

**DRAFT – FOR COMMENT ONLY**

# Cervical Fusion

**DRAFT – FOR COMMENT ONLY**



## DEFINING APPROPRIATE COVERAGE POSITIONS

**Important Note: The following is a working DRAFT document that should not be considered an official NASS position until finalized. This DRAFT document is being shared ONLY for purposes of receiving comments, suggestions and/or edits from our members, and should not be used for any other purpose. Specifically, no decisions on patient care or coverage should be made on the basis of this DRAFT document, as this document and all information contained herein is subject to change significantly during the review process. Please visit NASS website to access our FINAL Coverage Recommendations.**

## Introduction

North American Spine Society (NASS) coverage policy recommendations are intended to assist payers and members by proactively defining appropriate coverage positions. Historically, NASS has provided comment on payer coverage policy upon request. However, in considering coverage policies received by the organization, NASS believes proactively examining medical evidence and recommending credible and reasonable positions may be to the benefit of both payers and members in helping achieve consensus on coverage before it becomes a matter of controversy.

## Methodology

The coverage policies put forth by NASS use an evidence-based approach to spinal care when possible. In the absence of strict evidence-based criteria, policies reflect the multidisciplinary and non-conflicted experience and expertise of the authors in order to reflect reasonable standard practice indications in the United States.

### [NASS Coverage Policy Methodology](#)

## Scope and Clinical Indications

Cervical fusion is commonly performed for a number of clinical disorders and in a variety of different ways. Anterior cervical fusion is usually performed in conjunction with a decompression, either in the form of a discectomy or corpectomy, and often with stabilization (e.g. plate and screws). Posterior fusion is also usually performed with stabilization (e.g. screws and rods) but is more variably used in conjunction with decompression. Traumatic injuries to the cervical spine are often treated with stabilization and fusion without an indication for decompression (laminectomy). Likewise, instability of the craniocervical junction (occiput-C1, C1-C2) in patients with inflammatory arthritis (e.g. rheumatoid arthritis) is most often treated with stabilization and fusion without formal decompression. Other conditions, such as cervical myelopathy from spinal stenosis, if being treated with posterior surgery, are often addressed via a laminectomy and instrumented fusion. The scope of this coverage recommendation includes all levels from the occiput to the upper thoracic spine (T1).

## Clinical Criteria for the Procedure

**Cervical Fusion** may be indicated for the following diagnoses with qualifying criteria, when appropriate.

1. **Infection** (including tuberculosis) involving the spine in the form of discitis, osteomyelitis, or epidural abscess in EITHER of the following cases:

NASS coverage recommendations should not be construed as including all proper methods of care or excluding other acceptable methods of care reasonably directed to obtaining the same results. The ultimate judgment regarding any specific procedure or treatment is to be made by the physician and patient in light of all circumstances presented by the patient and the needs and resources particular to the locality or institution. **The coverage recommendations do not represent a "standard of care,"** nor are they intended as a fixed treatment protocol. It is anticipated that there will be patients who will require less or more treatment than the average. It is also acknowledged that in atypical cases, treatment falling outside these criteria will sometimes be necessary. This document should not be seen as prescribing the type, frequency or duration of intervention. Treatment and accompanying payment should be based on this information in addition to an individual patient's needs as well as the doctor's professional judgment and experience. This document is designed to function as a guide and should not be used as the sole reason for denial of treatment and services. It is not intended to supersede applicable ethical standards or provisions of law. This is not a legal document.

- a. Instability is present
  - b. Debridement and/or decompression is anticipated to result in instability
2. **Tumor** involving the spine or spinal canal in EITHER of the following cases:
  - a. Instability is present
  - b. Resection and/or decompression is anticipated to result in instability
3. **Traumatic** injuries, including fracture, fracture-dislocations, dislocations, or traumatic ligamentous disruption in EITHER of the following cases:
  - a. Instability is present
  - b. Decompression of the spinal canal is anticipated to result in instability
4. **Deformity** that includes the cervical spine (e.g. kyphosis, head-drop syndrome, post-laminectomy deformity) that meets ANY of the following criteria:
  - a. Clinically significant deformity that results in the inability of the patient to maintain a forward gaze
  - b. Substantial functional limitation including severe neck pain, difficulty ambulating, and decreased ability to perform activities of daily living
  - c. Documented progression of deformity
5. **Cervical myelopathy** (either from disc herniation, bony stenosis, or OPLL) as an adjunct to decompression, that meet ANY of the following criteria:
  - a. An anterior cervical discectomy or corpectomy is planned for decompression of the spinal cord
  - b. A posterior laminectomy is planned for decompression of the spinal cord
6. **Cervical radiculopathy from degenerative disorders** (either from disc herniation or bony stenosis), as an adjunct to disc excision, that meet ALL of the following criteria:
  - a. Pattern of radiculopathy explained by imaging
  - b. 6-12 weeks of an appropriate course nonoperative treatment
  - c. The following can mitigate the need for initial nonoperative trial
    - i. Severity of symptoms prevent the patient from working
    - ii. Functionally limiting motor weakness
7. **Synovial facet cysts** in the cervical spine, as an adjunct to cyst excision
8. **Pseudarthrosis** in the cervical spine that meet ALL of the following criteria (a-d) OR demonstrate presence of a gross failure of the instrumentation (e.g. screw breakage, screw loosening, curve/correction decompression)
  - a. Postoperative onset of mechanical neck pain that is approximately at the level of the pseudarthrosis
  - b. A period of time following the index surgery during which the patient had symptomatic relief
  - c. Nonoperative care of at least 6 months from the onset of symptoms

NASS coverage recommendations should not be construed as including all proper methods of care or excluding other acceptable methods of care reasonably directed to obtaining the same results. The ultimate judgment regarding any specific procedure or treatment is to be made by the physician and patient in light of all circumstances presented by the patient and the needs and resources particular to the locality or institution. **The coverage recommendations do not represent a "standard of care,"** nor are they intended as a fixed treatment protocol. It is anticipated that there will be patients who will require less or more treatment than the average. It is also acknowledged that in atypical cases, treatment falling outside these criteria will sometimes be necessary. This document should not be seen as prescribing the type, frequency or duration of intervention. Treatment and accompanying payment should be based on this information in addition to an individual patient's needs as well as the doctor's professional judgment and experience. This document is designed to function as a guide and should not be used as the sole reason for denial of treatment and services. It is not intended to supersede applicable ethical standards or provisions of law. This is not a legal document.

- d. CT or plain films that are highly suggestive of nonunion at a motion segment at which a fusion had been previously attempted. These criteria include:
  - i. Lack of bridging bone
  - ii. Dynamic motion noted on flexion-extension radiographs
9. **Non-traumatic Instability** of a motion segment (defined as two adjacent vertebrae and associated ligaments, disc, and facet capsules), such as that which occurs in patients with inflammatory arthritis, that meets the ANY of the following criteria:
  - a. Basilar invagination of the odontoid process into the foramen magnum
  - b. C1-C2 dynamic instability noted as widening of the atlantodens interval greater than 3 mm
  - c. Subaxial instability (C2-T1) noted as a translational difference of at least 2 mm on flexion-extension views

**Cervical fusion** is **NOT** indicated in cases that do not fulfill the above criteria. Of note, cervical fusion is not indicated in the following scenarios:

- **Cervical radiculopathy from isolated foraminal stenosis** treated with a partial medial facetectomy/foraminotomy
- **Discogenic, axial neck pain** without radiographic evidence of nerve root or spinal cord compression, instability, or spinal deformity

## Rationale

In **item 1**, the rationale for coverage of cervical fusion for infections is based on what most practitioners would consider to be reasonable practice. There are numerous studies reporting the outcomes of anterior and posterior decompression and fusion procedures for the treatment of pyogenic infections (including epidural abscesses and discitis osteomyelitis) and atypical infections (e.g. tuberculosis, fungal infections).<sup>1,2</sup> In addition, there is a wide body of data indicating the safety of using metallic instrumentation in the setting of a primary spinal infection.<sup>3,4</sup> Of note, the primary focus of treatment of a spinal infection is to either treat impending neurological deficit from a progressive deformity or expanding focus of infection. The latter can be manifest from an epidural abscess or an invasion of infected, necrotic, or pathologically fracture bone into the spinal canal or neural foramina. Instability remains judged on an individual case-by-case basis and can be evidenced by progressive deformity, bone loss, or involvement of a stabilizing structure such as a facet joint. Instability is a frequent by-product of surgical debridement or decompression, such as in cases in which an anterior corpectomy is performed in order to remove infected bone and disc material or access an epidural abscess. Of note, there are no randomized controlled trials comparing operative to nonoperative intervention for spinal

NASS coverage recommendations should not be construed as including all proper methods of care or excluding other acceptable methods of care reasonably directed to obtaining the same results. The ultimate judgment regarding any specific procedure or treatment is to be made by the physician and patient in light of all circumstances presented by the patient and the needs and resources particular to the locality or institution. **The coverage recommendations do not represent a "standard of care,"** nor are they intended as a fixed treatment protocol. It is anticipated that there will be patients who will require less or more treatment than the average. It is also acknowledged that in atypical cases, treatment falling outside these criteria will sometimes be necessary. This document should not be seen as prescribing the type, frequency or duration of intervention. Treatment and accompanying payment should be based on this information in addition to an individual patient's needs as well as the doctor's professional judgment and experience. This document is designed to function as a guide and should not be used as the sole reason for denial of treatment and services. It is not intended to supersede applicable ethical standards or provisions of law. This is not a legal document.

infections or comparing decompression versus decompression and fusion. The most likely reason for this is that most would consider such trials to be unethical in nature because of the established benefit of fusion in this patient population.

**In item 2**, the rationale for coverage of cervical fusion for spinal tumors is also based on what most practitioners would consider to be accepted practice patterns. Of note, in distinction to some other policies that the NASS Coverage Committee has reviewed, this should not be limited to primary bone tumors. The removal of extradural soft-tissue tumors, such as might occur with metastatic disease or lymphoma that do not necessarily cause bone destruction will often require destabilizing approaches to the spine in order to safely access and remove the lesion. Thus, for a similar rationale as detailed above for item 1, the spine necessitates instrumentation and fusion to restore stability. Of note, there is a randomized controlled trial comparing operative to nonoperative treatment for the treatment of metastatic spinal cord compression, which has clearly shown an advantage for surgery in maintaining and restoring neurological function.<sup>5</sup>

**In item 3**, the rationale for coverage for fusion for traumatic injuries of the cervical spine is based on both published evidence and accepted practice patterns. The main indications for surgery after a traumatic injury to the cervical spine are instability, which can be evidenced in a number of different manners, and neurological compression with or without a neurological deficit. While there are a number of high-level studies comparing operative to nonoperative treatment for specific injuries, there are certainly not comparative studies for all injury types. In a retrospective study, Fisher et al found superior radiographic outcomes with anterior corpectomy, fusion, and instrumentation as compared to nonoperative treatment with a halo vest for flexion-type teardrop fractures.<sup>6</sup> Vaccaro et al, in a prospective nonrandomized study, found elderly patients with odontoid fractures had better outcomes than with nonoperative treatment.<sup>7</sup> In a subset of elderly patients (less than 75 years old), Schoenfeld et al found lower mortality with operative treatment (usually in the form of C1-C2 posterior fusion) for odontoid fractures.<sup>8</sup> Sears and Fazl were one of the first to document the inappropriateness of nonoperative treatment for unstable subaxial cervical spine fractures such as facet dislocations.<sup>9</sup>

**In item 4**, the rationale for coverage of cervical fusion for spinal deformities is based on reasonable extrapolation of the body of literature regarding fixed kyphotic cervical deformities, such as occurs with ankylosing spondylitis. In these patients, as well as other kyphotic deformity patients, the primary indication for deformity correction is to restore the patient's horizontal gaze. This is usually achieved through one or more osteotomies, releases, and other surgical correction maneuvers followed by instrumented cervical spinal fusion.<sup>10</sup> Spinal cord compression and myelopathy can be associated with kyphotic deformities, which can make the indications for surgery more urgent and primarily intended for decompression. Other rare conditions, such as dropped head deformity or so-called drop-head

NASS coverage recommendations should not be construed as including all proper methods of care or excluding other acceptable methods of care reasonably directed to obtaining the same results. The ultimate judgment regarding any specific procedure or treatment is to be made by the physician and patient in light of all circumstances presented by the patient and the needs and resources particular to the locality or institution. **The coverage recommendations do not represent a "standard of care,"** nor are they intended as a fixed treatment protocol. It is anticipated that there will be patients who will require less or more treatment than the average. It is also acknowledged that in atypical cases, treatment falling outside these criteria will sometimes be necessary. This document should not be seen as prescribing the type, frequency or duration of intervention. Treatment and accompanying payment should be based on this information in addition to an individual patient's needs as well as the doctor's professional judgment and experience. This document is designed to function as a guide and should not be used as the sole reason for denial of treatment and services. It is not intended to supersede applicable ethical standards or provisions of law. This is not a legal document.

syndrome, can lead to significant functional impairment from the inability to hold one's head up for forward gaze. Satisfactory outcomes have been reported with surgical treatment (involving cervical fusion) for this condition.<sup>11</sup> Of note, there is no absolute numerical criterion of kyphosis that has been defined as an indication for surgery for any of these conditions. In the absence of myelopathy, nonoperative care can be initiated, particularly for flexible deformities. A period of six months of nonoperative care has been described by highly experienced centers.<sup>12</sup>

**In item 5**, the rationale for fusion for patients with cervical myelopathy is based on the nature of the decompressive procedures that are considered standard and reasonable by most practitioners. While there are some non-fusion procedures available to decompress the spinal canal such as laminoplasty and anterior cervical discectomy without fusion, the workhorses of surgical treatments for cervical spondylotic myelopathy (CSM) are anterior cervical discectomy and fusion (ACDF), anterior corpectomy and fusion, and posterior laminectomy and fusion. It is well-accepted that nonoperative care is acceptable in only the most mild cases and that surgery should be considered in most.<sup>13</sup> Anterior cervical decompression and fusion has long been considered one of the gold standard procedures for treating patients with CSM.<sup>14, 15</sup> With the availability of modern posterior cervical screw fixation, posterior cervical laminectomy and fusion has become an additional workhorse for treatment of CSM, with equivalent results as anterior surgery.<sup>16</sup> Cervical laminectomy without fusion should not be considered a standard treatment as it has resulted in unacceptably high rates of post-laminectomy kyphosis.

**In item 6**, cervical radiculopathy from degenerative disorders is perhaps the most common indication for cervical fusion. The rationale for clinical coverage of this entity rests upon a reasonable treatment algorithm. First, it is paramount that the pattern of radiculopathy noted by history and exam corresponds to an area of nerve root compression on imaging studies.<sup>17</sup> As the majority of patients with cervical radiculopathy will improve with nonoperative treatment, particularly within three months from onset, most practitioners would agree that a six to 12 week period of nonoperative care seems reasonable.<sup>18</sup> Specific provisions of what should be included during the course of nonoperative treatment were not outlined as there is no universally agreed upon group of modalities. The types of treatment that one would consider, however, should include physical therapy, anti-inflammatory pain medications, and epidural steroid injections. Because of the functionally limiting nature of significant motor weakness of an upper extremity muscle group, such as those enabling shoulder abduction or elbow flexion, this criterion is considered an indication for decompression and fusion without a period of nonoperative treatment. This should also be considered in the context of a patient's occupation. For example, someone who requires full strength of hand (e.g. jeweler, surgeon) might consider 4/5 weakness functional.

NASS coverage recommendations should not be construed as including all proper methods of care or excluding other acceptable methods of care reasonably directed to obtaining the same results. The ultimate judgment regarding any specific procedure or treatment is to be made by the physician and patient in light of all circumstances presented by the patient and the needs and resources particular to the locality or institution. **The coverage recommendations do not represent a "standard of care,"** nor are they intended as a fixed treatment protocol. It is anticipated that there will be patients who will require less or more treatment than the average. It is also acknowledged that in atypical cases, treatment falling outside these criteria will sometimes be necessary. This document should not be seen as prescribing the type, frequency or duration of intervention. Treatment and accompanying payment should be based on this information in addition to an individual patient's needs as well as the doctor's professional judgment and experience. This document is designed to function as a guide and should not be used as the sole reason for denial of treatment and services. It is not intended to supersede applicable ethical standards or provisions of law. This is not a legal document.

**In item 7**, the rationale for coverage of cervical fusion (usually posterior) as an adjunct to excision of synovial facet cysts is based on the destabilizing nature of the procedure required. While some have reported the ability to remove cervical facet cysts via decompression alone or decompression alone, laminectomy alone is not recommended, as discussed above, because of the high incidence of post-laminectomy kyphosis.<sup>19</sup>

**In item 8**, the rationale for coverage of pseudarthrosis (nonunion) following an attempted cervical spine fusion rests on a number of factors. First, the level of mechanical neck pain should correspond to the approximate level of nonunion. Second, most would consider that a patient should have a period of time following the index procedure during which symptoms were improved. If neck pain was a component of the initial presenting symptom and did not significantly improve following fusion, regardless of the presence of a nonunion, this cannot be reasonably correlated to the presence of an unhealed segment. It is clear from multiple studies that pseudarthrosis in the cervical spine can (and usually is) asymptomatic.<sup>20, 21, 22</sup> Though there is a paucity of evidence concerning the ideal time period for nonoperative care, 6 months is a course of time in the absence of catastrophic construct failure. Finally, a computerized tomogram (CT) or plain films should confirm the absence of solid bridging bone or dynamic motion between the unhealed segments. The exact radiographic criteria of the amount of dynamic motion for which a diagnosis of pseudarthrosis can be made have varied.<sup>23, 24</sup>

Concerning the scenarios in which cervical fusion is not indicated, recent rigorous evidence-based medicine reviews have concluded that there is little to no evidence that fusion is an effective treatment for axial neck pain without neurological symptoms.<sup>26, 27</sup> For patients in which an isolated posterior foraminotomy is performed in which the major portion of the facet is kept intact, fusion is not indicated unless there is other evidence of instability.

**In item 9**, the rationale for coverage of non-traumatic instability of the cervical spine is rooted in the literature concerning inflammatory arthritis, of which rheumatoid arthritis is most common. Regardless of the presence of neurological or other symptoms, cervical instability can place spinal cord function at risk. This can be manifest as occipitocervical instability (also known as basilar invagination), C1-C2 instability (also known as atlantoaxial instability), and least commonly as subaxial instability, which often gives a so-called step-ladder appearance of the cervical spine. Any degree of basilar invagination is considered an abnormal finding.<sup>28, 29</sup> This can lead to brainstem compression, respiratory depression, and sudden death in addition to other neurological complications. In the normal adult, the atlantodens interval should not measure more than 3 mm. Thus, distances greater than 3 mm can be anatomically considered abnormal and unstable. Research has indicated that patients with less canal compromise have better neurological recovery following C1-C2 fusion.<sup>28, 30</sup> Subaxial instability, though less common, can be equally problematic, particularly in patients with underlying cervical stenosis. The measurement

NASS coverage recommendations should not be construed as including all proper methods of care or excluding other acceptable methods of care reasonably directed to obtaining the same results. The ultimate judgment regarding any specific procedure or treatment is to be made by the physician and patient in light of all circumstances presented by the patient and the needs and resources particular to the locality or institution. **The coverage recommendations do not represent a "standard of care,"** nor are they intended as a fixed treatment protocol. It is anticipated that there will be patients who will require less or more treatment than the average. It is also acknowledged that in atypical cases, treatment falling outside these criteria will sometimes be necessary. This document should not be seen as prescribing the type, frequency or duration of intervention. Treatment and accompanying payment should be based on this information in addition to an individual patient's needs as well as the doctor's professional judgment and experience. This document is designed to function as a guide and should not be used as the sole reason for denial of treatment and services. It is not intended to supersede applicable ethical standards or provisions of law. This is not a legal document.

error for translation in the cervical spine is approximately 1 mm.<sup>31,32</sup> Considering this, 2 mm of measurable translation on standard flexion-extension views can be considered a detectable pathological change.

## References

1. Shousha M, Heyde C, Boehm H. *Cervical spondylodiscitis: change in clinical picture and operative management during the last two decades. A series of 50 patients and review of literature. Eur Spine J.* 2015 Mar;24(3):571-6.
2. Djientcheu VP, Mouafo Tambo FF, Ndougsa IS, Eloundou NJ, Kouna Tsala IN, Ngowe Ngowe M, Andze OG, Sosso MA. *The role of surgery in the management of Pott's disease in Yaoundé. A review of 43 cases. Orthop Traumatol Surg Res.* 2013 Jun;99(4):419-23.
3. Bydon M, De la Garza-Ramos R, Macki M, Naumann M, Sciubba DM, Wolinsky JP, Bydon A, Gokaslan ZL, Witham TF. *Spinal instrumentation in patients with primary spinal infections does not lead to greater recurrent infection rates: an analysis of 118 cases. World Neurosurg.* 2014 Dec;82(6):e807-14.
4. Koptan W, Elmiligui Y, Elsharkawi M. *Single stage anterior reconstruction using titanium mesh cages in neglected kyphotic tuberculous spondylodiscitis of the cervical spine. Eur Spine J.* 2011 Feb;20(2):308-13.
5. Patchell RA, Tibbs PA, Regine WF, Payne R, Saris S, Kryscio RJ, Mohiuddin M, Young B. *Direct decompressive surgical resection in the treatment of spinal cord compression caused by metastatic cancer: a randomised trial. Lancet.* 2005 Aug 20-26;366(9486):643-8.
6. Fisher CG, Dvorak MD, Leith J, Wing PC. *Comparison of outcomes for unstable lower cervical flexion teardrop fractures managed with halo thoracic vest versus anterior corpectomy and plating. Spine (Phila Pa 1976).* 2002 Jan 15;27(2): 160-6.
7. Vaccaro AR, Kepler CK, Kopjar B, Chapman J, Shaffrey C, Arnold P, Gokaslan Z, Brodke D, France J, Dekutoski M, Sasso R, Yoon ST, Bono C, Harrop J, Fehlings MG. *Functional and quality-of-life outcomes in geriatric patients with type-II dens fracture. J Bone Joint Surg Am.* 2013 Apr 17;95(8):729-35.
8. Schoenfeld AJ, Bono CM, Reichmann WM, Warholc N, Wood KB, Losina E, Katz JN, Harris MB. *Type II odontoid fractures of the cervical spine: do treatment type and medical comorbidities affect mortality in elderly patients? Spine (Phila Pa 1976).* 2011 May 15;36(11):879-85.

NASS coverage recommendations should not be construed as including all proper methods of care or excluding other acceptable methods of care reasonably directed to obtaining the same results. The ultimate judgment regarding any specific procedure or treatment is to be made by the physician and patient in light of all circumstances presented by the patient and the needs and resources particular to the locality or institution. **The coverage recommendations do not represent a "standard of care,"** nor are they intended as a fixed treatment protocol. It is anticipated that there will be patients who will require less or more treatment than the average. It is also acknowledged that in atypical cases, treatment falling outside these criteria will sometimes be necessary. This document should not be seen as prescribing the type, frequency or duration of intervention. Treatment and accompanying payment should be based on this information in addition to an individual patient's needs as well as the doctor's professional judgment and experience. This document is designed to function as a guide and should not be used as the sole reason for denial of treatment and services. It is not intended to supersede applicable ethical standards or provisions of law. This is not a legal document.



9. *Sears W, Fazl M. Prediction of stability of cervical spine fracture managed in the halo vest and indications for surgical intervention. J Neurosurg. 1990 Mar;72(3):426-32.*
10. *Simmons EH. Kyphotic deformity of the spine in ankylosing spondylitis. Clin Orthop Relat Res. 1977 Oct;(128):65-77.*
11. *Gerling MC, Bohlman HH. Dropped head deformity due to cervical myopathy: surgical treatment outcomes and complications spanning twenty years. Spine (Phila Pa 1976). 2008 Sep 15;33(20):E739-45.*
12. *Gerling MC, Ghiselli G, Bohlman HH. Surgical management of neuromuscular kyphosis. In The Cervical Spine, Benzel EC, 5<sup>th</sup> edition. Pp. 1115-1129, 2012).*
13. *Rhee JM, Shamji MF, Erwin WM, Bransford RJ, Yoon ST, Smith JS, Kim HJ, Ely CG, Dettori JR, Patel AA, Kalsi-Ryan S. Nonoperative management of cervical myelopathy: a systematic review. Spine (Phila Pa 1976). 2013 Oct 15;38(22 Suppl 1):S55-67.*
14. *Emery SE, Bohlman HH, Bolesta MJ, Jones PK. Anterior cervical decompression and arthrodesis for the treatment of cervical spondylotic myelopathy. Two to seventeen-year follow-up. J Bone Joint Surg Am. 1998 Jul;80(7):941-51.*
15. *Okada K, Shirasaki N, Hayashi H, Oka S, Hosoya T. Treatment of cervical spondylotic myelopathy by enlargement of the spinal canal anteriorly, followed by arthrodesis. J Bone Joint Surg Am. 1991 Mar;73(3):352-64.*
16. *Fehlings MG, Barry S, Kopjar B, Yoon ST, Arnold P, Massicotte EM, Vaccaro A, Brodke DS, Shaffrey C, Smith JS, Woodard E, Banco RJ, Chapman J, Janssen M, Bono C, Sasso R, Dekutoski M, Gokaslan ZL. Anterior versus posterior surgical approaches to treat cervical spondylotic myelopathy: outcomes of the prospective multicenter AOSpine North America CSM study in 264 patients. Spine (Phila Pa 1976). 2013 Dec 15;38(26):2247-52.*
17. *Rao RD, Currier BL, Albert TJ, Bono CM, Marawar SV, Poelstra KA, Eck JC. Degenerative cervical spondylosis: clinical syndromes, pathogenesis, and management. J Bone Joint Surg Am. 2007 Jun;89(6):1360-78. Review.*
18. *Saal JS, Saal JA, Yurth EF. Nonoperative management of herniated cervical intervertebral disc with radiculopathy. Spine (Phila Pa 1976). 1996 Aug 15;21(16):1877-83.*

NASS coverage recommendations should not be construed as including all proper methods of care or excluding other acceptable methods of care reasonably directed to obtaining the same results. The ultimate judgment regarding any specific procedure or treatment is to be made by the physician and patient in light of all circumstances presented by the patient and the needs and resources particular to the locality or institution. **The coverage recommendations do not represent a "standard of care,"** nor are they intended as a fixed treatment protocol. It is anticipated that there will be patients who will require less or more treatment than the average. It is also acknowledged that in atypical cases, treatment falling outside these criteria will sometimes be necessary. This document should not be seen as prescribing the type, frequency or duration of intervention. Treatment and accompanying payment should be based on this information in addition to an individual patient's needs as well as the doctor's professional judgment and experience. This document is designed to function as a guide and should not be used as the sole reason for denial of treatment and services. It is not intended to supersede applicable ethical standards or provisions of law. This is not a legal document.

19. Machino M, Yukawa Y, Ito K, Kato F. Cervical degenerative intraspinal cyst: a case report and literature review involving 132 cases. *BMJ Case Rep.* 2012 Nov 28;2012.
20. Emery SE, Fisher JR, Bohlman HH. Three-level anterior cervical discectomy and fusion: radiographic and clinical results. *Spine (Phila Pa 1976).* 1997 Nov 15;22(22):2622-4; discussion 2625.
21. Bolesta MJ, Rechtine GR 2nd, Chrin AM. Three- and four-level anterior cervical discectomy and fusion with plate fixation: a prospective study. *Spine (Phila Pa 1976).* 2000 Aug 15;25(16):2040-4; discussion 2045-6.
22. Phillips FM, Carlson G, Emery SE, Bohlman HH. Anterior cervical pseudarthrosis. Natural history and treatment. *Spine (Phila Pa 1976).* 1997 Jul 15;22(14):1585-9.
23. Cannada LK, Scherping SC, Yoo JU, Jones PK, Emery SE. Pseudoarthrosis of the cervical spine: a comparison of radiographic diagnostic measures. *Spine (Phila Pa 1976).* 2003 Jan 1;28(1):46-51.
24. Song KS, Piyaskulkaew C, Chuntarapas T, Buchowski JM, Kim HJ, Park MS, Kang H, Riew KD.
25. Dynamic radiographic criteria for detecting pseudarthrosis following anterior cervical arthrodesis. *J Bone Joint Surg Am.* 2014 Apr 2;96(7):557-63.
26. Riew KD, Ecker E, Dettori JR. Anterior cervical discectomy and fusion for the management of axial neck pain in the absence of radiculopathy or myelopathy. *Evid Based Spine Care J.* 2010 Dec;1(3):45-50.
27. Carragee EJ, Hurwitz EL, Cheng I, Carroll LJ, Nordin M, Guzman J, Peloso P, Holm LW, Côté P, Hogg-Johnson S, van der Velde G, Cassidy JD, Haldeman S; Bone and Joint Decade 2000-2010 Task Force on Neck Pain and Its Associated Disorders. Treatment of neck pain: injections and surgical interventions: results of the Bone and Joint Decade 2000-2010 Task Force on Neck Pain and Its Associated Disorders. *Spine (Phila Pa 1976).* 2008 Feb 15;33(4 Suppl):S153-69.
28. Reiter MF, Boden SD. Inflammatory disorders of the cervical spine. *Spine (Phila Pa 1976).* 1998 Dec 15;23(24):2755-66. Review.
29. Boden SD, Dodge LD, Bohlman HH, Rechtine GR. Rheumatoid arthritis of the cervical spine. A long-term analysis with predictors of paralysis and recovery. *J Bone Joint Surg Am.* 1993 Sep;75(9):1282-97.

NASS coverage recommendations should not be construed as including all proper methods of care or excluding other acceptable methods of care reasonably directed to obtaining the same results. The ultimate judgment regarding any specific procedure or treatment is to be made by the physician and patient in light of all circumstances presented by the patient and the needs and resources particular to the locality or institution. **The coverage recommendations do not represent a "standard of care,"** nor are they intended as a fixed treatment protocol. It is anticipated that there will be patients who will require less or more treatment than the average. It is also acknowledged that in atypical cases, treatment falling outside these criteria will sometimes be necessary. This document should not be seen as prescribing the type, frequency or duration of intervention. Treatment and accompanying payment should be based on this information in addition to an individual patient's needs as well as the doctor's professional judgment and experience. This document is designed to function as a guide and should not be used as the sole reason for denial of treatment and services. It is not intended to supersede applicable ethical standards or provisions of law. This is not a legal document.

30. Boden SD. Rheumatoid arthritis of the cervical spine. Surgical decision making based on predictors of paralysis and recovery. *Spine (Phila Pa 1976)*. 1994 Oct 15;19(20):2275-80. Review.
31. Frobin W, Leivseth G, Biggemann M, Brinckmann P. Sagittal plane segmental motion of the cervical spine. A new precision measurement protocol and normal motion data of healthy adults. *Clin Biomech (Bristol, Avon)*. 2002 Jan;17(1):21-31.
32. Leivseth G, Kolstad F, Nygaard OP, Zoega B, Frobin W, Brinckmann P. Comparing precision of distortion-compensated and stereophotogrammetric Roentgen analysis when monitoring fusion in the cervical spine. *Eur Spine J*. 2006 Jun;15(6):774-9.

## Authors

### NASS Coverage Committee

**Co-Chairs:** John Glaser, MD & Scott Kreiner, MD

### Members:

Jamie Baisden, MD  
Ray Baker, MD  
Ashok Biyani, MD  
Maxwell Boakye, MD  
Christopher Bono, MD  
Charles Cho, MD, MBA  
Michael DePalma, MD  
Donald Dietze, MD  
John Easa, MD  
Gary Ghiselli, MD  
James Harrop, MD  
Anthony Lapinsky, MD  
Darren Lebl, MD  
Paul Matz, MD  
David O'Brien, MD  
Alpesh Patel, MD, FACS  
Mitchell Reiter, MD

NASS coverage recommendations should not be construed as including all proper methods of care or excluding other acceptable methods of care reasonably directed to obtaining the same results. The ultimate judgment regarding any specific procedure or treatment is to be made by the physician and patient in light of all circumstances presented by the patient and the needs and resources particular to the locality or institution. **The coverage recommendations do not represent a "standard of care,"** nor are they intended as a fixed treatment protocol. It is anticipated that there will be patients who will require less or more treatment than the average. It is also acknowledged that in atypical cases, treatment falling outside these criteria will sometimes be necessary. This document should not be seen as prescribing the type, frequency or duration of intervention. Treatment and accompanying payment should be based on this information in addition to an individual patient's needs as well as the doctor's professional judgment and experience. This document is designed to function as a guide and should not be used as the sole reason for denial of treatment and services. It is not intended to supersede applicable ethical standards or provisions of law. This is not a legal document.

Charles Reitman, MD  
Lee Riley, MD  
Alok Sharan, MD  
Jeffrey Summers, MD  
William Tontz, MD  
Scott Tromanhauser, MD, MBA  
Eric Truumees, MD

### Financial Statement

These Coverage Recommendations were developed in their entirety by the North American Spine Society (NASS). All participating authors have disclosed potential conflicts of interest consistent with NASS' disclosure policy.

### Author Disclosures

**Baisden, Jamie:** Nothing to Disclose.

**Biyani, Ashok:** Royalties: Globus Medical (E), custom spine (C); Consulting: K2M (B)

**Boakye, Maxwell:** Nothing to Disclose.

**Bono, Christopher:** Royalties: Wolters Kluwer (B); Consulting: Harvard Clinical Research Institute (Financial), United Health Care (B); Board of Directors: North American Spine Society (Nonfinancial)  
Other Office: JAAOS (B), The Spine Journal (Nonfinancial)

**Cho, Charles:** Nothing to Disclose.

**DePalma, Michael:** Consulting: Vertiflex, Inc (Financial); Trips/Travel: Medtronic (Financial); Board of Directors: International Spine Intervention Society (Financial), Virginia Spine Research Institute, Inc (Financial); Scientific Advisory Board: Medtronic; Kimberly Clark (Financial); Other Office: Secretary, International Spine Intervention Society (Financial); Research Support (Investigator Salary): Relieva (B), SI Bone (B), Mesoblast, Inc (B); Research Support (Staff/Materials): Relieva (B), Mesoblast (B), SI Bone (B); Relationships Outside the One Year Requirement: AOI Medical (Upcoming Committee Meeting [Clinical Guidelines]), Stryker Interventional Spine (B), St. Jude Medical (NASS Annual Meeting, Consulting), Stryker Biotech (NASS Annual Meeting), ATRM (NASS Annual Meeting)

NASS coverage recommendations should not be construed as including all proper methods of care or excluding other acceptable methods of care reasonably directed to obtaining the same results. The ultimate judgment regarding any specific procedure or treatment is to be made by the physician and patient in light of all circumstances presented by the patient and the needs and resources particular to the locality or institution. **The coverage recommendations do not represent a "standard of care,"** nor are they intended as a fixed treatment protocol. It is anticipated that there will be patients who will require less or more treatment than the average. It is also acknowledged that in atypical cases, treatment falling outside these criteria will sometimes be necessary. This document should not be seen as prescribing the type, frequency or duration of intervention. Treatment and accompanying payment should be based on this information in addition to an individual patient's needs as well as the doctor's professional judgment and experience. This document is designed to function as a guide and should not be used as the sole reason for denial of treatment and services. It is not intended to supersede applicable ethical standards or provisions of law. This is not a legal document.

**Dietze, Donald:** Stock Ownership: Globus Medical Consulting: Globus Medical (Financial); Other: DePuy Spine (B)

**Easa, John:** Stock Ownership: Janus Biotherapeutics

**Ghiselli, Gary:** Private Investments: DiFusion; Consulting: Biomet (C); Speaking and/or teaching arrangements: Medacta (B); Scientific Advisory Board: DiFusion (Nonfinancial)

**Glaser, John A.:** Trips/Travel: Depuy Synthes Spine (Nonfinancial, Trip expenses, A); Grants: SI Bone (D, Research grant funding, Paid directly to institution/employer).

**Harrop, James:** Consulting: Depuy Spine (B); Board of Directors: Jefferson Medical College Physician Board (Nonfinancial); Scientific Advisory Board: Axiomed (Nonfinancial); Other Office: Bioventus (B), Penn Neurologic Society (Nonfinancial); Research Support (Staff/Materials): NACTN (E); Grants: AO Spine/ NREF (F)

**Kreiner, Scott:** Stock Ownership: LDR Holdings; Speaking and/or Teaching Arrangements: NASS Trips/Travel: ISIS (Nonfinancial)

**Lapinsky, Anthony:** Royalties: RTI formerly Pioneer (B); Consulting: Orthofix (Financial)

**Lebl, Darren:** Nothing to Disclose.

**Matz, Paul:** Speaking and/or teaching arrangements: AO Spine North America (B); Trips/Travel: NASS (A)

**O'Brien, David:** Speaking and/or teaching arrangements: NASS (B); Trips/Travel: ISIS & AAPMR (B); Other Office: ISIS & AAPMR (Nonfinancial)

**Patel, Alpesh:** Royalties: Amedica (B); Stock Ownership: Amedica, Cytonics, Nocimed Vital5; Consulting: Amedica (B), Stryker (B), Biomet (Financial), Depuy (B); Board of Directors: Lumbar Spine Research Society (Nonfinancial), Cervical Spine Research Society (Nonfinancial), Indo-American Spine Alliance (Nonfinancial); Fellowship Support: OREF (D), Omega (B); Other: Amedica (Financial)

**Reiter, Mitchell:** Private Investments: CreOsso

NASS coverage recommendations should not be construed as including all proper methods of care or excluding other acceptable methods of care reasonably directed to obtaining the same results. The ultimate judgment regarding any specific procedure or treatment is to be made by the physician and patient in light of all circumstances presented by the patient and the needs and resources particular to the locality or institution. **The coverage recommendations do not represent a "standard of care,"** nor are they intended as a fixed treatment protocol. It is anticipated that there will be patients who will require less or more treatment than the average. It is also acknowledged that in atypical cases, treatment falling outside these criteria will sometimes be necessary. This document should not be seen as prescribing the type, frequency or duration of intervention. Treatment and accompanying payment should be based on this information in addition to an individual patient's needs as well as the doctor's professional judgment and experience. This document is designed to function as a guide and should not be used as the sole reason for denial of treatment and services. It is not intended to supersede applicable ethical standards or provisions of law. This is not a legal document.

**Reitman, Charles:** Trips/Travel: NASS - BOD (Financial), AAOS - Evidence Based Committee (Financial); Scientific Advisory Board: Clinical Orthopedics And Related Research - Deputy Editor (B)

**Riley, Lee:** Stock Ownership: Spinal kinetics; Speaking and/or teaching arrangements: AOSNA (B); Trips/Travel: DePuy Spine (B); Board of Directors: Lifenet Health (C); Other Office: CSRS (A); Grants: DePuy Spine (B)

**Sharan, Alok:** Consulting: Paradigm Spine (B); Speaking and/or teaching arrangements: Synthes Spine (B)

**Summers, Jeffrey:** Stock Ownership: MedWorx ; Private Investments: Morris Innovative (2000 Shares); Board of Directors: International Spine Intervention Society (ISIS) (Nonfinancial)

**Tontz, William:** Stock Ownership: Phygen; Consulting: Medtronic (C); Speaking and/or teaching arrangements: SpineArt (B); Trips/Travel: Medtronic (B); Scientific Advisory Board: Medtronic (Financial)

**Tromanhauser, Scott:** Stock Ownership: Soteira, Inc.; Speaking and/or teaching arrangements: DePuy Synthes Spine, Inc. (B); Other Office: Best Doctors Occupational Health Institute (E)

**Truumees, Eric:** Royalties: Stryker Spine (C); Stock Ownership: Doctor's Research Group (D); Board of Directors: North American Spine Society (Nonfinancial); Other Office: AAOS Communications Cabinet (Financial); Research Support (Investigator Salary): Relieva (B) Globus (B); Other: Stryker Biotech (Nonfinancial)

## Comments

Comments regarding the coverage recommendations may be submitted to [coverage@spine.org](mailto:coverage@spine.org) and will be considered in development of future revisions of the work.

NASS coverage recommendations should not be construed as including all proper methods of care or excluding other acceptable methods of care reasonably directed to obtaining the same results. The ultimate judgment regarding any specific procedure or treatment is to be made by the physician and patient in light of all circumstances presented by the patient and the needs and resources particular to the locality or institution. **The coverage recommendations do not represent a "standard of care,"** nor are they intended as a fixed treatment protocol. It is anticipated that there will be patients who will require less or more treatment than the average. It is also acknowledged that in atypical cases, treatment falling outside these criteria will sometimes be necessary. This document should not be seen as prescribing the type, frequency or duration of intervention. Treatment and accompanying payment should be based on this information in addition to an individual patient's needs as well as the doctor's professional judgment and experience. This document is designed to function as a guide and should not be used as the sole reason for denial of treatment and services. It is not intended to supersede applicable ethical standards or provisions of law. This is not a legal document.