Indications for Cervical Spine Surgery:

A. **Anterior Cervical Decompression with Fusion (ACDF) - Single Level**

   The following criteria must be met*:

   - Positive clinical findings of myelopathy with evidence of progressive neurologic deficits consistent with **spinal cord compression** - immediate surgical evaluation is indicated (AAOS, 2013; Bono, 2011; Cunningham, 2010; Holly, 2009; Matz, 2009a; Matz, 2009b; Matz, 2009d; Matz, 2009e; Mummaneni, 2009; Tetreault, 2013; Yalamanchili, 2012; Zhu, 2013). Symptoms may include:
     - Upper extremity weakness
     - Unsteady gait related to myelopathy/balance or generalized lower extremity weakness
     - Disturbance with coordination
     - Hyperreflexia
     - Hoffmann sign
     - Positive Babinski sign and/or clonus

   OR

   - Progressive neurological deficit (motor deficit, bowel or bladder dysfunction) with evidence of spinal cord or nerve root compression on Magnetic Resonance Imaging (MRI) or Computed Tomography (CT) imaging - immediate surgical evaluation is indicated. (Bono, 2011; Matz, 2009b; Tetreault, 2013);

   OR

   - When **ALL** of the following criteria are met (Bono, 2011; Nikolaidis, 2010):
     - Cervical radiculopathy or myelopathy from ruptured disc, spondylosis, spinal instability, or deformity; **AND**
     - Persistent or recurrent symptoms/pain with functional limitations that are unresponsive to **at least 6 weeks** of appropriate conservative treatment; **AND**
     - Documented failure of at least 6 consecutive weeks in the last 6 months of any 2 of the following physician-directed conservative treatments:
       - Analgesics, steroids, and/or NSAIDs
       - Structured program of physical therapy
       - Structured home exercise program prescribed by a physical therapist, chiropractic provider or physician
       - Epidural steroid injections and/or selective nerve root block; **AND**
     - Imaging studies confirm the presence of spinal cord or spinal nerve root compression (disc herniation or foraminal stenosis) at the level **corresponding with the clinical findings** (Bono, 2011). Imaging studies may include:
       - MRI (preferred study for assessing cervical spine soft tissue); **OR**
       - CT with or without myelography— indicated in patients in whom MRI is contraindicated; preferred for examining bony structures, or in patients presenting with clinical symptoms or signs inconsistent with MRI findings (e.g., foraminal compression not seen on MRI).

* Cervical spine decompression with fusion as first-line treatment without conservative care measures in the following clinical cases (Matz, 2009b; Tetreault, 2013; White, 1987; Zhu, 2013):

   - As outlined above for myelopathy or progressive neurological deficit scenarios.
   - Significant spinal cord or nerve root compression due to tumor, infection, or trauma.
   - Fracture or instability on radiographic films measuring:
B. Anterior Cervical Decompression with Fusion (ACDF) - Multiple Level

The following criteria must be met:

- Positive clinical findings of myelopathy with evidence of progressive neurologic deficits consistent with worsening spinal cord compression - immediate surgical evaluation is indicated (AAOS, 2013; Bono, 2011; Cunningham, 2010; Holly, 2009; Matz, 2009a; Matz, 2009b; Matz, 2009d; Matz, 2009e; Mummaneni, 2009; Tetreault, 2013; Yalamanchili, 2012; Zhu, 2013). Symptoms may include:
  - Upper extremity weakness
  - Unsteady gait related to myelopathy/balance or generalized lower extremity weakness
  - Disturbance with coordination
  - Hyperreflexia
  - Hoffmann sign
  - Positive Babinski sign and/or clonus

  OR

- Progressive neurological deficit (motor deficit, bowel or bladder dysfunction) with corresponding evidence of spinal cord or nerve root compression on an MRI or CT scan images - immediate surgical evaluation is indicated (Bono, 2011; Matz, 2009b; Tetreault, 2013).

OR

- When ALL of the following criteria are met (Bono, 2011; Nikolaidis, 2010):
  - Cervical radiculopathy or myelopathy due to ruptured disc, spondylosis, spinal instability, or deformity; AND
  - Persistent or recurrent pain/symptoms with functional limitations that are unresponsive to at least 6 weeks of conservative treatment; AND
  - Documented failure of at least 6 consecutive weeks in the last 6 months of any 2 of the following physician-directed conservative treatments
    - Analgesics, steroids, and/or NSAIDs
    - Structured program of physical therapy
    - Structured home exercise program prescribed by a physical therapist, chiropractic provider or physician
    - Epidural steroid injections and/or selective nerve root block; AND
  - Imaging studies confirm the presence of spinal cord or spinal nerve root compression (disc herniation or foraminal stenosis) at multiple levels corresponding with the clinical findings. Imaging studies may include any of the following (Bono, 2011):
    - MRI (preferred study for assessing cervical spine soft tissue); OR
    - CT with or without myelography - indicated in patients in whom MRI is contraindicated; preferred for examining bony structures, or in patients presenting with clinical symptoms or signs inconsistent with MRI findings (e.g., foraminal compression not seen on MRI).
Cervical spine decompression with fusion performed as first-line treatment without conservative care measures in the following clinical cases (Matz, 2009b; Tetreault, 2013; White, 1987; Zhu, 2013):

- As outlined above for myelopathy or progressive neurological deficit scenarios.
- Significant spinal cord or nerve root compression due to tumor, infection or trauma.
- Fracture or instability on radiographic films measuring:
  - Sagittal plane angulation of greater than 11 degrees at a single interspace or greater than 3.5 mm anterior subluxation in association with radicular/cord dysfunction; OR
  - Subluxation at the (C1) level of the atlantodental interval of more than 3 mm in an adult and 5 mm in a child.

Not Recommended (Nikolaidis, 2010; van Middelkoop, 2012):
- In asymptomatic or mildly symptomatic cases of cervical spinal stenosis.
- In cases of neck pain alone, without neurological deficits, and no evidence of significant spinal nerve root or cord compression on MRI or CT. See: Cervical Fusion for Treatment of Axial Neck Pain Criteria.

C. Cervical Posterior Decompression with Fusion - Single Level

The following criteria must be met:

  - Symptoms may include:
    - Upper extremity weakness
    - Unsteady gait related to myelopathy/balance or generalized lower extremity weakness
    - Disturbance with coordination
    - Hyperreflexia
    - Hoffmann sign
    - Positive Babinski sign and/or clonus
  OR
  - Progressive neurological deficit (motor deficit, bowel or bladder dysfunction) with corresponding evidence of spinal cord or nerve root compression on an MRI or CT scan images - immediate surgical evaluation is indicated (Bono, 2011; Matz, 2009b; Tetreault, 2013).

OR

- When ALL of the following criteria are met (Bono, 2011; Nikolaidis, 2010):
  - Cervical radiculopathy or myelopathy from ruptured disc, spondylosis, spinal instability, or deformity; AND
  - Persistent or recurrent symptoms/pain with functional limitations that are unresponsive to at least 6 weeks of conservative treatment; AND
  - Documented failure of at least 6 consecutive weeks in the last 6 months of any 2 of the following physician-directed conservative treatments:
    - Analgesics, steroids, and/or NSAIDs
    - Structured program of physical therapy
    - Structured home exercise program prescribed by a physical therapist, chiropractic provider or physician
    - Epidural steroid injections and/or selective nerve root block; AND
  - Imaging studies confirm the presence of spinal cord or spinal nerve root compression (disc herniation or foraminal stenosis) at single level corresponding with the clinical findings (Bono, 2011). Imaging studies may include:
    - MRI (preferred study for assessing cervical spine soft tissue); OR
CT with or without myelography - indicated in patients in whom MRI is contraindicated; preferred for examining bony structures, or in patients presenting with clinical symptoms or signs inconsistent with MRI findings (e.g., foraminal compression not seen on MRI); AND

*Cervical spine decompression with fusion performed as first-line treatment without conservative care measures in the following clinical cases (Fehlings, 2013; Tetreault, 2013; White, 1987; Zhu, 2013):

- As outlined above for myelopathy or progressive neurological deficit scenarios.
- Significant spinal cord or nerve root compression due to tumor, infection or trauma.
- Fracture or instability on radiographic films measuring:
  - Sagittal plane angulation of greater than 11 degrees at a single interspace or greater than 3.5 mm anterior subluxation in association with radicular/cord dysfunction; OR
  - Subluxation at the (C1) level of the atlantodental interval of more than 3 mm in an adult and 5 mm in a child.

Not Recommended (Nikolaidis, 2010; Wang, 2011):

- In asymptomatic or mildly symptomatic cases of cervical spinal stenosis.
- In cases of neck pain alone, without neurological deficits, and no evidence of significant spinal nerve root or cord compression on MRI or CT. See: Cervical Fusion for Treatment of Axial Neck Pain Criteria.

D. Cervical Posterior Decompression with Fusion - Multiple Levels

The following criteria must be met*:

  - Symptoms may include:
    - Upper extremity weakness
    - Unsteady gait related to myelopathy/balance or generalized lower extremity weakness
    - Disturbance with coordination
    - Hyperreflexia
    - Hoffmann sign
    - Positive Babinski sign and/or clonus
  - OR
  - Progressive neurological deficit (motor deficit, bowel or bladder dysfunction) with corresponding evidence of spinal cord or nerve root compression on an MRI or CT scan images - immediate surgical evaluation is indicated (Bono, 2011; Matz, 2009b; Tetreault, 2013).
  - OR
  - When ALL of the following criteria are met (Bono, 2011; Nikolaidis, 2010):
    - Cervical radiculopathy or myelopathy from ruptured disc, spondylosis, spinal instability, or deformity; AND
    - Persistent or recurrent symptoms/pain with functional limitations that are unresponsive to at least 6 weeks of conservative treatment; AND
    - Documented failure of at least 6 consecutive weeks in the last 6 months of any 2 of the following physician-directed conservative treatments:
      - Analgesics, steroids, and/or NSAIDs
      - Structured program of physical therapy
      - Structured home exercise program prescribed by a physical therapist, chiropractic provider or physician
• Epidural steroid injections and/or facet injections/selective nerve root block; AND
  o Imaging studies indicate significant spinal cord or spinal nerve root compression at multiple levels corresponding with the clinical findings. Imaging studies may include (Bono, 2011):
    □ MRI (preferred study for assessing cervical spine soft tissue); OR
    □ CT with or without myelography - indicated in patients in whom MRI is contraindicated; preferred for examining bony structures, or in patients presenting with clinical symptoms or signs inconsistent with MRI findings (e.g., foraminal compression not seen on MRI); AND

*Cervical spine decompression with fusion performed as first-line treatment without conservative care measures in the following clinical cases* (Fehlings, 2013; Tetreault, 2013; White, 1987; Zhu, 2013):
  • As outlined above for myelopathy or progressive neurological deficit scenarios.
  • Significant spinal cord or nerve root compression due to tumor, infection or trauma.
  • Fracture or instability on radiographic films measuring:
    □ Sagittal plane angulation of greater than 11 degrees at a single interspace or greater than 3.5 mm anterior subluxation in association with radicular/cord dysfunction; OR
    □ Subluxation at the (C1) level of the atlantodental interval of more than 3 mm in an adult and 5 mm in a child.

**Not Recommended** (Nikolaidis, 2010; Wang, 2011):
  • In asymptomatic or mildly symptomatic cases of cervical spinal stenosis.
  • In cases of neck pain alone, without neurological deficits, and no evidence of significant spinal nerve root or cord compression on MRI or CT. See: Cervical Fusion for Treatment of Axial Neck Pain Criteria.

**E. Cervical Fusion for Treatment of Axial Neck Pain:**
In patients with non-radicular cervical pain for whom fusion is being considered, **ALL of the following criteria must be met** (Riew, 2010):
  • Improvement of the symptoms has failed or plateaued, and the residual symptoms of pain and functional disability are unacceptable at the end of 6 to 12 consecutive months of appropriate, active treatment or at the end of longer duration of non-operative programs for debilitated patients with complex problems [NOTE: Mere passage of time with poorly guided treatment is not considered an active treatment program]; AND
  • All pain generators are adequately defined and treated; AND
  • All physical medicine and manual therapy interventions are completed; AND
  • X-ray, MRI, or CT demonstrating disc pathology or spinal instability; AND
  • Spine pathology limited to one or two levels unless other complicating factors are involved; AND
  • Psychosocial evaluation for confounding issues addressed.

**NOTE:** The effectiveness of three-level or greater cervical fusion for non-radicular pain has not been established (van Middelkoop, 2012).

**F. Cervical Posterior Decompression**
The following criteria must be met:
  • Positive clinical findings of myelopathy with evidence of progressive neurologic deficits consistent with worsening spinal cord compression - immediate surgical evaluation is indicated (AAOS, 2013; Bono, 2011; Heary, 2009; Mummaneni, 2009; Ryken, 2009; Tetreault, 2013; Wang, 2013; Yalamanchili, 2012; Zhu, 2013). Symptoms may include:
    □ Upper extremity weakness
Unsteady gait related to myelopathy/balance or generalized lower extremity weakness
Disturbance with coordination
Hyperc-reflexia
Hoffmann sign
Positive Babinski sign and/or clonus

OR
Progressive neurological deficit (motor deficit, bowel or bladder dysfunction) with corresponding evidence of spinal cord or nerve root compression on an MRI or CT scan images - immediate surgical evaluation is indicated (Tetreault, 2013; Wang, 2013).

OR
• When **ALL of the following criteria are met** (Bono, 2011):
  o Cervical radiculopathy from ruptured disc, spondylosis, or deformity; **AND**
  o Persistent or recurrent symptoms/pain with functional limitations that are unresponsive to **at least 6 weeks of appropriate conservative treatment** **AND**
  o Documented failure of at least 6 consecutive weeks in the last 6 months of **any 2** of the following physician-directed conservative treatments:
    ▪ Analgesics, steroids, and/or NSAIDs
    ▪ Structured program of physical therapy
    ▪ Structured home exercise program prescribed by a physical therapist, chiropractic provider, or physician
    ▪ Epidural steroid injections and/or facet injections/selective nerve root block; **AND**
  o Imaging studies confirm the presence of spinal cord or spinal nerve root compression at the level(s) **corresponding with the clinical findings** (Bono, 2011; Sahai, 2019). Imaging studies may include **any** of the following:
    ▪ MRI (preferred study for assessing cervical spine soft tissue); **OR**
    ▪ CT with or without myelography—indicated in patients in whom MRI is contraindicated; preferred for examining bony structures, or in patients presenting with clinical symptoms or signs inconsistent with MRI findings (e.g., foraminal compression not seen on MRI).

*Cervical decompression performed as first-line treatment without conservative care in the following clinical cases* (Ryken, 2009; Tetreault, 2013; Wang, 2013; Zhu, 2013):
- As outlined above for myelopathy or progressive neurological deficit scenarios.
- Spinal cord or nerve root compression due to tumor, infection or trauma.

**Not Recommended** (Nikolaidis, 2010; Wang, 2011):
- In asymptomatic or mildly symptomatic cases.
- In cases of neck pain alone, without neurological deficits and abnormal imaging findings. See: Cervical Fusion for Treatment of Axial Neck Pain Criteria.
- In patients with kyphosis or at risk for development of postoperative kyphosis.

G. Cervical Artificial Disc Replacement (Single or Two Level)
Indications for cervical artificial disc replacement are as follows (Bono, 2011; Cheng, 2009; Davis, 2015; Gomet, 2019; LaValle, 2019; Matz, 2009e):
- Skeletally mature patient; **AND**
- Patient has intractable radiculopathy caused by one or two level disease (either herniated disc or spondylosytic osteophyte) located at C3-C7; **AND**
- Persistent or recurrent symptoms/pain with functional limitations that are unresponsive to **at least 6 weeks** of appropriate conservative treatment; **AND**
- Documented failure of at least 6 consecutive weeks in the last 6 months of **any 2** of the following physician-directed conservative treatments:
  o Analgesics, steroids, and/or NSAIDs
Structured program of physical therapy
Structured home exercise program prescribed by a physical therapist, chiropractic provider or physician
Epidural steroid injections and/or facet injections/selective nerve root block; AND
Imaging studies confirm the presence of compression at the level(s) corresponding with the clinical findings (MRI or CT); AND
Use of an FDA-approved prosthetic intervertebral discs.

Cervical Artificial Disc Replacement is NOT indicated when **any of the following** clinical scenarios exists (Davis, 2015):
- Symptomatic multiple level disease affecting 3 or more levels
- Infection (at site of implantation or systemic)
- Osteoporosis or osteopenia
- Instability
  - Translation greater than 3 mm difference between lateral flexion-extension views at the symptomatic levels;
  - 11 degrees of angular difference between lateral flexion-extension views at the symptomatic levels
- Sensitivity or allergy to implant materials
- Severe spondylosis defined as (Davis, 2015):
  - > 50% disc height loss compared to minimally or non-degenerated levels; OR
  - Bridging osteophytes; OR
  - Absence of motion on lateral flexion-extension views at the symptomatic site
- Severe facet arthropathy
- Ankylosing spondylitis
- Rheumatoid arthritis
- Previous fracture with anatomical deformity
- Ossification of the posterior longitudinal ligament (OPLL)
- Active cervical spine malignancy

H. **Cervical Fusion Without Decompression**
Cervical fusion without decompression will be reviewed on a **case-by-case basis**. Atraumatic instability due to Down Syndrome-related spinal deformity, rheumatoid arthritis, or basilar invagination are uncommon, but may require cervical fusion (Trumees, 2017).

I. **Cervical Anterior Decompression (without Fusion)**
All requests for anterior decompression without fusion will be reviewed on a **case-by-case basis** (Bono, 2011; Botelho, 2012; Gebremariam, 2012; Matz, 2009a; Matz, 2009e).

**NOTE**: Refer to **Appendix A** to see the policy statement changes (if any) from the previous version.

**Policy Guidelines**

*Conservative Therapy*: (Musculoskeletal) includes primarily physical therapy and/or injections; and a combination of modalities, such as rest, ice, heat, modified activities, medical devices (such as a cervical collar), medications, diathermy, chiropractic treatments, or physician supervised home exercise program.

**Home Exercise Program** (HEP) – the following two elements are required to meet guidelines for completion of conservative therapy:
- Information provided on exercise prescription/plan; **AND**
- Follow up with member with documentation provided regarding completion of HEP, (after 4 - 6 week period) or inability to complete HEP due to physical reason - i.e. increased pain, inability to physically perform exercises. (Patient inconvenience or noncompliance without explanation does not constitute “inability to complete” HEP).
A comprehensive assimilation of factors should lead to a specific diagnosis with positive identification of the pathologic condition(s).

- Early intervention may be required in acute incapacitating pain or in the presence of progressive neurological deficits.
- Operative treatment is indicated when the natural history of surgically treated lesions is better than the natural history for non-operatively treated lesions.
- Patients may present with localized pain or severe pain in combination with numbness, extremity weakness, loss of coordination, gait issues, or bowel and bladder complaints. Nonoperative treatment continues to play an important role in the care of patients with degenerative cervical spine disorders. If these symptoms progress to neurological deficits from corresponding spinal cord or nerve root compression, then surgical intervention may be warranted.
- All patients being considered for surgical intervention should first undergo a comprehensive neuromusculoskeletal examination to identify those pain generators that may either respond to non-surgical techniques, or may be refractory to surgical intervention.
- If operative intervention is being considered, particularly those procedures that require a fusion, it is required that the person refrain from smoking/nicotine for at least six weeks prior to surgery and during the time of healing (Jackson, 2016; Kusin, 2015; Liang, 2017; Olsson, 2015; Rajaee, 2014; Tetreault, 2015).
- In situations requiring the possible need for operation, a second opinion may be necessary. Psychological evaluation is strongly encouraged when surgery is being performed for isolated axial pain to determine if the patient will likely benefit from the treatment.
- It is imperative for the clinician to rule out non-physiologic modifiers of pain presentation, or non-operative conditions mimicking radiculopathy, myelopathy or spinal instability (peripheral compressive neuropathy, chronic soft tissue injuries, and psychological conditions), prior to consideration of elective surgical intervention.

Degenerative cervical spine disorders, while often benign and episodic in nature, can become debilitating, resulting in axial pain and neurological damage to the spinal cord or roots. Compression on the nerve root and/or spinal cord may be caused by (1) a herniated disc with or without extrusion of disc fragments and/or (2) degenerative cervical spondylosis.

**Key Primary CPT Codes:**

**Anterior Cervical Decompression with Fusion - Single Level (ACDF):**
- 22548, 22551, 22554, 22864

**Anterior Cervical Decompression with Fusion - Multiple Level (ACDF):**
- 22548, 22551, 22554, 22552, 22585, 22864

**Cervical Posterior Decompression with Fusion - Single Level:**
- 22590, 22595, 22600

**Cervical Posterior Decompression with Fusion - Multiple Levels:**
- 22590, 22595, 22600, 22614

**Cervical Artificial Disc - Single Level:**
- 22856, 22861, 22864

**Cervical Artificial Disc - Two Levels:**
- 22856, 22858, 22861, 22864, 0098T, 0095T

**Cervical Anterior Decompression (w/o fusion):**
- 63075, 63076
Cervical Posterior Decompression (w/o fusion):

- 63001, 63015, 63020, 63040, 63045, 63050, 63051, 63035, 63043, 63048

Description

This guideline outlines the key surgical treatments and indications for common cervical spinal disorders and is a consensus document based upon the best available evidence. Spine surgery is a complex area of medicine, and this document breaks out the clinical indications by surgical type. Operative treatment is indicated only when the natural history of an operatively treatable problem is better than the natural history of the problem without operative treatment. Choice of surgical approach is based on anatomy, the patient's pathology, and the surgeon's experience and preference. All operative interventions must be based on a positive correlation with clinical findings, the natural history of the disease, the clinical course, and diagnostic tests or imaging results.

Related Policies

- N/A

Benefit Application

Benefit determinations should be based in all cases on the applicable contract language. To the extent there are any conflicts between these guidelines and the contract language, the contract language will control. Please refer to the member's contract benefits in effect at the time of service to determine coverage or non-coverage of these services as it applies to an individual member.

Some state or federal mandates (e.g., Federal Employee Program [FEP]) prohibits plans from denying Food and Drug Administration (FDA)-approved technologies as investigational. In these instances, plans may have to consider the coverage eligibility of FDA-approved technologies on the basis of medical necessity alone.

Regulatory Status

- N/A

Rationale

Anterior Approaches:

- Anterior surgical approaches to cervical spine decompression emerged in the 1950s in response to technical limitations experienced with posterior approaches, including restricted access to and exposure of midline bony spurs and disc fragments.
- The first reports in the literature describe anterior cervical discectomy combined with a spinal fusion procedure (ACDF). Fusion was added to address concerns about potential for loss of spinal stability and disc space height, leading to late postoperative complications such as kyphosis and radicular pain (Sonntag, 1996; Dowd, 1999; Matz, 2009a; Matz, 2009b; Denaro, 2011; Botelho, 2012; Van Middelkoop, 2012).
- Anterior cervical fusion (ACF) accounted for approximately 80% of cervical spine procedures performed in the United States between 2002 and 2009, while posterior cervical fusion (PCF) accounted for 8.5% of these procedures (Oglesby, 2013).

Anterior Cervical Discectomy and Fusion (ACDF) – removal of all or part of a herniated or ruptured disc or spondolytic bony spur to alleviate pressure on the nerve roots or on the spinal
cord in patients with symptomatic radiculopathy. Discectomy is most often combined with fusion to stabilize the spine.

Cervical Artificial Disc Replacement: This involves the insertion of a prosthetic device into the cervical intervertebral space with the goal of maintaining physiologic motion at the treated cervical segment. The use of artificial discs in motion-preserving technology is based on the surgeon's preference and training. Only FDA-approved artificial discs are appropriate.

Posterior Approaches:
- **Laminectomy** – removal of the bone between the spinal process and facet pedicle junction to expose the neural elements of the spine. This allows for the inspection of the spinal canal, identification and removal of pathological tissue, and decompression of the cord and roots.
- **Laminoplasty** – the opening of the lamina to enlarge the spinal canal. There are several laminoplasty techniques; all aim to alleviate cord compression by reconstructing the spinal canal. Laminoplasty is commonly performed to decompress the spinal cord in patients with multilevel degenerative spinal stenosis and neutral or lordotic alignment.
- **Laminoforaminotomy (also known as posterior discectomy)** – the creation of a small window in the lamina to facilitate removal of arthritic bone spurs and herniated disc material pressing on the nerve root as it exits through the foramen. The procedure widens the opening of the foramen so that the nerve exits without being compressed.

References


Documentation for Clinical Review

Please provide the following documentation:
- History and physical and/or consultation notes including:
  - Activity limitations
  - Clinical findings
  - Comorbidities
  - Conservative treatments and duration
  - Duration of back pain
  - Reason for procedure
- Radiology report(s) (i.e., MRI, CT, discogram)

Post Service (in addition to the above, please include the following):
- Procedure report(s)

Coding

This Policy relates only to the services or supplies described herein. Benefits may vary according to product design; therefore, contract language should be reviewed before applying the terms
of the Policy. Inclusion or exclusion of codes does not constitute or imply member coverage or provider reimbursement.

<table>
<thead>
<tr>
<th>Type</th>
<th>Code</th>
<th>Description</th>
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<tbody>
<tr>
<td></td>
<td>0095T</td>
<td>Removal of total disc arthroplasty (artificial disc), anterior approach, each additional interspace, cervical (List separately in addition to code for primary procedure)</td>
</tr>
<tr>
<td></td>
<td>0098T</td>
<td>Revision including replacement of total disc arthroplasty (artificial disc), anterior approach, each additional interspace, cervical (List separately in addition to code for primary procedure)</td>
</tr>
<tr>
<td></td>
<td>0274T</td>
<td>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 (e.g., fluoroscopic, CT), single or multiple levels, unilateral or bilateral; cervical or thoracic</td>
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<tr>
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<td>22548</td>
<td>Arthrodesis, anterior transoral or extraoral technique, clivus-C1-C2 (atlas-axis), with or without excision of odontoid process</td>
</tr>
<tr>
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<td>22551</td>
<td>Arthrodesis, anterior interbody, including disc space preparation, discectomy, osteophytectomy and decompression of spinal cord and/or nerve roots; cervical below C2</td>
</tr>
<tr>
<td></td>
<td>22552</td>
<td>Arthrodesis, anterior interbody, including disc space preparation, discectomy, osteophytectomy and decompression of spinal cord and/or nerve roots; cervical below C2, each additional interspace (List separately in addition to code for separate procedure)</td>
</tr>
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<td>22554</td>
<td>Arthrodesis, anterior interbody technique, including minimal discectomy to prepare interspace (other than for decompression); cervical below C2</td>
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<tr>
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<td>22585</td>
<td>Arthrodesis, anterior interbody technique, including minimal discectomy to prepare interspace (other than for decompression); each additional interspace (List separately in addition to code for primary procedure)</td>
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<td>22595</td>
<td>Arthrodesis, posterior technique, atlas-axis (C1-C2)</td>
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<td>22600</td>
<td>Arthrodesis, posterior or posterolateral technique, single level; cervical below C2 segment</td>
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<tr>
<td></td>
<td>22614</td>
<td>Arthrodesis, posterior or posterolateral technique, single level; each additional vertebral segment (List separately in addition to code for primary procedure)</td>
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<td>22856</td>
<td>Total disc arthroplasty (artificial disc), anterior approach, including discectomy with end plate preparation (includes osteophytectomy for nerve root or spinal cord decompression and microdissection); single interspace, cervical</td>
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<td>22858</td>
<td>Total disc arthroplasty (artificial disc), anterior approach, including discectomy with end plate preparation (includes osteophytectomy for nerve root or spinal cord decompression and microdissection); second level, cervical (List separately in addition to code for primary procedure)</td>
</tr>
<tr>
<td></td>
<td>22861</td>
<td>Revision including replacement of total disc arthroplasty (artificial disc), anterior approach, single interspace; cervical</td>
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<tr>
<td></td>
<td>22864</td>
<td>Removal of total disc arthroplasty (artificial disc), anterior approach, single interspace; cervical</td>
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<tr>
<td></td>
<td>22899</td>
<td>Unlisted procedure, spine</td>
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<td>63001</td>
<td>Laminectomy with exploration and/or decompression of spinal cord and/or cauda equina, without facetectomy, foraminotomy or discectomy (e.g., spinal stenosis), 1 or 2 vertebral segments; cervical</td>
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</tbody>
</table>
### Type

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<tr>
<th>Code</th>
<th>Description</th>
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<tbody>
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<td>Laminectomy with exploration and/or decompression of spinal cord and/or cauda equina, without facetectomy, foraminotomy or discectomy (e.g., spinal stenosis), more than 2 vertebral segments; cervical</td>
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<tr>
<td>63020</td>
<td>Laminotomy (hemilaminectomy), with decompression of nerve root(s), including partial facetectomy, foraminotomy and/or excision of hemiated intervertebral disc; 1 interspace, cervical</td>
</tr>
<tr>
<td>63035</td>
<td>Laminotomy (hemilaminectomy), with decompression of nerve root(s), including partial facetectomy, foraminotomy and/or excision of hemiated intervertebral disc; each additional interspace, cervical or lumbar (List separately in addition to code for primary procedure)</td>
</tr>
<tr>
<td>63040</td>
<td>Laminotomy (hemilaminectomy), with decompression of nerve root(s), including partial facetectomy, foraminotomy and/or excision of hemiated intervertebral disc, reexploration, single interspace; cervical</td>
</tr>
<tr>
<td>63043</td>
<td>Laminotomy (hemilaminectomy), with decompression of nerve root(s), including partial facetectomy, foraminotomy and/or excision of hemiated intervertebral disc, reexploration, single interspace; each additional cervical interspace (List separately in addition to code for primary procedure)</td>
</tr>
<tr>
<td>63045</td>
<td>Laminectomy, facetectomy and foraminotomy (unilateral or bilateral with decompression of spinal cord, cauda equina and/or nerve root[s], [e.g., spinal or lateral recess stenosis]), single vertebral segment; cervical</td>
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<tr>
<td>63048</td>
<td>Laminectomy, facetectomy and foraminotomy (unilateral or bilateral with decompression of spinal cord, cauda equina and/or nerve root[s], [e.g., spinal or lateral recess stenosis]), single vertebral segment; each additional segment; cervical, thoracic, or lumbar (List separately in addition to code for primary procedure)</td>
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<tr>
<td>63050</td>
<td>Laminoplasty, cervical, with decompression of the spinal cord, 2 or more vertebral segments</td>
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<tr>
<td>63051</td>
<td>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 [e.g., wire, suture, mini-plates], when performed)</td>
</tr>
<tr>
<td>63075</td>
<td>Discectomy, anterior, with decompression of spinal cord and/or nerve root(s), including osteophysectomy; cervical, single interspace</td>
</tr>
<tr>
<td>63076</td>
<td>Discectomy, anterior, with decompression of spinal cord and/or nerve root(s), including osteophysectomy; cervical, each additional interspace (List separately in addition to code for primary procedure)</td>
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</table>

### HCPCS
None

### Policy History
This section provides a chronological history of the activities, updates and changes that have occurred with this Medical Policy.

<table>
<thead>
<tr>
<th>Effective Date</th>
<th>Action</th>
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</thead>
<tbody>
<tr>
<td>01/01/2017</td>
<td>Adoption of National Imaging Associates (NIA) Clinical Guidelines</td>
</tr>
<tr>
<td>07/01/2018</td>
<td>NIA Clinical Guideline update</td>
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<tr>
<td>07/01/2019</td>
<td>NIA Clinical Guideline update</td>
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<tr>
<td>07/01/2020</td>
<td>Annual NIA clinical guideline update</td>
</tr>
</tbody>
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Effective Date | Action
---|---
03/01/2021 | Annual NIA clinical guideline update. Policy title changed from Cervical Spinal Surgery to current one.

**Definitions of Decision Determinations**

**Medically Necessary:** Services that are Medically Necessary include only those which have been established as safe and effective, are furnished under generally accepted professional standards to treat illness, injury or medical condition, and which, as determined by Blue Shield, are: (a) consistent with Blue Shield medical policy; (b) consistent with the symptoms or diagnosis; (c) not furnished primarily for the convenience of the patient, the attending Physician or other provider; (d) furnished at the most appropriate level which can be provided safely and effectively to the patient; and (e) not more costly than an alternative service or sequence of services at least as likely to produce equivalent therapeutic or diagnostic results as to the diagnosis or treatment of the Member’s illness, injury, or disease.

**Investigational/Experimental:** A treatment, procedure, or drug is investigational when it has not been recognized as safe and effective for use in treating the particular condition in accordance with generally accepted professional medical standards. This includes services where approval by the federal or state governmental is required prior to use, but has not yet been granted.

**Split Evaluation:** Blue Shield of California/Blue Shield of California Life & Health Insurance Company (Blue Shield) policy review can result in a split evaluation, where a treatment, procedure, or drug will be considered to be investigational for certain indications or conditions, but will be deemed safe and effective for other indications or conditions, and therefore potentially medically necessary in those instances.

**Prior Authorization Requirements (as applicable to your plan)**

Within five days before the actual date of service, the provider must confirm with Blue Shield that the member's health plan coverage is still in effect. Blue Shield reserves the right to revoke an authorization prior to services being rendered based on cancellation of the member’s eligibility. Final determination of benefits will be made after review of the claim for limitations or exclusions.

Questions regarding the applicability of this policy should be directed to the Prior Authorization Department at (800) 541-6652, or the Transplant Case Management Department at (800) 637-2066 ext. 3507708 or visit the provider portal at www.blueshieldca.com/provider.

Disclaimer: This medical policy is a guide in evaluating the medical necessity of a particular service or treatment. Blue Shield of California may consider published peer-reviewed scientific literature, national guidelines, and local standards of practice in developing its medical policy. Federal and state law, as well as contract language, including definitions and specific contract provisions/exclusions, take precedence over medical policy and must be considered first in determining covered services. Member contracts may differ in their benefits. Blue Shield reserves the right to review and update policies as appropriate.
## Appendix A

<table>
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*Cervical spine decompression with fusion as first-line treatment without conservative care measures in the following clinical cases (Matz, 2009b; Tetreault, 2013; Zhu, 2013; White, 1987):*  
- As outlined above for myelopathy or progressive neurological deficit scenarios.<br>  - Significant spinal cord or nerve root compression due to tumor, infection, or trauma.<br>  - Fracture or instability on radiographic films measuring:<br>    - Sagittal plane angulation of greater than 11 degrees at a single interspace or greater than 3.5 mm anterior
### POLICY STATEMENT

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| Subluxation in association with radicular/cord dysfunction; **OR**  
| Subluxation at the (C1) level of the atlantodental interval of more than 3 mm in an adult and 5 mm in a child.  
|  
| Not Recommended (Nikolaidis, 2010; Van Middelkoop, 2012):  
| - In asymptomatic or mildly symptomatic cases of cervical spinal stenosis.  
| - In cases of neck pain alone, without neurological deficits, and no evidence of significant spinal nerve root or cord compression on MRI or CT. See: Cervical Fusion for Treatment of Axial Neck Pain Criteria  

#### AFTER
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### B. Anterior Cervical Decompression with Fusion (ACDF) - Multiple Level

The following criteria must be met:

- Positive clinical findings of myelopathy with evidence of progressive neurologic deficits consistent with worsening spinal cord compression - immediate surgical evaluation is indicated (AAOS, 2013; Bono, 2011; Cunningham, 2010; Holly, 2009; Matz, 2009a; Matz, 2009b; Matz, 2009d; Matz, 2009e; Mummaneni, 2009; Tetreault, 2013; Yalamanchili, 2012; Zhu, 2013). Symptoms may include:
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  - Hyperreflexia
  - Hoffmann sign
  - Positive Babinski sign and/or clonus  
  
**OR**

- Progressive neurological deficit (motor deficit, bowel or bladder dysfunction) with corresponding evidence of spinal cord or nerve root compression on an MRI or CT scan images - immediate surgical evaluation is indicated (Bono, 2011; Matz, 2009b; Tetreault, 2013).
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- **When ALL of the following criteria are met** (Bono, 2011; Nikolaidis, 2010):
  - Cervical radiculopathy or myelopathy due to ruptured disc, spondylosis, spinal instability, or deformity; **AND**
  - Persistent or recurrent pain/symptoms with functional limitations that are unresponsive to at least 6 weeks of conservative treatment; **AND**
  - Documented failure of at least 6 consecutive weeks in the last 6 months of any 2 of the following physician-directed conservative treatments:
  - Analgesics, steroids, and/or NSAIDs
  - Structured program of physical therapy
  - Structured home exercise program prescribed by a physical therapist, chiropractic provider or physician
  - Epidural steroid injections and/or selective nerve root block; **AND**
  - Imaging studies confirm the presence of spinal cord or spinal nerve root compression (disc herniation or foraminal stenosis) at multiple levels corresponding with the clinical findings. Imaging studies may include any of the following (Bono, 2011):
  - MRI (preferred study for assessing cervical spine soft tissue); **OR**
  - CT with or without myelography - indicated in patients in whom MRI is contraindicated; preferred for examining bony structures, or in patients presenting with clinical symptoms or signs inconsistent with MRI findings (e.g., foraminal compression not seen on MRI).

\*Cervical spine decompression with fusion performed as first-line treatment without conservative care measures in the following clinical cases (Matz, 2009b; Tetreault, 2013; White, 1987; Zhu, 2013):
- As outlined above for myelopathy or progressive neurological deficit scenarios.
- Significant spinal cord or nerve root compression due to tumor, infection or trauma.

- **When ALL of the following criteria are met** (Bono, 2011; Nikolaidis, 2010):
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**Not Recommended (Nikolaidis, 2010; van Middelkoop, 2012):**

- In asymptomatic or mildly symptomatic cases of cervical spinal stenosis.
- In cases of neck pain alone, without neurological deficits, and no evidence of significant spinal nerve root or cord compression on MRI or CT. See: Cervical Fusion for Treatment of Axial Neck Pain Criteria.

**C. Cervical Posterior Decompression with Fusion - Single Level**
The following criteria must be met*:

- Positive clinical findings of myelopathy with evidence of progressive neurologic deficits consistent with worsening spinal cord compression - immediate surgical evaluation is indicated (AAOS, 2013; Cunningham, 2010; Fehlings, 2013; Holly, 2009; Matz, 2009d; Mummaneni, 2009; Tetreault, 2013; Yalamanchili, 2012; Zhu, 2013). Symptoms may include:
  - Upper extremity weakness
  - Unsteady gait related to myelopathy/balance or generalized lower extremity weakness
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  - Hoffmann sign
  - Positive Babinski sign and/or clonus

**OR**

- Progressive neurological deficit (motor deficit, bowel or bladder dysfunction) with corresponding evidence of spinal cord or nerve root compression on an MRI or CT scan images - immediate surgical evaluation is indicated (Bono, 2011; Matz, 2009b; Tetreault, 2013).
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|    |   ▪ Epidural steroid injections and/or selective nerve root block; **AND**
|    | • Imaging studies confirm the presence of spinal cord or spinal nerve root compression (disc herniation or foraminal stenosis) at single level corresponding with the clinical findings (Bono, 2011). Imaging studies may include:
|    |   ▪ MRI (preferred study for assessing cervical spine soft tissue); **OR**
|    |   ▪ CT with or without myelography - indicated in patients in whom MRI is contraindicated; preferred for examining bony structures, or in patients presenting with clinical symptoms or signs inconsistent with MRI findings (e.g., foraminal compression not seen on MRI); **AND**

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- In asymptomatic or mildly symptomatic cases of cervical spinal stenosis.
- In cases of neck pain alone, without neurological deficits, and no evidence of significant spinal nerve root or cord compression on MRI or CT. See: Cervical Fusion for Treatment of Axial Neck Pain Criteria.

#### D. Cervical Posterior Decompression with Fusion - Multiple Levels

The following criteria must be met*:

- Positive clinical findings of myelopathy with evidence of progressive neurologic deficits consistent with worsening spinal cord compression - immediate surgical evaluation is indicated (AAOS, 2013; Cunningham, 2010; Fehlings, 2013; Holly, 2009; Matz, 2009d; Mummaneni, 2009; Tetreault, 2013; Yalamanchili, 2012; Zhu, 2013). Symptoms may include:
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**OR**

- When **ALL of the following criteria are met** (Bono, 2011; Nikolaidis, 2010):
  - Cervical radiculopathy or myelopathy from ruptured disc, spondylosis, spinal instability, or deformity; **AND**
  - Persistent or recurrent symptoms/pain with functional limitations that are unresponsive to at least 6 weeks of conservative treatment; **AND**
  - Documented failure of at least 6 consecutive weeks in the last 6 months of any 2 of the following physician-directed conservative treatments:
    - Analgesics, steroids, and/or NSAIDs
    - Structured program of physical therapy
    - Structured home exercise program prescribed by a physical therapist, chiropractic provider or physician
    - Epidural steroid injections and/or facet injections/selective nerve root block; **AND**
  - Imaging studies indicate significant spinal cord or spinal nerve root compression at multiple levels corresponding with the clinical findings. Imaging studies may include (Bono, 2011):
    - MRI (preferred study for assessing cervical spine soft tissue); **OR**
    - CT with or without myelography - indicated in patients in whom MRI is contraindicated; preferred for examining bony structures, or in patients presenting with clinical symptoms or signs inconsistent with MRI findings (e.g., foraminal compression not seen on MRI); **AND**

*Cervical spine decompression with fusion performed as first-line treatment without conservative care measures in the following clinical cases (Fehlings, 2013; Tetreault, 2013; White, 1987; Zhu, 2013):*
### POLICY STATEMENT

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| - As outlined above for myelopathy or progressive neurological deficit scenarios.  
  - Significant spinal cord or nerve root compression due to tumor, infection or trauma.  
  - Fracture or instability on radiographic films measuring:  
    - Sagittal plane angulation of greater than 11 degrees at a single interspace or greater than 3.5 mm anterior subluxation in association with radicular/cord dysfunction; **OR**  
    - Subluxation at the (C1) level of the atlantodental interval of more than 3 mm in an adult and 5 mm in a child. | - As outlined above for myelopathy or progressive neurological deficit scenarios.  
  - Significant spinal cord or nerve root compression due to tumor, infection or trauma.  
  - Fracture or instability on radiographic films measuring:  
    - Sagittal plane angulation of greater than 11 degrees at a single interspace or greater than 3.5 mm anterior subluxation in association with radicular/cord dysfunction; **OR**  
    - Subluxation at the (C1) level of the atlantodental interval of more than 3 mm in an adult and 5 mm in a child. |

**Not Recommended** (Nikolaidis, 2010; Wang, 2011):  
- In asymptomatic or mildly symptomatic cases of cervical spinal stenosis.  
- In cases of neck pain alone, without neurological deficits, and no evidence of significant spinal nerve root or cord compression on MRI or CT. See: Cervical Fusion for Treatment of Axial Neck Pain Criteria.

### E. Cervical Fusion for Treatment of Axial Neck Pain:

In patients with non-radicular cervical pain for whom fusion is being considered, **ALL** of the following criteria must be met (Riew, 2010):  
- Improvement of the symptoms has failed or plateaued, and the residual symptoms of pain and functional disability are unacceptable at the end of 6 to 12 consecutive months of appropriate, active treatment, or at the end of longer duration of non-operative programs for debilitated patients with complex problems [NOTE: Mere passage of time with poorly guided treatment is not considered an active treatment program]; **AND**  
- All pain generators are adequately defined and treated; **AND**  
- All physical medicine and manual therapy interventions are completed; **AND**  
- X-ray, MRI, or CT demonstrating disc pathology or spinal instability; **AND**

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### POLICY STATEMENT

#### BEFORE

- Spine pathology limited to one or two levels unless other complicating factors are involved; **AND**
- Psychosocial evaluation for confounding issues addressed.

**NOTE:** The effectiveness of three-level or greater cervical fusion for non-radicular pain has not been established (van Middelkoop, 2012).

#### AFTER

- Spine pathology limited to one or two levels unless other complicating factors are involved; **AND**
- Psychosocial evaluation for confounding issues addressed.

**NOTE:** The effectiveness of three-level or greater cervical fusion for non-radicular pain has not been established (van Middelkoop, 2012).

### F. Cervical Posterior Decompression

The following criteria must be met:

- Positive clinical findings of myelopathy with evidence of progressive neurologic deficits consistent with worsening spinal cord compression - immediate surgical evaluation is indicated (AAOS, 2013; Bono, 2011; Heary, 2009; Mummaneni, 2009; Ryken, 2009; Tetreault, 2013; Wang, 2013; Yalamanchili, 2012; Zhu, 2013). Symptoms may include:
  - Upper extremity weakness
  - Unsteady gait related to myelopathy/balance or generalized lower extremity weakness
  - Disturbance with coordination
  - Hyperreflexia
  - Hoffmann sign
  - Positive Babinski sign and/or clonus

**OR**

- Progressive neurological deficit (motor deficit, bowel or bladder dysfunction) with corresponding evidence of spinal cord or nerve root compression on an MRI or CT scan images - immediate surgical evaluation is indicated (Tetreault, 2013; Wang, 2013).

**OR**

When **ALL** of the following criteria are met (Bono, 2011):

- Cervical radiculopathy from ruptured disc, spondylosis, or deformity; **AND**
- Persistent or recurrent symptoms/pain with functional limitations that are unresponsive to at least 6 weeks of appropriate conservative treatment; **AND**
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- Documented failure of at least 6 consecutive weeks in the last 6 months of any 2 of the following physician-directed conservative treatments:
  - Analgesics, steroids, and/or NSAIDs
  - Structured program of physical therapy
  - Structured home exercise program prescribed by a physical therapist, chiropractic provider or physician
  - Epidural steroid injections and/or facet injections/selective nerve root block; **AND**

- Imaging studies confirm the presence of spinal cord or spinal nerve root compression at the level(s) corresponding with the clinical findings (Bono, 2011; Sahai, 2019). Imaging studies may include **any** of the following:
  - MRI (preferred study for assessing cervical spine soft tissue); **OR**
  - CT with or without myelography—indicated in patients in whom MRI is contraindicated; preferred for examining bony structures, or in patients presenting with clinical symptoms or signs inconsistent with MRI findings (e.g., foraminal compression not seen on MRI);

*Cervical decompression performed as first-line treatment without conservative care in the following clinical cases (Ryken, 2009; Tetreault, 2013; Wang, 2013; Zhu, 2013):*
- As outlined above for myelopathy or progressive neurological deficit scenarios.
- Spinal cord or nerve root compression due to tumor, infection or trauma.

*Not Recommended (Nikolaidis, 2010; Wang, 2011):*
- In asymptomatic or mildly symptomatic cases.
- In cases of neck pain alone, without neurological deficits and abnormal imaging findings. See: Cervical Fusion for Treatment of Axial Neck Pain Criteria.
- In patients with kyphosis or at risk for development of postoperative kyphosis.

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*Cervical decompression performed as first-line treatment without conservative care in the following clinical cases (Ryken, 2009; Tetreault, 2013; Wang, 2013; Zhu, 2013):*
- As outlined above for myelopathy or progressive neurological deficit scenarios.
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*Not Recommended (Nikolaidis, 2010; Wang, 2011):*
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<td>• Skeletally mature patient; <strong>AND</strong></td>
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<tr>
<td>• Patient has intractable radiculopathy caused by one or two level disease (either hemiated disc or spondolytic osteophyte) located at C3-C7; <strong>AND</strong></td>
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<tr>
<td>• Use of an FDA-approved prosthetic intervertebral discs.</td>
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Cervical Artificial Disc Replacement is **NOT** indicated when any of the following clinical scenarios exists (Davis, 2015):

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<td>• Osteoporosis or osteopenia</td>
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<td>• Instability</td>
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<td>o Translation greater than 3 mm difference between lateral flexion-extension views at the symptomatic levels;</td>
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<td>o 11 degrees of angular difference between lateral flexion-extension views at the symptomatic levels</td>
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<td>• Sensitivity or allergy to implant materials</td>
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<td>• Severe spondylosis defined as (Davis, 2015):</td>
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| o >50% disc height loss compared to minimally or non-degenerated levels; **OR**
o Bridging osteophytes; **OR**
o Absence of motion on lateral flexion-extension views at the symptomatic site
  • Severe facet arthropathy
  • Ankylosing spondylitis
  • Rheumatoid arthritis
  • Previous fracture with anatomical deformity
  • Ossification of the posterior longitudinal ligament (OPLL)
  • Active cervical spine malignancy | o >50% disc height loss compared to minimally or non-degenerated levels; **OR**
o Bridging osteophytes; **OR**
o Absence of motion on lateral flexion-extension views at the symptomatic site
  • Severe facet arthropathy
  • Ankylosing spondylitis
  • Rheumatoid arthritis
  • Previous fracture with anatomical deformity
  • Ossification of the posterior longitudinal ligament (OPLL)
  • Active cervical spine malignancy |

### H. Cervical Fusion Without Decompression

Cervical fusion without decompression will be reviewed on a case-by-case basis. Atraumatic instability due to Down Syndrome-related spinal deformity, rheumatoid arthritis, or basilar invagination are uncommon, but may require cervical fusion (Trumees, 2017).

### I. Cervical Anterior Decompression (Without Fusion)

All requests for anterior decompression without fusion will be reviewed on a case-by-case basis (Bono, 2011; Botelho, 2012; Gebremariam, 2012; Matz, 2009a; Matz, 2009e).