoliosis Associated with Tethered Spinal Cord and Type II Split Cord Malformation. *World Neurosurgery*, 139, e151-e158.
- [188] Zhang, H., Li, M., . . . Gao, Q. (2019). Minimum 5-Year Follow-Up Outcomes for Comparison Between Titanium Mesh Cage and Allogeneic Bone Graft to Reconstruct Anterior Column Through Posterior Approach for the Surgical treatment of Thoracolumbar Spinal Tuberculosis with Kyphosis. *World Neurosurgery*, 127, e407-e415.
- [189] Zhang, H., Xu, M., . . . Hu, Y. (2020). Percutaneous vertebral augmentation procedures in the management of spinal metastases. *Cancer Letters*, 475, 136-142.
- [190] Zheng, C., Liao, Z. & Chen, H. (2021). Percutaneous Endoscopic Posterior Decompression for Therapy of Spinal Cord Compression Due to Ossification of the Ligamentum Flavum: A Long-Term Follow-up. *World Neurosurgery*, 156, e249-e253.
- [191] Zhang, J. & Chou, D. (2018). Spinal Sclerosing Epithelioid Fibrosarcoma at the Cervicothoracic Junction. *World Neurosurgery*, 114, 155-160.



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Disclaimer section

Purpose

The purpose of the HealthHelp's clinical guidelines is to assist healthcare professionals in selecting the medical service that may be appropriate and supported by evidence to safely improve outcomes. Medical information is constantly evolving, and HealthHelp reserves the right to review and update these clinical guidelines periodically. HealthHelp reserves the right to include in these guidelines the clinical indications as appropriate for the organization's program objectives. Therefore the guidelines are not a list of all the clinical indications for a stated procedure, and associated Procedure Code Tables may not represent all codes available for that state procedure or that are managed by a specific client-organization.

Clinician Review

These clinical guidelines neither preempt clinical judgment of trained professionals nor advise anyone on how to practice medicine. Healthcare professionals using these clinical guidelines are responsible for all clinical decisions based on their assessment. All Clinical Reviewers are instructed to apply clinical indications based on individual patient assessment and documentation, within the scope of their clinical license.

Payment

The use of these clinical guidelines does not provide authorization, certification, explanation of benefits, or guarantee of payment; nor do the guidelines substitute for, or constitute, medical advice. Federal and State law, as well as member benefit contract language (including definitions and specific contract provisions/exclusions) take precedence over clinical guidelines and must be considered first when determining eligibility for coverage. All final determinations on coverage and payment are the responsibility of the health plan. Nothing contained within this document can be interpreted to mean otherwise.

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National and Local Coverage Determination (NCD and LCD)



NOTICE

To ensure appropriate review occurs to the most current NCD and/or LCD, always defer to <https://www.cms.gov/medicare-coverage-database/search.aspx>.

Background

National Coverage Determinations (NCD) and Local Coverage Determinations (LCD) are payment policy documents outlined by the Centers for Medicare and Medicaid Services (CMS) and the government's delegated Medicare Audit Contractors (MACs) that operate regionally in jurisdictions. CMS introduced variation between different jurisdictions/Medicare Audit Contractors (MACs) and their associated covered code lists with the transition to ICD 10. The variation resulted in jurisdictions independently defining how codes are applied for exclusions, limitations, groupings, ranges, etc. for the medical necessity indications outlined in the NCD and LCD. Due to this variation, there is an inconsistent use/application of codes and coverage determinations across the United States between the different MACs.

In addition, **WITHOUT** notice, CMS can change the codes that indicate medical necessity and the format of the coverage determinations/associated documents (eg, Articles). This is an additional challenge for organizations to keep up with ongoing, unplanned changes in covered codes and medical necessity indications.

Medical Necessity Codes

Due to the variation in code application between jurisdictions/MACs and that updates can happen without notification, HealthHelp is not able to guarantee full accuracy of the codes listed for any Coverage Determination, and advises that prior to use, the associated Coverage Determination Articles are reviewed to ensure applicability to HealthHelp's programs and any associated NCDs and LCDs.

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