



Appropriate Use Criteria

Cervical Fusion

North American Spine Society

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Comments

Comments regarding this document may be submitted to the North American Spine Society and will be considered in development of future revisions of the work.

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The North American Spine Society (NASS) is a medical specialty society representing orthopedic surgeons, neurosurgeons, physiatrists, pain management specialists, radiologists, chiropractors, nurses, nurse practitioners, physical therapists, psychologists, researchers and others committed to a multidisciplinary approach to spine care. NASS is dedicated to fostering the highest quality, ethical value-based and evidence-based spine care through education, research and advocacy.

INTRODUCTION

With advances in research, including evaluation of clinical outcomes, evidence-based decision-making is needed for management of medical conditions. Because the volume and quality of the literature base varies across disorders, the levels of evidence are variable as well. Where there is high level evidence, recommendations are strong and easily acquired. Unfortunately, there are still numerous conditions where high level evidence is still developing or missing. This is certainly true for many spinal disorders. For those circumstances where evidence is low level or absent, it can be more difficult to determine appropriateness of treatment.

Although relatively new to the spine field, Appropriate Use Criteria (AUC) have been used for years in other fields as a means of determining appropriate recommendations for

medical care. Methodology has been developed and accepted to indicate reasonable recommendations for treatment. While higher level evidence is preferred, this approach allows for appropriateness criteria to be developed regardless of the current level of evidence. In the simplest terms, AUC indicate reasonable care based on available evidence combined with a rigorous, transparent recommendation process and well-defined scenarios.

AUC specify when it is appropriate to use a procedure.¹ They are determined through the use of clinical scenarios and consider the relative potential benefits versus harm of a procedure.² AUC indicate what is reasonable to do. To provide some perspective, clinical practice guidelines reflect best practices based on available evidence only and indicate what should (or should not) be done. Performance measures are based on selective, measureable interventions known to improve outcomes. These are used as quality indicators and indicate what must be done. In an AUC, an “appropriate” procedure is one for which the expected benefits exceed the expected negative consequences.³

Regardless of established levels of evidence, spine care providers must regularly make decisions about indications for procedures. AUCs are intended to facilitate these decisions by

¹ American Academy of Orthopaedic Surgeons. Appropriate Use Criteria. Available at: http://www.aaos.org/research/Appropriate_Use/auc_new.asp. Accessed: 12/18/12.

² Fitch K, Bernstein SJ, Aguilar MD et al. *The RAND/UCLA Appropriateness Method User's Manual*. Santa Monica, CA: RAND Corporation; 2001.

³ Fitch K, Bernstein SJ, Aguilar MD et al. *The RAND/UCLA Appropriateness Method User's Manual*. Santa Monica, CA: RAND Corporation; 2001.

combining the best available scientific evidence with the collective judgment of physicians to determine the appropriateness of performing a procedure.¹

Why AUCs?

The initial purpose of AUCs was to assist physician and patient decision-making, and ensure the safest and highest quality care for patients undergoing these procedures. AUCs also have additional broader applications for use by payers and in health policy development.

While clinical guidelines can apply to either clinical diagnoses or procedures, AUCs tend to apply more to specific procedures. Although it is clearly preferable to base clinical recommendations upon high level medical evidence, AUC can address those procedures where evidence may be more limited. Using structured methodological approaches for the development of clinical scenarios, acquisition and interpretation of available data, and ratings from a multidisciplinary panel that do not require consensus, AUCs are far more robust than isolated expert opinion.

In general, topics that would be of interest for AUC development are:

- Procedures that are done frequently;
- Procedures that consume significant resources;
- Procedures that have wide variations in their use;
- Procedures that are associated with substantial morbidity and mortality;
- Procedures that are controversial; or
- Combinations of the above.³

AUC development in general is easiest and arguably most accurate for those procedures that have high level consensus and evidence, although they can be developed regardless of levels of evidence.

Objective

The objective of NASS Appropriate Use Criteria is to define appropriate (meaning reasonable) care of spinal disorders. This document is intended to reflect contemporary treatment concepts and to assist in the delivery of optimum, efficacious treatment and functional recovery.

This document supersedes any other existing NASS documents, with the exception of current clinical guidelines.

These criteria 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 may 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 expand or restrict a health care provider’s scope of practice or to supersede applicable ethical standards or provisions of law. This is not a legal document.

Revision

Criteria will be revised as appropriate. NASS understands that the state of the evidence is dynamic and that these recommendations may change as evidence, technology or practice evolve.

Intended Users

These criteria are intended to assist everyone involved in spine care, including but not limited to, spine care providers, patients, payers and quality improvement bodies.

Patient Population

Patients aged 18-80 with the degenerative diagnoses of:

- Acute herniated nucleus pulposus;
- Spondylosis (asymptomatic or axial);
- Spondylosis with foraminal stenosis;
- Spondylosis with central stenosis.

This document applies to the skeletally mature spine only.

METHODOLOGY

There is currently no “gold standard” for AUC development. The most utilized methodology is currently the RAND/UCLA Appropriateness Method, a modified Delphi process where AUCs are developed using evidence-based information in conjunction with the clinical expertise of physicians from multiple specialties. The NASS AUC methodology is closely patterned after the RAND method, although not identical.

1. **Topic Selection.** A topic is selected at the recommendation of the NASS Research and Health Policy Councils based on what topics are of interest to members and payers, considering the six criteria outlined by RAND (see page 7).
2. **Standardization of Definitions.** The Oversight Work Group develops project definitions for consistency in the evaluation, communication and rating of scenarios.
3. **Scenario Writing.** The scenarios are written by the Scenario Writing Work Group after identifying the variables to be considered. These scenarios can number in the hundreds. Scenarios are intended to describe all the clinical scenarios that could potentially require the procedure of interest. In brief, all variables that could contribute to outcomes of a procedure are considered, and from these the scenarios are developed. These are comprehensive and include, but are not limited to, technical, diagnostic, demographic and psychosocial factors. Conflicts of interest are permissible within the Scenario Writing Work Group as long as writers adhere to the NASS Disclosure Policy (www.spine.org).
4. **Scenario Review.** The scenarios are then reviewed by the Scenario Review Work Group to determine completeness and suitability. Comments are sent back to the Scenario Writing Work Group to consider further scenario refinement and a final draft of scenarios is created. As part of the review process, the scenario document is scored by the review group as if they were raters in order to provide feedback and

suggest improvements to the document. Conflicts of interest are permissible as long as reviewers adhere to the NASS Disclosure Policy.

5. **Literature Review Group.** Concurrent to scenario writing and review, a literature review is conducted. Members of this group are required to be trained in evidence-analysis techniques. Literature review and completion of accompanying evidentiary tables is a critical component to the process. The initial literature search is done after the first scenario document is drafted and search terms are targeted to the procedure as well as all the variables that comprise the scenarios. Initially, a search is done and screened by the project chair for only higher levels of evidence, including review articles, randomized controlled trials, meta-analyses, systematic reviews and level 1 and 2 therapeutic or prognostic studies as well as existing related clinical guidelines. If the abstracts of these manuscripts indicate that all variables within the scenarios will be addressed at some level, no further search is needed. If not, for those variables with no information, a search of all evidence is completed. All relevant studies are summarized in evidentiary tables which are then provided to the raters to assist them with informed voting. Each paper is reviewed by at least two reviewers. Clinical guidelines are reviewed and summarized by the chair. Conflicts of interest are permissible as long as reviewers adhere to the NASS Disclosure Policy.
6. **Rating.** A multidisciplinary group of 14 raters were identified representing the specialties of orthopedics, neurosurgery, physical medicine and rehabilitation, and pain management who were considered thought leaders in the field. This group also included an independent and experienced moderator and at least one rater had to have participated in the development of a clinical guideline. Raters were not required to be trained in evidence-analysis. They did not have to be conflict-free; however, they were required to have participated in the NASS disclosure process. When possible, NASS prefers a rater group where greater than 50% of the members have no direct conflict of interest with the topic. In addition, relevant conflicts were requested to be disclosed verbally to the group at the beginning of the final in-person rating session. The group was introduced to the scenarios, the rating method and perspective on two pre-rating conference calls. Scenarios were to be rated based on appropriateness at large, not relative to a rater's practice. The raters were then given the scenarios to rate independently and anonymously. The raters then met for a one day meeting to discuss the scenarios and participate in a second round of anonymous rating. Scores from the first round of rating were compiled and presented to the group to facilitate discussion. Scenarios were also modified or added where the need for clarity was identified. Consensus was not a goal and cost was not considered in the ratings. Raters were directed to consider whether a procedure was reasonable, in general, relative to the scenarios presented. Raters combined evidence with personal experience and voted on the appropriateness of each scenario using a 1-9 scale. The votes were recorded, and the median used to determine the final score. Scores of 1 to 3 indicate that the procedure is rarely appropriate, >3 to 6 uncertain, and >6 to 9 appropriate. In addition, appropriate scenarios are further characterized as "with agreement" or "with disagreement," the

latter indicating those scenarios where the median score was >6 but there was wide disparity in voting.

Scenarios that are appropriate with agreement are clearly reasonable to consider. Those that are rarely appropriate are most likely unreasonable to consider. Those that are appropriate with disagreement or those that are uncertain do not have clear indications. Uncertain ratings likely arise when, to date, the strength of the literature is weaker, and the experience with the procedure has been variable. These are often scenarios where success has been realized, but results are more inconsistent and controversial, and more scientific study is needed to clarify the direction of recommendation. This is not a declaration that these procedures are appropriate or inappropriate, but rather that recommendations can be considered, but deserve more attention and scrutiny on an individual basis. The final score would suggest an appropriate, equivocal or rarely appropriate use for each scenario.

A third round of rating can be undertaken to determine necessity. Necessity indicates what should be done, rather than what is reasonable to do. Necessity was not determined for this AUC. For a scenario to be considered necessary, it must first be appropriate with agreement. The health benefits must exceed the risks by a sufficient margin that it is worth doing. Other features include the fact that it would be improper care not to offer the treatment to the patient, and that the magnitude of the expected benefits is not small.

7. **Scoring.** Final rating assignment is based on the median score. Since there was an even number of raters, the median scores were the seventh and eighth highest ratings. Per the RAND methodology, for those scenarios where the 7th and 8th scores varied, assignment of grade defaulted to the higher or 8th highest score. The categories for assignment were as follows:
- 1 to 3=Rarely appropriate
 - >3 to 6=Uncertain
 - >6 to 9=Appropriate

Agreement or disagreement only applies to appropriate ratings. There is disagreement when, after discarding the two highest and the two lowest votes, among the remaining votes, there is still at least one rating in the 1-3 range.

A,A=Appropriate with Agreement

A,D=Appropriate with Disagreement

DEFINITIONS AND CONSIDERATIONS

Definitions

Spondylosis

Degenerative changes affecting the cervical vertebrae, intervertebral disc, uncovertebral and facet joints, and surrounding connective tissue.

Herniated Nucleus Pulposus

Localized displacement of disc material beyond the normal margins of the intervertebral disc space defined by the outer edge of the endplate.

Foraminal Stenosis

A decrease in dimension of the intervertebral foramen.

Central Stenosis

A decrease in the dimension of the spinal canal resulting in diminution of surrounding cerebrospinal fluid and radiographic compression or deformation of the spinal cord.

Radiculopathy*

Symptoms in a radiating pattern in one or both upper extremities or into the scapular area, and/or signs that can include varying degrees of sensory, motor and/or reflex changes related to nerve root(s) without evidence of myelopathy.

**When radiculopathy and myelopathy present together, for the purpose of the matrix, the patient will be classified as myelopathy.*

Myelopathy*

Loss of function in the upper and/or lower extremities. This can include subjective reports of loss of function, and/or objective signs of cord dysfunction such as weakness, numbness and/or reflex changes.

**When radiculopathy and myelopathy present together, for the purpose of the matrix, the patient will be classified as myelopathy.*

Kyphosis

The curve in the neck from C2 to C7 has an apex that points posteriorly on both neutral and extension x-rays.

Lordosis

The curve in the neck from C2 to C7 has an apex that points anteriorly.

Axial Pain

Pain confined to the neck without radiation to the upper extremities or scapulae.

Psychosocial Comorbidities

The presence of, either alone or in combination, a personality disorder, ongoing or recent substance abuse, workers' compensation or litigation related to the cervical process being treated, history of failed spine surgery, or clinically significant depression or anxiety. There is reference in the document to mild versus severe. For this document, mild refers to either truly mild disease such as mild fear avoidance behavior or disease that could be severe, but is well controlled such as a patient with paranoid schizophrenia compliant with medications.

Severe refers to severe disease that is not manageable, or is poorly managed or controlled, including the patient who appears to be malingering for secondary gain.

Medical Comorbidities

The presence of medical conditions affecting the cardio-pulmonary, renal, hepatic, endocrine, neurologic (central or peripheral disease), vascular or other systems to a degree that either an increased risk of peri-operative medical complications or a decreased potential for obtaining fusion would be expected.

Pseudarthrosis

Without symptoms-Absence of radiographic ossification of all fusion surfaces that is present beyond six months following surgery, and not showing progression of ossification on serial imaging with minimum of three month interval.

With symptoms-Absence of radiographic ossification of all fusion surfaces that is present beyond six months following surgery, and not showing progression of ossification on serial imaging with minimum of three month interval, plus pain thought to be related to pseudarthrosis.

Signal Change in the Cord

This refers to presence of hypointensity in the cord on T1 images and/or hyperintensity on T2 images, present on both sagittal and axial images.

Abbreviations

ACF	anterior cervical fusion
PCF	posterior cervical fusion
APCF	anterior and posterior cervical fusion
L	laminectomy
LF	laminoforaminotomy
FS	foraminal stenosis
CS	central stenosis
PC	psychosocial comorbidities
MC	medical comorbidities
SC	signal change in the cord

Assumptions

The purpose of this document is to evaluate the appropriateness of fusion. As such, decompression is not always included in the scenarios. For clarification, where there is no reference to decompression, the reader should interpret any scenario as fusion with or without decompression. This document assumes that the reader can appropriately determine the need for decompression in those scenarios where decompression is not specified. In addition, where medical/interventional treatment is mentioned, the document assumes that the type of medical/interventional treatment provided was within an acceptable community standard of care to the reader.

Medical and psychosocial comorbidities are grouped by such terms as mild, moderate, severe, well-controlled, poorly controlled, etc. It is recognized that these terms are vague. In very simple terms, these modifiers will be absent, not that bad, or severe. It is

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acknowledged that this can be subjective, but nonetheless, it is assumed that the provider can group their patients accordingly when these modifying variables are present.

Organization and Considerations

Tables are followed by written scenarios. Each table essentially represents a chapter, defined by the written legend accompanying each table. Within each table (chapter), there are a varying number of variables that compose each matrix. The written scenarios to follow are taken directly from the matrix, and the number in the table represents the numbered written scenario. There are a few scenarios that were written outside a matrix, so not every numbered scenario will be contained within a table.

The topic is cervical fusion. Thus anterior, posterior, or anterior-posterior (A-P) fusion are included for almost everything. The variables chosen that may affect appropriateness of fusion include the following: (*See Project Definitions*)

- Axial pain vs radiculopathy vs myelopathy
- Radiculopathy without or with severe neurological deficit
- Spondylosis without stenosis vs foraminal stenosis vs central stenosis
- Disc herniation with foraminal stenosis vs central stenosis
- Lordosis vs kyphosis
- Immediate surgery vs 6 weeks to 6 months of medical/interventional care vs greater than 6 months of medical/interventional care
- Presence or absence of psychosocial comorbidities
- Presence or absence of medical comorbidities
- Presence of pseudarthrosis
- Presence or absence of signal change in cord with central stenosis
- First symptomatic episode vs recurrent symptomatic episode
- Presence or absence of a cervical plate

Variables were chosen by the Oversight Committee. Realizing that the potential scenarios grow exponentially with each new variable, the goal was to include those factors that most contribute to surgical decision-making, indications and outcomes. Because of multiple variables, certain tables go together, and their collective rating would determine final appropriateness. This makes interpretation much easier than writing lengthy scenarios that would require multiple variables in each sentence.

For example, rather than one scenario that says ACF is appropriate for 1 to 2 level disease resulting in foraminal stenosis with a lordotic spine in a patient with radiculopathy who presents after 6 weeks of symptoms with failed medical/interventional management and poorly controlled diabetes with mild psychosocial comorbidities, there are multiple sections that break down scenarios into components. The combination of multiple sections would be used to arrive at final appropriateness for a patient with all these variables. For this document, scenarios from Section I and II go together, III to V together, V to VII together, and V and VIII together. Section IX stands alone.

OUTLINE OF SCENARIO CHAPTERS-MATRIX COMPONENTS

Section I

- Spondylosis without stenosis and with axial complaints of pain
- ACF or PCF or APCF
- 1 level or 2 level or >2 level disease

Section II

- Fusion for patients with axial pain and spondylosis without stenosis
- 1 level or 2 level or >2 level disease
- Smoking or MC well controlled or MC poorly controlled or PC mild or PC severe or pseudarthrosis

Section III

- Foraminal stenosis
- ACF or PCF with L and kyphosis or PCF with L and lordosis or PCF with LF and kyphosis or PCF with LF and lordosis
- 1-2 levels and radiculopathy or >2 levels and radiculopathy or 1-2 levels and axial pain or >2 levels and axial pain

Section IV

- Cervical fusion for foraminal stenosis
- 1-2 levels and radiculopathy or >2 levels and radiculopathy or 1-2 levels and axial pain or >2 levels and axial pain
- Smoking or MC controlled or MC poorly controlled or PC mild or PC severe or pseudarthrosis

Section V

- Cervical fusion with stenosis due to spondylosis or disc herniation
- FS + radiculopathy without or with severe neurological deficit or FS + axial pain or CS (no SC) + radiculopathy without or with severe neurological deficit or CS (no SC) + axial pain or CS (no SC) + myelopathy or CS (SC) + radiculopathy without or with severe neurological deficit or CS (SC) + axial pain or CS (SC) + myelopathy
- At symptom onset or after six weeks to six months of treatment or greater than six months treatment

First section pertains to first symptomatic episode, second section for recurrent episodes

Section VI

- Central stenosis plus/minus foraminal stenosis
- 1-2 level + myelopathy or >2 level + myelopathy or 1-2 level with radiculopathy or >2 level with radiculopathy or 1-2 level axial pain or >2 level axial pain
- ACF with kyphosis or PCF with kyphosis or ACF with lordosis or PCF with lordosis
- First section pertains to central stenosis (CS) with signal change in the cord (SC). Second section for CS with no signal change.

Section VII

- Cervical fusion for central stenosis
- 1-2 level with radiculopathy or >2 level with radiculopathy or 1-2 level with axial pain or >2 level with axial pain or 1-2 level with myelopathy or >2 level with myelopathy

- Smoking or MC controlled or MC poorly controlled or PC mild or PC severe or pseudarthrosis
- First section pertains to central stenosis (CS) with signal change in the cord (SC). Second section for CS with no signal change.

Section VIII

- Soft cervical disc herniation, 1 or 2 levels
- ACF or PCF
- Axial pain or radiculopathy or myelopathy

Section IX

- Cervical plate
- ACF
- 1 level, >1 level

EXECUTIVE SUMMARY

This document reviews appropriateness of fusion for the treatment of various degenerative cervical conditions. Conclusions are drawn from a methodology designed to provide answers to clinical scenarios based on the existing evidence and clinical expertise from a balanced panel of “thought leaders” in care of the cervical spine. **This does not represent a standard of care.** However, it does provide an evidence-based review to help guide decision-making for patients, providers, payers and policy makers. The words are important. Appropriate does not mean you must follow a scenario, but rather that it would be reasonable to consider that line of treatment. Uncertainty implies either a lack of evidence or conflicting evidence that combined with experience does not establish clear certainty for treatment for a given scenario. Lastly, rarely appropriate is a fairly strong declaration of opposition, but does not mean that a scenario would be ill-advised in all circumstances. The scenarios were developed using variables the scenario writers and reviewers thought best represented the common clinical concerns for indications for cervical fusion among spine care providers.

Several trends emerged in the 250 plus scenarios. Where evidence existed, either for or against, recommendations reflected the evidence as expected. Regarding the variables examined, fusion for degenerative conditions that resulted in axial pain tended to be less appropriate than those resulting in radiculopathy. These in turn tended to be slightly less appropriate than in the setting of myelopathy unless severe neurological deficit was present, in which case there was approximate equivalence. Along the same lines, fusion for degenerative conditions with central stenosis was most consistently rated as appropriate followed by those with foraminal stenosis followed by conditions with no radiographic stenosis. The presence of signal changes in the spinal cord on MRI with central stenosis tended to be associated with stronger support for fusion in some select scenarios, but the ratings were mostly equivalent to similar scenarios without cord signal changes. In the presence of neurological problems, either myelopathy or radiculopathy, both short and long fusions were often considered appropriate. In contrast, for conditions without stenosis or causing axial pain only, one level (versus multilevel disease) was more likely to be considered appropriate for fusion, if at all.

In general, anterior fusion was appropriate regardless of sagittal alignment. Posterior fusion was more often appropriate with kyphosis than lordosis, although this was felt to be appropriate for several scenarios with lordosis, as well. Trends for anterior and posterior surgery were rare except for patients undergoing corpectomy, and, to improve fusion rates. The longer the fusion, the more likely combined anterior and posterior surgery was felt to be appropriate. There was consistent support for revision fusion for pseudarthrosis if it was symptomatic, and just as consistent lack of support for fusion for asymptomatic pseudarthroses. The exceptions to the latter were patients with some element of central stenosis and persistent neurological problems, particularly myelopathy.

Finally, comorbidities definitely affected appropriateness of cervical fusion, including smoking, medical and psychosocial problems. The more severe the comorbidities, the more caution there was to support fusion. These variables resulted in stronger opposition for conditions with axial complaints and for conditions without stenosis than for conditions with radiculopathy and with foraminal stenosis. They had the least effect on conditions with central stenosis and cervical myelopathy.

Key	
ACF	anterior cervical fusion
PCF	posterior cervical fusion
APCF	anterior and posterior cervical fusion
L	laminectomy
LF	laminoforaminotomy
FS	foraminal stenosis
CS	central stenosis
PC	psychosocial comorbidities
MC	medical comorbidities
SC	signal change in the cord
A,A	Appropriate with Agreement
A,D	Appropriate with Disagreement
U	Uncertain
RA	Rarely Appropriate
Note: Agreement or disagreement only applies to appropriate ratings.	

SECTION I

Spondylosis without stenosis and with axial complaints of pain

	1 level	2 level	>2 level
ACF	1 U	4 U	7 U
PCF	2 U	5 RA	8 RA
APCF	3 U	6 U	9 RA

Summary. Cervical fusion for axial neck pain without stenosis was never considered appropriate. There was a trend to be rarely appropriate for two or greater level fusions, whereas there was more uncertainty for one level fusions. Although uncertain, anterior procedures were overall favored over posterior or anterior and posterior procedures.

Key

ACF anterior cervical fusion
PCF posterior cervical fusion
APCF anterior and posterior cervical fusion
L laminectomy
LF laminoforaminotomy
FS foraminal stenosis
CS central stenosis
PC psychosocial comorbidities
MC medical comorbidities
SC signal change in the cord

A,A Appropriate with Agreement
A,D Appropriate with Disagreement
U Uncertain
RA Rarely Appropriate

Note: Agreement or disagreement only applies to appropriate ratings.

■ SECTION II

Fusion for patients with axial pain and spondylosis without stenosis

	Smoking	MC Poorly Controlled	MC Well Controlled	PC mild	PC Severe	Pseudo
1 level	12 RA	15 RA	18 U	21 U	24 RA	27 RA, 28 A,A
2 level	13 RA	16 RA	19 U	22 RA	25 RA	
>2 level	14 RA	17 RA	20 RA	23 RA	26 RA	

Summary. This section included the effect of comorbidities or the presence of a symptomatic pseudarthrosis in the treatment of axial neck pain without stenosis. Taken together with Section I, the presence of smoking resulted in rarely appropriate ratings for fusion for axial neck pain, even for one level disease. The same was true for the presence of poorly controlled medical or psychosocial comorbidities. In general, the presence of mild medical or psychosocial comorbidities did not change the rating.

Revision for symptomatic pseudarthrosis was considered appropriate, but fusion for asymptomatic pseudarthrosis was considered rarely appropriate. This assumes the surgeon can determine the source of the symptoms when present.

Key

ACF anterior cervical fusion
PCF posterior cervical fusion
APCF anterior and posterior cervical fusion
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PC psychosocial comorbidities
MC medical comorbidities
SC signal change in the cord

A,A Appropriate with Agreement
A,D Appropriate with Disagreement
U Uncertain
RA Rarely Appropriate

Note: Agreement or disagreement only applies to appropriate ratings.

SECTION III
Foraminal stenosis

	1-2 level with radiculopathy	> 2 level with radiculopathy	1-2 level with axial pain	> 2 level with axial pain
ACF	29 A,A	30 A,A	31 U	32 RA

	Kyphosis	Lordosis
1 to 2 level L and PCF	33 A,A	37 A,A
>2 level L and PCF	34 A,A	38 A,A
1-2 level LF and PCF	35 A,A	39 U
>2 level LF and PCF	36 A,A	40 U

Summary. This section addressed the use of fusion in patients with foraminal stenosis and either radiculopathy or axial pain. In the presence of foraminal stenosis and concordant radiculopathy, both anterior and posterior surgery were considered appropriate regardless of the number of levels involved. If axial pain was present rather than radiculopathy, the indications for surgery were uncertain for one or two level disease, and rarely appropriate for greater than two level disease. For posterior procedures, when laminectomy was necessary, fusion was considered appropriate regardless of sagittal alignment. If decompression could be limited to a foraminotomy, fusion was considered appropriate in the presence of kyphosis, but uncertain if lordosis was present.

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Key

ACF anterior cervical fusion
PCF posterior cervical fusion
APCF anterior and posterior cervical fusion
L laminectomy
LF laminoforaminotomy
FS foraminal stenosis
CS central stenosis
PC psychosocial comorbidities
MC medical comorbidities
SC signal change in the cord

A,A Appropriate with Agreement
A,D Appropriate with Disagreement
U Uncertain
RA Rarely Appropriate

Note: Agreement or disagreement only applies to appropriate ratings.

SECTION IV

Cervical fusion for foraminal stenosis

	Smoking	MC Poorly Controlled	MC Controlled	PC Mild	PC Severe	Pseudo
1 to 2 level with radiculopathy	41 A,A	45 U	49 A,A	53 A,A	57 A,A	61 A,A
>2 level with radiculopathy	42 A,A	46 U	50 A,A	54 A,A	58 A,D	
1 to 2 level with axial pain	43 RA	47 RA	51 U	55 U	59 RA	62 A,A
>2 level with axial pain	44 RA	48 RA	52 RA	56 RA	60 RA	

Summary. This section addressed the effect of comorbidities on the role of fusion for patients with foraminal stenosis with radiculopathy or axial pain. Comorbidities had less of an effect on decision-making for symptoms related to foraminal stenosis than for the scenarios without stenosis (Section II). Again, for 1 or 2 level disease with axial pain, fusion was considered rarely appropriate in the presence of severe psychosocial or medical comorbidities as well as smoking, and uncertain if medical or psychosocial factors were mild. On the other hand, if radiculopathy was present, fusion remained appropriate in all cases except for the presence of severe medical comorbidities, where fusion was rated as rarely appropriate. Interestingly,

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severe psychosocial comorbidity did not affect appropriateness as much in this circumstance, although there was disagreement for greater than two level disease only. Appropriateness for surgery for pseudarthrosis only when symptomatic remained consistent.

Key	
ACF	anterior cervical fusion
PCF	posterior cervical fusion
APCF	anterior and posterior cervical fusion
L	laminectomy
LF	laminoforaminotomy
FS	foraminal stenosis
CS	central stenosis
PC	psychosocial comorbidities
MC	medical comorbidities
SC	signal change in the cord
A,A	Appropriate with Agreement
A,D	Appropriate with Disagreement
U	Uncertain
RA	Rarely Appropriate
Note: Agreement or disagreement only applies to appropriate ratings.	

■ SECTION V

Cervical fusion with stenosis (FS or CS) due to spondylosis or disc herniation

FIRST SYMPTOMATIC EPISODE

	Symptom Onset	6 Wks to 6 Mos Rx	> 6 Mos Rx
FS + radiculopathy	64 RA	65 A,A	66 A,A
FS + radiculopathy with severe neurological deficit	67 A,A	68 A,A	69 A,A
FS + axial pain	70 RA	71 RA	72 U
CS (no SC) + radiculopathy	73 RA	74 A,A	75 A,A
CS (no SC) + radiculopathy + severe neurological deficit	76 A,A	77 A,A	78 A,A
CS (no SC) + axial pain	79 RA	80 U	81 U
CS (no SC) + myelopathy	82 A,A	83 A,A	84 A,A

CS (SC) + radiculopathy	85 A,A	86 A,A	87 A,A
CS (SC) + radiculopathy + severe neurological deficit	88 A,A	89 A,A	90 A,A
CS (SC) + axial pain	91 U	92 A,A	93 A,A
CS (SC) + myelopathy	94 A,A	95 A,A	96 A,A

Cervical fusion with stenosis (FS or CS) due to spondylosis or disc herniation
RECURRENT symptomatic episodes of radiculopathy, axial symptoms or myelopathy

	Symptom Onset	6 Wks to 6 Mos Rx	> 6 Mos Rx
FS + radiculopathy	97 U	98 A,A	99 A,A
FS + radiculopathy + severe neuro deficit	100 A,A	101 A,A	102 A,A
FS + axial pain	103 RA	104 U	105 U
CS (no SC) + radiculopathy	106 U	107 A,A	108 A,A
CS (no SC) + radiculopathy + severe neruo deficit	109 A,A	110 A,A	111 A,A
CS (no SC) + axial pain	112 RA	113 U	114 A,A
CS (no SC) + myelopathy	115 A,A	116 A,A	117 A,A
CS (SC) + radiculopathy	118 A,A	119 A,A	120 A,A
CS (SC) + radiculopathy + severe neruo deficit	121 A,A	122 A,A	123 A,A
CS (SC) + axial pain	124 U	125 A,A	126 A,A
CS (SC) + myelopathy	127 A,A	128 A,A	129 A,A

Summary. The key variable for this section was timing for surgery. The first group was all patients presenting with symptoms for the first time. For those patients with FS and radiculopathy without severe neurological deficit, immediate surgery was rarely appropriate. For those presenting with severe deficit, immediate surgery was appropriate. After 6 weeks or 6 months of care, surgery was appropriate in all cases. If the episode was recurrent, immediate

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surgery for FS without severe neurological deficit was uncertain rather than rarely appropriate. Otherwise, recommendations were the same as first time episode.

For a first time episode of axial pain with FS, fusion was rarely appropriate for at least the first 6 months, at which time indications were uncertain. For recurrent episodes, fusion was uncertain after 6 weeks. For a first time episode and CS without signal change in the cord with axial pain, the timetable was shifted slightly, but appropriateness for surgery was still uncertain at best. Fusion was considered rarely appropriate at time of onset and uncertain beyond 6 weeks of care. If the episode was recurrent, recommendations were the same until 6 months when fusion was appropriate. For the same scenarios, but with the presence of signal change in the cord, surgery was considerably more favorable. Fusion was considered uncertain at immediate onset but appropriate after 6 weeks. This was true for first time as well as recurrent episodes.

For a first time episode and central stenosis with radiculopathy without signal change in the cord, fusion was rarely appropriate at onset and then appropriate after 6 weeks. For recurrent episodes, fusion was uncertain at onset, with similar indications otherwise. If there was presence of severe neurological deficit with the radiculopathy or if there was myelopathy, surgery was appropriate from the onset. For all scenarios with CS with signal change in the cord and either radiculopathy or myelopathy, fusion was appropriate at the onset for first time as well as recurrent episodes.

Key

ACF anterior cervical fusion
PCF posterior cervical fusion
APCF anterior and posterior cervical fusion
L laminectomy
LF laminoforaminotomy
FS foraminal stenosis
CS central stenosis
PC psychosocial comorbidities
MC medical comorbidities
SC signal change in the cord

A,A Appropriate with Agreement
A,D Appropriate with Disagreement
U Uncertain
RA Rarely Appropriate

Note: Agreement or disagreement only applies to appropriate ratings.

SECTION VI

Central stenosis plus/minus foraminal stenosis plus/minus signal change in cord for all scenarios 130-153.

ALL SCENARIOS assume PRESENCE of SIGNAL CHANGE IN CORD

	ACF w/Kyphosis	PCF w/Kyphosis	ACF w/Lordosis	PCF w/Lordosis
1-2 level + SC + myelopathy	130 A,A	136 A,A	142 A,A	148 A,A
>2 level + SC + myelopathy	131 A,A	137 A,A	143 A,A	149 A,A
1-2 level + SC + radiculopathy	132 A,A	138 A,A	144 A,A	150 A,A
>2 level + SC + radiculopathy	133 A,A	139 A,A	145 A,A	151 A,A
1-2 level + SC +axial pain	134 U	140 U	146 A,A	152 U
>2 level + SC + axial pain	135 U	141 A,A	147 A,A	153 U

Key

ACF anterior cervical fusion
PCF posterior cervical fusion
APCF anterior and posterior cervical fusion
L laminectomy
LF laminoforaminotomy
FS foraminal stenosis
CS central stenosis
PC psychosocial comorbidities
MC medical comorbidities
SC signal change in the cord

A,A Appropriate with Agreement
A,D Appropriate with Disagreement
U Uncertain
RA Rarely Appropriate

Note: Agreement or disagreement only applies to appropriate ratings.

Central stenosis plus/minus foraminal stenosis with NO signal change in cord for all scenarios 154-177.

ALL SCENARIOS assume ABSENCE of SIGNAL CHANGE IN CORD

	ACF w/Kyphosis	PCF w/Kyphosis	ACF w/Lordosis	PCF w/Lordosis
1-2 level myelopathy	154 A,A	160 A,A	166 A,A	172 A,A
>2 level myelopathy	155 A,A	161 A,A	167 A,A	173 A,A
1-2 level with radiculopathy	156 A,A	162 A,A	168 A,A	174 A,A
>2 level with radiculopathy	157 A,A	163 A,A	169 A,A	175 A,A
1-2 level axial pain	158 U	164 U	170 U	176 U
>2 level axial pain	159 U	165 U	171 U	177 U

Summary. This section addresses decisions on anterior or posterior approaches for fusion in the setting of either kyphosis or lordosis, considering patients either with or without cord signal change. The first set of scenarios all include patients with central stenosis **with** signal change in their cord. For those with myelopathy or pure radiculopathy regardless of the number of levels of stenosis or the sagittal alignment, either anterior or posterior fusion was appropriate. If patients had only axial pain, there was some uncertainty. As long as there was central stenosis with cord changes, fusion was never considered rarely appropriate.

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For the same scenarios but **without** signal change in the cord, fusion remained appropriate for myelopathy or radiculopathy. For axial pain, all scenarios were uncertain.

In summary, fusion, either anterior or posterior, was always considered appropriate in the presence of central stenosis with or without signal change in the cord regardless of number of levels or the sagittal alignment as long as patients presented with myelopathy or radiculopathy. If they presented with axial pain, there was some uncertainty in the presence of cord changes, and this uncertainty became ubiquitous if signal change was absent.

Key

ACF anterior cervical fusion
PCF posterior cervical fusion
APCF anterior and posterior cervical fusion
L laminectomy
LF laminoforaminotomy
FS foraminal stenosis
CS central stenosis
PC psychosocial comorbidities
MC medical comorbidities
SC signal change in the cord

A,A Appropriate with Agreement
A,D Appropriate with Disagreement
U Uncertain
RA Rarely Appropriate

Note: Agreement or disagreement only applies to appropriate ratings.

SECTION VII

Cervical fusion for central stenosis with signal change in cord for all scenarios 178-210.

ALL SCENARIOS assume PRESENCE of SIGNAL CHANGE IN CORD

	Smoking	MC Poorly Controlled	MC Controlled	PC Mild	PC Severe	Pseudo
1-2 level with radiculopathy	178 A,A	184 U	190 A,A	196 A,A	202 U	208 A,A
>2 level with radiculopathy	179 A,A	185 U	191 A,A	197 A,A	203 U	
1-2 level with axial pain	180 U	186 RA	192 U	198 U	204 RA	209 A,A
>2 level with axial pain	181 U	187 RA	193 U	199 U	205 RA	
1-2 level with myelopathy	182 A,A	188 A,A	194 A,A	200 A,A	206 A,A	210 A,A
>2 level with myelopathy	183 A,A	189 A,A	195 A,A	201 A,A	207 A,A	

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Cervical fusion for central stenosis **with NO signal change in cord for all scenarios 214-246.**

ALL SCENARIOS assume ABSENCE of SIGNAL CHANGE IN CORD

	Smoking	MC Poorly Controlled	MC Controlled	PC Mild	PC Severe	Pseudo
1-2 level with radiculopathy	214 A,A	220 U	226 A,A	232 A,A	238 U	244 A,A
>2 level with radiculopathy	215 U	221 U	227 A,A	233 A,A	239 U	
1-2 level with axial pain	216 U	222 RA	228 U	234 U	240 RA	245 A,A
>2 level with axial pain	217 U	223 RA	229 U	235 RA	241 RA	
1-2 level with myelopathy	218 A, D	224 A,A	230 A,A	236 A,A	242A,A	246 A,A
>2 level with myelopathy	219 A, D	225 A,A	231 A,A	237 A,A	243 A,A	

Summary. This section looks at the effect of comorbidities on decision-making for conditions with central stenosis. The first group of scenarios look at central stenosis with signal change in the cord. For patients with myelopathy, fusion was always appropriate, regardless of number of levels treated, severity of medical or psychosocial problems, or smoking. For patients with radiculopathy, if patients had severe medical or psychosocial problems, there was uncertainty. Otherwise, fusion was still appropriate for all remaining scenarios. In contrast, for patients with axial pain only, fusion was considered rarely appropriate for those with severe medical or psychosocial conditions, and uncertain for all other scenarios. No scenarios were considered appropriate if the patient presented with axial pain only and any of these comorbidities.

For symptomatic pseudarthrosis fusion again was appropriate for all scenarios, whether the associated problem was myelopathy, radiculopathy or axial pain. If the patient was asymptomatic, in contrast to prior scenarios where fusion was rarely appropriate (Sections II and IV), fusion was uncertain for these patients with central stenosis and cord changes.

If cord changes were absent, recommendations for fusion were generally weaker. Fusion remained appropriate for myelopathy for all scenarios, although there was disagreement for smoking. For radiculopathy without cord signal change, fusion was appropriate for one or two level involvement, but uncertain for greater than two levels. Fusion was also rated as uncertain if either medical or psychosocial problems were severe, but remained appropriate if they were mild. For axial pain, fusion was uncertain with smoking, as well as mild medical or psychosocial problems across all scenarios except psychosocial problems with greater than two level disease which was considered rarely appropriate. For poorly controlled medical or psychosocial problems, fusion was considered rarely appropriate for all scenarios.

Key	
ACF	anterior cervical fusion
PCF	posterior cervical fusion
APCF	anterior and posterior cervical fusion
L	laminectomy
LF	laminoforaminotomy
FS	foraminal stenosis
CS	central stenosis
PC	psychosocial comorbidities
MC	medical comorbidities
SC	signal change in the cord
A,A	Appropriate with Agreement
A,D	Appropriate with Disagreement
U	Uncertain
RA	Rarely Appropriate
Note: Agreement or disagreement only applies to appropriate ratings.	

■ SECTION VIII

Soft cervical disc herniation, 1 or 2 levels

	Axial pain	Radiculopathy	Myelopathy
ACF	250 U	252 A,A	254 A,A
PCF	251 RA	253 U	255 U

Summary. This section relates to conditions that arise from soft cervical disc herniations. In general, myelopathy and radiculopathy are more appropriate indications for fusion than axial pain, and anterior fusion is favored over posterior fusion.

Key

ACF	anterior cervical fusion
PCF	posterior cervical fusion
APCF	anterior and posterior cervical fusion
L	laminectomy
LF	laminoforaminotomy
FS	foraminal stenosis
CS	central stenosis
PC	psychosocial comorbidities
MC	medical comorbidities
SC	signal change in the cord

A,A	Appropriate with Agreement
A,D	Appropriate with Disagreement
U	Uncertain
RA	Rarely Appropriate

Note: Agreement or disagreement only applies to appropriate ratings.

SECTION IX

Presence or absence of plate for ACF

	Plate	No plate
1 level anterior cervical discectomy	256 A,A	260 A,A
>1 level anterior cervical discectomy	257 A,A	261 RA
1 level anterior cervical corpectomy	258 A,A	262 RA
>1 level anterior cervical corpectomy	259 A,A	263 RA

Summary. This section looks at utilization of anterior cervical plates for fusion. The use of anterior plating was always appropriate for discectomy or corpectomy regardless of number of levels fused. On the contrary, excluding a plate was considered rarely appropriate for a corpectomy of any sort or a multilevel discectomy. It was only considered appropriate to exclude an anterior plate for a one level discectomy.

SCENARIOS

Key

ACF	anterior cervical fusion
PCF	posterior cervical fusion
APCF	anterior and posterior cervical fusion
L	laminectomy
LF	laminoforaminotomy
FS	foraminal stenosis
CS	central stenosis
PC	psychosocial comorbidities
MC	medical comorbidities
SC	signal change in the cord

A,A	Appropriate with Agreement
A,D	Appropriate with Disagreement
U	Uncertain
RA	Rarely Appropriate

Note: Agreement or disagreement only applies to appropriate ratings.

SECTION I

Spondylosis without stenosis and with axial complaints of pain

	1 level	2 level	>2 level
ACF	1 U	4 U	7 U
PCF	2 U	5 RA	8 RA
APCF	3 U	6 U	9 RA

1. **ACF** is appropriate in patients with 1 level cervical spondylosis and complaints of axial pain without stenosis. RATING=U
2. **PCF** is appropriate in patients with 1 level cervical spondylosis and complaints of axial pain without stenosis. RATING=U
3. **APCF** is appropriate in patients with 1 level cervical spondylosis and complaints of axial pain without stenosis. RATING=U
4. **ACF** is appropriate in patients with 2 level cervical spondylosis and complaints of axial pain without stenosis. RATING=U
5. **PCF** is appropriate in patients with 2 level cervical spondylosis and complaints of axial pain without stenosis. RATING=RA

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6. **APCF** is appropriate in patients with 2 level cervical spondylosis and complaints of axial pain without stenosis. RATING=U
7. **ACF** is appropriate in patients with greater than 2 level cervical spondylosis and complaints of axial pain without stenosis. RATING=U
8. **PCF** is appropriate in patients with greater than 2 level cervical spondylosis and complaints of axial pain without stenosis. RATING=RA
9. **APCF** is appropriate in patients with greater than 2 level cervical spondylosis and complaints of axial pain without stenosis. RATING=RA
10. In patients undergoing ACF for greater than 2 levels for a degenerative condition without deformity, addition of posterior PCF is appropriate to improve the fusion rate. RATING=A,A
11. Patients with axial pain with cervical spondylosis without stenosis should not be considered for surgery until undergoing unsuccessful medical/interventional treatment for minimum of six months. RATING=A,A

Summary. Cervical fusion for axial neck pain without stenosis was never considered appropriate. There was a trend to be rarely appropriate for 2 or greater level fusions, whereas there was more uncertainty for 1 level fusions. Although uncertain, anterior procedures were overall favored over posterior or anterior and posterior procedures.

Key

ACF	anterior cervical fusion
PCF	posterior cervical fusion
APCF	anterior and posterior cervical fusion
L	laminectomy
LF	laminoforaminotomy
FS	foraminal stenosis
CS	central stenosis
PC	psychosocial comorbidities
MC	medical comorbidities
SC	signal change in the cord

A,A	Appropriate with Agreement
A,D	Appropriate with Disagreement
U	Uncertain
RA	Rarely Appropriate

Note: Agreement or disagreement only applies to appropriate ratings.

SECTION II

Fusion for patients with axial pain and spondylosis without stenosis

	Smoking	MC Poorly Controlled	MC Well Controlled	PC mild	PC Severe	Pseudo
1 level	12 RA	15 RA	18 U	21 U	24 RA	27 RA, 28 A,A
2 level	13 RA	16 RA	19 U	22 RA	25 RA	
>2 level	14 RA	17 RA	20 RA	23 RA	26 RA	

12. In patients who are actively smoking, it is appropriate to offer fusion for **1 level** cervical spondylosis **without stenosis** and with complaints of **axial pain**. RATING=RA

13. In patients who are actively smoking, it is appropriate to offer fusion for **2 level** cervical spondylosis **without stenosis** and with complaints of **axial pain**. RATING=RA

14. In patients who are actively smoking, it is appropriate to offer fusion for **greater than 2 level** cervical spondylosis **without stenosis** and with complaints of **axial pain**. RATING=RA

	MC Poorly Controlled	MC Well Controlled
1 level	15	18
2 level	16	19
>2 level	17	20

15. Patients with **medical comorbidity(ies) poorly controlled** are appropriate for fusion for **1 level** cervical spondylosis without stenosis and with complaints of axial pain.
RATING=**RA**
16. Patients with **medical comorbidity(ies) poorly controlled** are appropriate for fusion for **2 level** cervical spondylosis without stenosis and with complaints of axial pain.
RATING=**RA**
17. Patients with **medical comorbidity(ies) poorly controlled** are appropriate for fusion for **greater than 2 level** cervical spondylosis without stenosis and with complaints of axial pain. RATING=**RA**
18. Patients with **medical comorbidity(ies) with well controlled** disease are appropriate for fusion for **1 level** cervical spondylosis without stenosis and with complaints of axial pain. RATING=**U**
19. Patients with medical **comorbidity(ies) with well controlled** disease are appropriate for fusion for **2 level** cervical spondylosis without stenosis and with complaints of axial pain. RATING=**U**
20. Patients with **medical comorbidity(ies) with well controlled** disease are appropriate for fusion for **greater than 2 level** cervical spondylosis without stenosis and with complaints of axial pain. RATING=**RA**

	PC Mild	PC Severe
1 level	21	24
2 level	22	25
>2 level	23	26

21. Patients with **mild psychological comorbidity(ies)** (PC) are appropriate for fusion for **1 level** cervical spondylosis without stenosis and with complaints of axial pain. RATING=U
22. Patients with **mild psychological comorbidity(ies)** (PC) are appropriate for fusion for **2 level** cervical spondylosis without stenosis and with complaints of axial pain. RATING=RA
23. Patients with **mild PC** are appropriate for fusion for **greater than 2 level** cervical spondylosis without stenosis and with complaints of axial pain. RATING=RA
24. Patients with **severe PC** are appropriate for fusion for **1 level** cervical spondylosis without stenosis and with complaints of axial pain. RATING=RA
25. Patients with **severe PC** are appropriate for fusion for **2 level** cervical spondylosis without stenosis and with complaints of axial pain. RATING=RA
26. Patients with **severe PC** are appropriate for fusion for **greater than 2 level** cervical spondylosis without stenosis and with complaints of axial pain. RATING=RA

Pseudarthrosis

27. Patients with a history of prior cervical fusion and **asymptomatic pseudarthrosis** are appropriate for revision of the fusion. RATING=RA
28. Patients with a history of prior cervical fusion with persistent axial pain and **symptomatic pseudarthrosis** are appropriate for revision of the fusion. RATING=A,A

Summary. This section included the effect of comorbidities or the presence of a symptomatic pseudarthrosis in the treatment of axial neck pain without stenosis. Taken together with Section I the presence of smoking resulted in rarely appropriate ratings for fusion for axial neck pain,

even for 1 level disease. The same was true for the presence of poorly controlled medical or psychosocial comorbidities. In general, the presence of mild medical or psychosocial comorbidities did not change the rating.

Revision for symptomatic pseudarthrosis was considered appropriate, but fusion for asymptomatic pseudarthrosis was considered rarely appropriate. This assumes that the surgeon can determine that the source of the symptoms when present.

Key

ACF	anterior cervical fusion
PCF	posterior cervical fusion
APCF	anterior and posterior cervical fusion
L	laminectomy
LF	laminoforaminotomy
FS	foraminal stenosis
CS	central stenosis
PC	psychosocial comorbidities
MC	medical comorbidities
SC	signal change in the cord

A,A	Appropriate with Agreement
A,D	Appropriate with Disagreement
U	Uncertain
RA	Rarely Appropriate

Note: Agreement or disagreement only applies to appropriate ratings.

SECTION III
Foraminal stenosis

	1-2 level with radiculopathy	> 2 level with radiculopathy	1-2 level with axial pain	> 2 level with axial pain
ACF	29 A,A	30 A,A	31 U	32 RA

29. ACF with decompression is appropriate in patients with **1-2** level foraminal stenosis and concordant **radiculopathy**. RATING=A,A

30. ACF with decompression is appropriate in patients with **≥2** level foraminal stenosis and concordant **radiculopathy**. RATING=A,A

31. ACF with decompression is appropriate in patients with **1-2 level** foraminal stenosis and **axial pain** only. RATING=U

32. ACF with decompression is appropriate in patients with **≥2** level foraminal stenosis and **axial pain** only. RATING=RA

	Kyphosis	Lordosis
1-2 level L and PCF	33 A,A	37 A,A
>2 level L and PCF	34 A,A	38 A,A
1-2 level LF and PCF	35 A,A	39 U
>2 level LF and PCF	36 A,A	40 U

33. In patients with appropriate indications for laminectomy for 1-2 levels with foraminal stenosis, posterior fusion is appropriate in presence of regional cervical **kyphosis**.
RATING=A,A

34. In patients with appropriate indications for laminectomy for greater than 2 levels with foraminal stenosis, posterior fusion is appropriate in presence of regional cervical **kyphosis**. RATING=A,A

35. In patients with appropriate indications for laminoforaminotomy for 1-2 levels with foraminal stenosis, posterior fusion is appropriate in presence of regional cervical kyphosis. RATING=A,A

36. In patients with appropriate indications for laminoforaminotomy for greater than 2 levels with foraminal stenosis, posterior fusion is appropriate in presence of regional cervical kyphosis. RATING=A,A

37. In patients with appropriate indications for laminectomy for 1-2 levels with foraminal stenosis, posterior fusion is appropriate in presence of regional cervical lordosis.
RATING=A,A

38. In patients with appropriate indications for laminectomy for greater than 2 levels with foraminal stenosis, posterior fusion is appropriate in presence of regional cervical lordosis. RATING=A,A

39. In patients with appropriate indications for laminoforaminotomy for 1-2 levels with foraminal stenosis, posterior fusion is appropriate in presence of regional cervical lordosis. RATING=U

40. In patients with appropriate indications for laminoforaminotomy for greater than 2 levels with foraminal stenosis, posterior fusion is appropriate in presence of regional cervical lordosis. RATING=U

Summary. This section addressed the use of fusion in patients with foraminal stenosis and either radiculopathy or axial pain. In the presence of foraminal stenosis and concordant radiculopathy, both anterior and posterior surgery were considered appropriate regardless of the number of levels involved. If axial pain was present rather than radiculopathy, the indications for surgery were uncertain for 1-2 level disease, and rarely appropriate for greater than 2 level disease. For posterior procedures, when laminectomy was necessary, fusion was considered appropriate regardless of sagittal alignment. If decompression could be limited to a foraminotomy, fusion was considered appropriate in the presence of kyphosis, but uncertain if lordosis was present.

Key

ACF anterior cervical fusion
PCF posterior cervical fusion
APCF anterior and posterior cervical fusion
L laminectomy
LF laminoforaminotomy
FS foraminal stenosis
CS central stenosis
PC psychosocial comorbidities
MC medical comorbidities
SC signal change in the cord

A,A Appropriate with Agreement
A,D Appropriate with Disagreement
U Uncertain
RA Rarely Appropriate

Note: Agreement or disagreement only applies to appropriate ratings.

SECTION IV

Cervical fusion for foraminal stenosis

	Smoking	MC Poorly Controlled	MC Controlled	PC Mild	PC Severe	Pseudo
1 to 2 level with radiculopathy	41 A,A	45 U	49 A,A	53 A,A	57 A,A	61 A,A
>2 level with radiculopathy	42 A,A	46 U	50 A,A	54 A,A	58 A,D	
1 to 2 level with axial pain	43 RA	47 RA	51 U	55 U	59 RA	62 A,A
>2 level with axial pain	44 RA	48 RA	52 RA	56 RA	60 RA	

41. In patients who are actively smoking, it is appropriate to offer fusion for 1-2 level cervical foraminal stenosis with concordant **radiculopathy**. RATING=A,A
42. In patients who are actively smoking, it is appropriate to offer fusion for greater than 2 level cervical foraminal stenosis with concordant **radiculopathy**. RATING=A,A
43. In patients who are actively smoking, it is appropriate to offer fusion for 1-2 level cervical foraminal stenosis with **axial** pain only. RATING=RA

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44. In patients who are actively smoking, it is appropriate to offer fusion for greater than 2 level cervical foraminal stenosis with **axial** pain only. RATING=**RA**

Key

ACF anterior cervical fusion
PCF posterior cervical fusion
APCF anterior and posterior cervical fusion
L laminectomy
LF laminoforaminotomy
FS foraminal stenosis
CS central stenosis
PC psychosocial comorbidities
MC medical comorbidities
SC signal change in the cord

A,A Appropriate with Agreement
A,D Appropriate with Disagreement
U Uncertain
RA Rarely Appropriate

Note: Agreement or disagreement only applies to appropriate ratings.

	MC Poorly Controlled	MC Controlled
1-2 level with radiculopathy	45	49
>2 level with radiculopathy	46	50
1-2 level with axial pain	47	51
>2 level with axial pain	48	52

45. Patients with medical comorbidity(ies) **poorly controlled** are appropriate for fusion for 1-2 level cervical foraminal stenosis with concordant **radiculopathy**. RATING=U
46. Patients with medical comorbidity(ies) **poorly controlled** are appropriate for fusion for greater than 2 level cervical foraminal stenosis with concordant **radiculopathy**. RATING=U
47. Patients with medical comorbidity(ies) **poorly controlled** are appropriate for fusion for 1-2 level cervical foraminal stenosis with **axial** pain only. RATING=**RA**

48. Patients with medical comorbidity(ies) **poorly controlled** are appropriate for fusion for greater than 2 level cervical foraminal stenosis with **axial** pain only. RATING=**RA**
49. Patients with medical comorbidity(ies) **controlled** are appropriate for fusion for 1-2 level cervical foraminal stenosis with concordant **radiculopathy**. RATING=A,A
50. Patients with medical comorbidity(ies) **controlled** are appropriate for fusion for greater than 2 level cervical foraminal stenosis with concordant **radiculopathy**. RATING=A,A
51. Patients with medical comorbidity(ies) **controlled** are appropriate for fusion for 1-2 level cervical foraminal stenosis with **axial** pain only. RATING=U
52. Patients with medical comorbidity(ies) **controlled** are appropriate for fusion for greater than 2 level cervical foraminal stenosis with **axial** pain only. RATING=**RA**

	PC Mild	PC Severe
1-2 level with radiculopathy	53	57
>2 level with radiculopathy	54	58
1-2 level with axial pain	55	59
>2 level with axial pain	56	60

53. Patients with **mild** psychosocial comorbidities (PC) are appropriate for fusion for 1-2 level cervical foraminal stenosis (FS) and complaints of concordant **radiculopathy**. RATING=A,A
54. Patients with **mild** PC are appropriate for fusion for greater than 2 level cervical FS and complaints of concordant **radiculopathy**. RATING=A,A
55. Patients with **mild** PC are appropriate for fusion for 1-2 level cervical FS and complaints of **axial** pain only. RATING=U
56. Patients with **mild** PC are appropriate for fusion for greater than 2 level cervical FS and complaints of **axial** pain only. RATING=**RA**

57. Patients with **severe** PC are appropriate for fusion for 1-2 level cervical FS and complaints of concordant **radiculopathy**. RATING=A,A
58. Patients with **severe** PC are appropriate for fusion for greater than 2 level cervical FS and complaints of concordant **radiculopathy**. RATING= A,D
59. Patients with **severe** PC are appropriate for fusion for 1-2 level cervical FS and complaints of **axial** pain only. RATING=**RA**
60. Patients with **severe** PC are appropriate for fusion for greater than 2 level cervical FS and complaints of **axial** pain only. RATING=**RA**

Pseudarthrosis

61. Patients with a history of prior cervical fusion and **pseudarthrosis and FS** at that level with **concordant radiculopathy** are appropriate for revision of the fusion. RATING=A,A
62. Patients with a history of prior cervical fusion and **pseudarthrosis and FS** at that level with **axial pain** only are appropriate for revision of the fusion. RATING=A,A
63. Patients with a history of prior cervical fusion and **pseudarthrosis and FS** at that level with **no symptoms** are appropriate for revision of the fusion. RATING=**RA**

Summary. This section addressed the effect of comorbidities on the role of fusion for patients with foraminal stenosis with radiculopathy or axial pain. Comorbidities had less of an effect on decision-making for symptoms related to foraminal stenosis than for the scenarios without stenosis (Section II). Again, for 1 or 2 level disease with axial pain, fusion was considered rarely appropriate in the presence of severe psychosocial or medical comorbidities as well as smoking, and uncertain if medical or psychosocial factors were mild. On the other hand, if radiculopathy was present, fusion remained appropriate in all cases except for the presence of severe medical comorbidities, where fusion was rated as rarely appropriate. Interestingly, severe psychosocial comorbidity did not affect appropriateness as much in this circumstance, although there was disagreement for greater than 2 level disease only. Appropriateness for surgery for pseudarthrosis only when symptomatic remained consistent.

Key

ACF anterior cervical fusion
PCF posterior cervical fusion
APCF anterior and posterior cervical fusion
L laminectomy
LF laminoforaminotomy
FS foraminal stenosis
CS central stenosis
PC psychosocial comorbidities
MC medical comorbidities
SC signal change in the cord

A,A Appropriate with Agreement
A,D Appropriate with Disagreement
U Uncertain
RA Rarely Appropriate

Note: Agreement or disagreement only applies to appropriate ratings.

SECTION V

**Cervical fusion with stenosis (FS or CS) due to spondylosis or disc herniation
FIRST SYMPTOMATIC EPISODE**

	Symptom Onset	6 Wks to 6 Mos Rx	> 6 Mos Rx
FS + radiculopathy	64 RA	65 A,A	66 A,A
FS + radiculopathy with severe neurological deficit	67 A,A	68 A,A	69 A,A
FS + axial pain	70 RA	71 RA	72 U
CS (no SC) + radiculopathy	73 RA	74 A,A	75 A,A
CS (no SC) + radiculopathy + severe neurological deficit	76 A,A	77 A,A	78 A,A
CS (no SC) + axial pain	79 RA	80 U	81 U
CS (no SC) + myelopathy	82 A,A	83 A,A	84 A,A
CS (SC) + radiculopathy	85 A,A	86 A,A	87 A,A
CS (SC) + radiculopathy + severe neurological deficit	88 A,A	89 A,A	90 A,A
CS (SC) + axial pain	91 U	92 A,A	93 A,A
CS (SC) + myelopathy	94 A,A	95 A,A	96 A,A

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	Symptom Onset	6Wks to 6 Mos Rx	> 6Mos Rx
FS + radiculopathy	64	65	66
FS + radiculopathy with severe neurological deficit	67	68	69
FS + axial pain	70	71	72

First symptomatic episode

64. Fusion for patients with **foraminal stenosis** and concordant **radiculopathy** is appropriate at the **onset** of symptoms. RATING=**RA**
65. Fusion for patients with **foraminal stenosis** and concordant **radiculopathy** is appropriate after **failed medical/interventional treatment for 6 weeks to 6 months**. RATING=A,A
66. Fusion for patients with **foraminal stenosis** and concordant **radiculopathy** is appropriate after failed **medical/interventional treatment for greater than 6 months**. RATING=A,A
67. Fusion for patients with **foraminal stenosis** and concordant **radiculopathy and severe neurological deficit** is appropriate at the **onset** of symptoms. RATING=A,A
68. Fusion for patients with **foraminal stenosis** and concordant **radiculopathy and severe neurological deficit** is appropriate after **failed medical/interventional treatment for 6 weeks to 6 months**. RATING=A,A
69. Fusion for patients with **foraminal stenosis** and concordant **radiculopathy and severe neurological deficit** is appropriate after failed **medical/interventional treatment for greater than 6 months**. RATING=A,A
70. Fusion for patients with **foraminal stenosis** and **axial** pain only is appropriate at the **onset** of symptoms. RATING=**RA**
71. Fusion for patients with **foraminal stenosis** and **axial** pain only is appropriate after failed medical/interventional treatment for **6 weeks to 6 months**. RATING=**RA**

72. Fusion for patients with **foraminal stenosis** and **axial** pain is appropriate after failed medical/interventional treatment for **greater than 6 months**. RATING=U

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MC medical comorbidities
SC signal change in the cord

A,A Appropriate with Agreement
A,D Appropriate with Disagreement
U Uncertain
RA Rarely Appropriate

Note: Agreement or disagreement only applies to appropriate ratings.

	Symptom Onset	6 Wks to 6 Mos Rx	>6 Mos Rx
CS (no SC) + radiculopathy	73	74	75
CS (no SC) + radiculopathy + severe neuro deficit	76	77	78
CS (no SC) + axial pain	79	80	81
CS (no SC) + myelopathy	82	83	84

First Symptomatic Episode

73. Fusion for patients with **central stenosis without signal change** in the cord plus/minus foraminal stenosis and concordant **radiculopathy** is appropriate at the **onset** of symptoms. RATING=RA

74. Fusion for patients with **central stenosis without signal change** in the cord plus/minus foraminal stenosis and concordant **radiculopathy** is appropriate after failed medical/interventional treatment for **6 weeks to 6 months**. RATING=A,A

75. Fusion for patients with **central stenosis without signal change in the cord** plus/minus foraminal stenosis and concordant **radiculopathy** is appropriate after failed medical/interventional treatment for greater than **6 months**. RATING=A,A
76. Fusion for patients with **central stenosis without signal change** in the cord plus/minus foraminal stenosis and concordant **radiculopathy and severe neurological deficit** is appropriate at the **onset** of symptoms. RATING=A,A
77. Fusion for patients with **central stenosis without signal change** in the cord plus/minus foraminal stenosis and concordant **radiculopathy and severe neurological deficit** is appropriate after failed medical/interventional treatment for **6 weeks to 6 months**. RATING=A,A
78. Fusion for patients with **central stenosis without signal change in the cord** plus/minus foraminal stenosis and concordant **radiculopathy and severe neurological deficit** is appropriate after failed medical/interventional treatment for greater than **6 months**. RATING=A,A
79. Fusion for patients with **central stenosis without signal change** in the cord plus/minus foraminal stenosis and **axial** pain only is appropriate at the **onset** of symptoms. RATING=RA
80. Fusion for patients with **central stenosis without signal change** in the cord plus/minus foraminal stenosis and **axial** pain only is appropriate after failed medical/interventional treatment for **6 weeks to 6 months**. RATING=U
81. Fusion for patients with **central stenosis without signal change** in the cord plus/minus foraminal stenosis and **axial** pain only is appropriate after failed medical/interventional treatment for greater than **6 months**. RATING=U
82. Fusion for patients with **central stenosis without signal change** in the cord plus/minus foraminal stenosis and **myelopathy** is appropriate at the **onset** of symptoms. RATING=A,A
83. Fusion for patients with **central stenosis without signal change** in the cord plus/minus foraminal stenosis and **myelopathy** is appropriate after failed medical/interventional treatment for **6 weeks to 6 months**. RATING=A,A
84. Fusion for patients with **central stenosis without signal change** in the cord plus/minus foraminal stenosis and **myelopathy** is appropriate after failed medical/interventional treatment for greater than **6 months**. RATING=A,A

Key

ACF	anterior cervical fusion
PCF	posterior cervical fusion
APCF	anterior and posterior cervical fusion
L	laminectomy
LF	laminoforaminotomy
FS	foraminal stenosis
CS	central stenosis
PC	psychosocial comorbidities
MC	medical comorbidities
SC	signal change in the cord

A,A	Appropriate with Agreement
A,D	Appropriate with Disagreement
U	Uncertain
RA	Rarely Appropriate

Note: Agreement or disagreement only applies to appropriate ratings.

	Symptom Onset	6 Wks to 6 Mos Rx	> 6 Mos Rx
CS (SC) + radiculopathy	85	86	87
CS (SC) + radiculopathy + severe neuro deficit	88	89	90
CS (SC) + axial pain	91	92	93
CS (SC) + myelopathy	94	95	96

First Symptomatic Episode

85. Fusion for patients with **central stenosis with signal change** in the cord plus/minus foraminal stenosis and concordant **radiculopathy** is appropriate at the **onset** of symptoms. RATING=A,A

86. Fusion for patients with **central stenosis with signal change** in the cord plus/minus foraminal stenosis and concordant **radiculopathy** is appropriate after failed medical/interventional treatment for **6 weeks to 6 months**. RATING=A,A

87. Fusion for patients with **central stenosis with signal change** in the cord plus/minus foraminal stenosis and concordant **radiculopathy** is appropriate after failed medical/interventional treatment for greater than **6 months**. RATING=A,A
88. Fusion for patients with **central stenosis with signal change** in the cord plus/minus foraminal stenosis and concordant **radiculopathy with severe neurological deficit** is appropriate at the **onset** of symptoms. RATING=A,A
89. Fusion for patients with **central stenosis with signal change** in the cord plus/minus foraminal stenosis and concordant **radiculopathy with severe neurological deficit** is appropriate after failed medical/interventional treatment for **6 weeks to 6 months**. RATING=A,A
90. Fusion for patients with **central stenosis with signal change** in the cord plus/minus foraminal stenosis and concordant **radiculopathy with severe neurological deficit** is appropriate after failed medical/interventional treatment for greater than **6 months**. RATING=A,A
91. Fusion for patients with **central stenosis with signal change** in the cord plus/minus foraminal stenosis and **axial** pain only is appropriate at the **onset** of symptoms. RATING=U
92. Fusion for patients with **central stenosis with signal change** in the cord plus/minus foraminal stenosis and **axial** pain only is appropriate after failed medical/interventional treatment for **6 weeks to 6 months**. RATING=A,A
93. Fusion for patients with **central stenosis with signal change** in the cord plus/minus foraminal stenosis and **axial** pain only is appropriate after failed medical/interventional treatment for greater than **6 months**. RATING=A,A
94. Fusion for patients with **central stenosis with signal change** in the cord plus/minus foraminal stenosis and **myelopathy** is appropriate at the **onset** of symptoms. RATING=A,A
95. Fusion for patients with **central stenosis with signal change** in the cord plus/minus foraminal stenosis and **myelopathy** is appropriate after failed medical/interventional treatment for **6 weeks to 6 months**. RATING=A,A
96. Fusion for patients with **central stenosis with signal change** in the cord plus/minus foraminal stenosis and **myelopathy** is appropriate after failed medical/interventional treatment for greater than **6 months**. RATING=A,A

Key

ACF anterior cervical fusion
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MC medical comorbidities
SC signal change in the cord

A,A Appropriate with Agreement
A,D Appropriate with Disagreement
U Uncertain
RA Rarely Appropriate

Note: Agreement or disagreement only applies to appropriate ratings.

**Cervical fusion with stenosis (FS or CS) due to spondylosis or disc herniation –
RECURRENT symptomatic episodes of radiculopathy, axial symptoms or myelopathy**

	Symptom Onset	6 Wks to 6 Mos Rx	> 6 Mos Rx
FS + radiculopathy	97 U	98 A,A	99 A,A
FS + radiculopathy + severe neuro deficit	100 A,A	101 A,A	102 A,A
FS + axial pain	103 RA	104 U	105 U
CS (no SC) + radiculopathy	106 U	107 A,A	108 A,A
CS (no SC) + radiculopathy + severe neruo deficit	109 A,A	110 A,A	111 A,A
CS (no SC) + axial pain	112 RA	113 U	114 A,A
CS (no SC) + myelopathy	115 A,A	116 A,A	117 A,A
CS (SC) + radiculopathy	118 A,A	119 A,A	120 A,A
CS (SC) + radiculopathy + severe neruo deficit	121 A,A	122 A,A	123 A,A
CS (SC) + axial pain	124 U	125 A,A	126 A,A
CS (SC) + myelopathy	127 A,A	128 A,A	129 A,A

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Key

ACF	anterior cervical fusion
PCF	posterior cervical fusion
APCF	anterior and posterior cervical fusion
L	laminectomy
LF	laminoforaminotomy
FS	foraminal stenosis
CS	central stenosis
PC	psychosocial comorbidities
MC	medical comorbidities
SC	signal change in the cord

A,A	Appropriate with Agreement
A,D	Appropriate with Disagreement
U	Uncertain
RA	Rarely Appropriate

Note: Agreement or disagreement only applies to appropriate ratings.

	Symptom Onset	6 Wks to 6 Mos Rx	> 6 Mos Rx
FS + radiculopathy	97	98	99
FS + radiculopathy + severe neuro deficit	100	101	102
FS + axial pain	103	104	105

Recurrent symptomatic episode

97. Fusion for patients with **foraminal stenosis** and **recurrent concordant radiculopathy** is appropriate at the **onset** of symptoms. RATING=U
98. Fusion for patients with **foraminal stenosis** and **recurrent concordant radiculopathy** is appropriate after **failed medical/interventional treatment for 6 weeks to 6 months**. RATING=A,A
99. Fusion for patients with **foraminal stenosis** and **recurrent concordant radiculopathy** is appropriate after failed **medical/interventional treatment for greater than 6 months**. RATING=A,A
100. Fusion for patients with **foraminal stenosis** and **recurrent concordant radiculopathy with severe neurological deficit** is appropriate at the **onset** of symptoms. RATING=A,A

101. Fusion for patients with **foraminal stenosis** and **recurrent concordant radiculopathy with severe neurological deficit** is appropriate after **failed medical/interventional treatment for 6 weeks to 6 months**. RATING=A,A
102. Fusion for patients with **foraminal stenosis** and **recurrent concordant radiculopathy with severe neurological deficit** is appropriate after **failed medical/interventional treatment for greater than 6 months**. RATING=A,A
103. Fusion for patients with **foraminal stenosis** and **recurrent axial** pain only is appropriate at the **onset** of symptoms. RATING=RA
104. Fusion for patients with **foraminal stenosis** and **recurrent axial** pain only is appropriate after failed medical/interventional treatment for **6 weeks to 6 months**. RATING=U
105. Fusion for patients with **foraminal stenosis** and **recurrent axial** pain is appropriate after failed medical/interventional treatment for **greater than 6 months**. RATING=U

	Symptom Onset	6 Wks to 6 Mos Rx	> 6 Mos Rx
CS (no SC) + radiculopathy	106	107	108
CS (no SC) + radiculopathy + severe neruo deficit	109	110	111
CS (no SC) + axial pain	112	113	114
CS (no SC) + myelopathy	115	116	117

Recurrent symptomatic episode

106. Fusion for patients with **central stenosis without signal change** in the cord plus/minus foraminal stenosis and **recurrent** concordant **radiculopathy** is appropriate at the **onset** of symptoms. RATING=U
107. Fusion for patients with **central stenosis without signal change** in the cord plus/minus foraminal stenosis and **recurrent** concordant **radiculopathy** is appropriate after failed medical/interventional treatment for **6 weeks to 6 months**. RATING=A,A

108. Fusion for patients with **central stenosis without signal change** in the cord plus/minus foraminal stenosis and **recurrent** concordant **radiculopathy** is appropriate after failed medical/interventional treatment for greater than **6 months**. RATING=A,A
109. Fusion for patients with **central stenosis without signal change** in the cord plus/minus foraminal stenosis and **recurrent** concordant **radiculopathy with severe neurologic deficit** is appropriate at the **onset** of symptoms. RATING=A,A
110. Fusion for patients with **central stenosis without signal change** in the cord plus/minus foraminal stenosis and **recurrent** concordant **radiculopathy with severe neurologic deficit** is appropriate after failed medical/interventional treatment for **6 weeks to 6 months**. RATING=A,A
111. Fusion for patients with **central stenosis without signal change** in the cord plus/minus foraminal stenosis and **recurrent** concordant **radiculopathy with severe neurologic deficit** is appropriate after failed medical/interventional treatment for greater than **6 months**. RATING=A,A
112. Fusion for patients with **central stenosis without signal change** in the cord plus/minus foraminal stenosis and **recurrent axial** pain only is appropriate at the **onset** of symptoms. RATING=RA
113. Fusion for patients with **central stenosis without signal change** in the cord plus/minus foraminal stenosis and **recurrent axial** pain only is appropriate after failed medical/interventional treatment for **6 weeks to 6 months**. RATING=U
114. Fusion for patients with **central stenosis without signal change** in the cord plus/minus foraminal stenosis and **recurrent axial** pain only is appropriate after failed medical/interventional treatment for greater than **6 months**. RATING=A,A
115. Fusion for patients with **central stenosis without signal change** in the cord plus/minus foraminal stenosis and **recurrent myelopathy** is appropriate at the **onset** of symptoms. RATING=A,A
116. Fusion for patients with **central stenosis without signal change** in the cord plus/minus foraminal stenosis and **recurrent myelopathy** is appropriate after failed medical/interventional treatment for **6 weeks to 6 months**. RATING=A,A
117. Fusion for patients **with central stenosis without signal change** in the cord plus/minus foraminal stenosis and **recurrent myelopathy** is appropriate after failed medical/interventional treatment for greater than **6 months**. RATING=A,A

Key

ACF	anterior cervical fusion
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L	laminectomy
LF	laminoforaminotomy
FS	foraminal stenosis
CS	central stenosis
PC	psychosocial comorbidities
MC	medical comorbidities
SC	signal change in the cord

A,A	Appropriate with Agreement
A,D	Appropriate with Disagreement
U	Uncertain
RA	Rarely Appropriate

Note: Agreement or disagreement only applies to appropriate ratings.

	Symptom Onset	6 Wks to 6 Mos Rx	>6 Mos Rx
CS (SC) + radiculopathy	118	119	120
CS (SC) + radiculopathy + severe neruo deficit	121	122	123
CS (SC) + axial pain	124	125	126
CS (SC) + myelopathy	127	128	129

Recurrent symptomatic episode

118. Fusion for patients with **central stenosis with signal change** in the cord plus/minus foraminal stenosis and **recurrent** concordant **radiculopathy** is appropriate at the **onset** of symptoms. RATING=A,A
119. Fusion for patients with **central stenosis with signal change** in the cord plus/minus foraminal stenosis and **recurrent** concordant **radiculopathy** is appropriate after failed medical/interventional treatment for **6 weeks to 6 months**. RATING=A,A
120. Fusion for patients with **central stenosis with signal change** in the cord plus/minus foraminal stenosis and **recurrent** concordant **radiculopathy** is appropriate after failed medical/interventional treatment for greater than **6 months**. RATING=A,A

121. Fusion for patients with **central stenosis with signal change** in the cord plus/minus foraminal stenosis and **recurrent** concordant **radiculopathy with severe neurological deficit** is appropriate at the **onset** of symptoms. RATING=A,A
122. Fusion for patients with **central stenosis with signal change** in the cord plus/minus foraminal stenosis and **recurrent** concordant **radiculopathy with severe neurological deficit** is appropriate after failed medical/interventional treatment for **6 weeks to 6 months**. RATING=A,A
123. Fusion for patients with **central stenosis with signal change** in the cord plus/minus foraminal stenosis and **recurrent** concordant **radiculopathy with severe neurological deficit** is appropriate after failed medical/interventional treatment for greater than **6 months**. RATING=A,A
124. Fusion for patients with **central stenosis with signal change** in the cord plus/minus foraminal stenosis and **recurrent axial** pain only is appropriate at the **onset** of symptoms. RATING=U
125. Fusion for patients with **central stenosis with signal change** in the cord plus/minus foraminal stenosis and **recurrent axial** pain only is appropriate after failed medical/interventional treatment for **6 weeks to 6 months**. RATING=A,A
126. Fusion for patients with central **stenosis with signal change** in the cord plus/minus foraminal stenosis and **recurrent axial** pain only is appropriate after failed medical/interventional treatment for greater than **6 months**. RATING=A,A
127. Fusion for patients with **central stenosis with signal change** in the cord plus/minus foraminal stenosis and **recurrent myelopathy** is appropriate at the **onset** of symptoms. RATING=A,A
128. Fusion for patients with **central stenosis with signal change** in the cord plus/minus foraminal stenosis and **recurrent myelopathy** is appropriate after failed medical/interventional treatment for **6 weeks to 6 months**. RATING=A,A
129. Fusion for patients with **central stenosis with signal change** in the cord plus/minus foraminal stenosis and **recurrent myelopathy** is appropriate after failed medical/interventional treatment for greater than **6 months**. RATING=A,A

Summary. The key variable for this section was timing for surgery. The first group was fully comprised of patients presenting with symptoms for the first time. For those patients with FS and radiculopathy without severe neurological deficit, immediate surgery was rarely appropriate. For those presenting with severe deficit, immediate surgery was appropriate. After 6 weeks or 6 months of care, surgery was appropriate in all cases. If the episode was recurrent, immediate surgery for FS without severe neurological deficit was uncertain rather than rarely appropriate. Otherwise, recommendations were the same as first time episode.

For a first time episode of axial pain with FS, fusion was rarely appropriate for at least the first 6 months, at which time indications were uncertain. For recurrent episodes, fusion was uncertain after 6 weeks. For a first-time episode and CS without signal change in the cord with axial pain, the timetable was shifted slightly, but appropriateness for surgery was still uncertain at best. Fusion was considered rarely appropriate at time of onset and uncertain beyond 6 weeks of care. If the episode was recurrent, recommendations were the same until 6 months when fusion was appropriate. For the same scenarios, but with the presence of signal change in the cord, surgery was considerably more favorable. Fusion was considered uncertain at immediate onset but appropriate after 6 weeks. This was true for first time as well as recurrent episodes.

For a first-time episode and central stenosis with radiculopathy without signal change in the cord, fusion was rarely appropriate at onset and then appropriate after 6 weeks. For recurrent episodes, fusion was uncertain at onset, with similar indications otherwise. If there was presence of severe neurological deficit with the radiculopathy or if there was myelopathy, surgery was appropriate from the onset. For all scenarios with CS with signal change in the cord and either radiculopathy or myelopathy, fusion was appropriate at the onset for first-time as well as recurrent episodes.

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A,D Appropriate with Disagreement
U Uncertain
RA Rarely Appropriate

Note: Agreement or disagreement only applies to appropriate ratings.

SECTION VI

Central stenosis plus/minus foraminal stenosis plus/minus signal change in cord for all scenarios 130-153.

ALL SCENARIOS assume PRESENCE of SIGNAL CHANGE IN CORD

	ACF w/Kyphosis	PCF w/Kyphosis	ACF w/Lordosis	PCF w/Lordosis
1-2 level + SC + myelopathy	130 A,A	136 A,A	142 A,A	148 A,A
>2 level + SC + myelopathy	131 A,A	137 A,A	143 A,A	149 A,A
1-2 level + SC + radiculopathy	132 A,A	138 A,A	144 A,A	150 A,A
>2 level + SC + radiculopathy	133 A,A	139 A,A	145 A,A	151 A,A
1-2 level + SC + axial pain	134 U	140 U	146 A,A	152 U
>2 level + SC + axial pain	135 U	141 A,A	147 A,A	153 U

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A,D Appropriate with Disagreement
U Uncertain
RA Rarely Appropriate

Note: Agreement or disagreement only applies to appropriate ratings.

	ACF w/Kyphosis	PCF w/Kyphosis
1-2 level + SC + myelopathy	130	136
>2 level + SC + myelopathy	131	137
1-2 level + SC + radiculopathy	132	138
>2 level + SC + radiculopathy	133	139
1-2 level + SC +axial pain	134	140
>2 level + SC + axial pain	135	141

Positive signal change in cord

130. ACF with decompression is appropriate for patients with central stenosis and myelopathy with regional kyphosis and 1-2 level disease. RATING=A,A
131. ACF with decompression is appropriate for patients with central stenosis and myelopathy with regional kyphosis and greater than two level disease. RATING=A,A
132. ACF with decompression is appropriate for patients with central stenosis and radiculopathy with regional kyphosis and 1-2 level disease. RATING=A,A

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- 133. ACF with decompression is appropriate for patients with central stenosis and radiculopathy with regional kyphosis and greater than two level disease. RATING=A,A
- 134. ACF with decompression is appropriate for patients with central stenosis and axial pain only with regional kyphosis and 1-2 level disease. RATING=U
- 135. ACF with decompression is appropriate for patients with central stenosis and axial pain only with regional kyphosis and greater than two level disease. RATING=U
- 136. PCF with decompression is appropriate for patients with central stenosis and myelopathy with regional kyphosis and 1-2 level disease. RATING=A,A
- 137. PCF with decompression is appropriate for patients with central stenosis and myelopathy with regional kyphosis and greater than two level disease. RATING=A,A
- 138. PCF with decompression is appropriate for patients with central stenosis and radiculopathy with regional kyphosis and 1-2 level disease. RATING=A,A
- 139. PCF with decompression is appropriate for patients with central stenosis and radiculopathy with regional kyphosis and greater than two level disease. RATING=A,A
- 140. PCF with decompression is appropriate for patients with central stenosis and axial pain only with regional kyphosis and 1-2 level disease. RATING=U
- 141. PCF with decompression is appropriate for patients with central stenosis and axial pain only with regional kyphosis and greater than two level disease. RATING=A,A

Key

ACF *anterior cervical fusion*
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APCF *anterior and posterior cervical fusion*
L *laminectomy*
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FS *foraminal stenosis*
CS *central stenosis*
PC *psychosocial comorbidities*
MC *medical comorbidities*
SC *signal change in the cord*

A,A *Appropriate with Agreement*
A,D *Appropriate with Disagreement*
U *Uncertain*
RA *Rarely Appropriate*

Note: Agreement or disagreement only applies to appropriate ratings.

	ACF w/Lordosis	PCF w/Lordosis
1-2 level + SC + myelopathy	142	148
>2 level + SC + myelopathy	143	149
1-2 level + SC + radiculopathy	144	150
>2 level + SC + radiculopathy	145	151
1-2 level + SC + axial pain	146	152
>2 level + SC + axial pain	147	153

Positive signal change in cord

142. ACF with decompression is appropriate for patients with central stenosis and myelopathy with regional lordosis and 1-2 level disease. RATING=A,A
143. ACF with decompression is appropriate for patients with central stenosis and myelopathy with regional lordosis and greater than two level disease. RATING=A,A

144. ACF with decompression is appropriate for patients with central stenosis and radiculopathy with regional lordosis and 1-2 level disease. RATING=A,A
145. ACF with decompression is appropriate for patients with central stenosis and radiculopathy with regional lordosis and greater than two level disease. RATING=A,A
146. ACF with decompression is appropriate for patients with central stenosis and axial pain only with regional lordosis and 1-2 level disease. RATING=A,A
147. ACF with decompression is appropriate for patients with central stenosis and axial pain only with regional lordosis and greater than two level disease. RATING=U
148. PCF with decompression is appropriate for patients with central stenosis and myelopathy with regional lordosis and 1-2 level disease. RATING=A,A
149. PCF with decompression is appropriate for patients with central stenosis and myelopathy with regional lordosis and greater than two level disease. RATING=A,A
150. PCF with decompression is appropriate for patients with central stenosis and concordant radiculopathy with regional lordosis and 1-2 level disease. RATING=A,A
151. PCF with decompression is appropriate for patients with central stenosis and concordant radiculopathy with regional lordosis and greater than two level disease. RATING=A,A
152. PCF with decompression is appropriate for patients with central stenosis and axial pain only with regional lordosis and 1-2 level disease. RATING=U
153. PCF with decompression is appropriate for patients with central stenosis and axial pain only with regional lordosis and greater than two level disease. RATING=U

Key

ACF *anterior cervical fusion*
PCF *posterior cervical fusion*
APCF *anterior and posterior cervical fusion*
L *laminectomy*
LF *laminoforaminotomy*
FS *foraminal stenosis*
CS *central stenosis*
PC *psychosocial comorbidities*
MC *medical comorbidities*
SC *signal change in the cord*

A,A *Appropriate with Agreement*
A,D *Appropriate with Disagreement*
U *Uncertain*
RA *Rarely Appropriate*

Note: Agreement or disagreement only applies to appropriate ratings.

Central stenosis plus/minus foraminal stenosis with NO signal change in cord for all scenarios 154-177

ALL SCENARIOS assume ABSENCE of SIGNAL CHANGE IN CORD

	ACF w/Kyphosis	PCF w/Kyphosis	ACF w/Lordosis	PCF w/Lordosis
1-2 level myelopathy	154 A,A	160 A,A	166 A,A	172 A,A
>2 level myelopathy	155 A,A	161 A,A	167 A,A	173 A,A
1-2 level with radiculopathy	156 A,A	162 A,A	168 A,A	174 A,A
>2 level with radiculopathy	157 A,A	163 A,A	169 A,A	175 A,A
1-2 level axial pain	158 U	164 U	170 U	176 U
>2 level axial pain	159 U	165 U	171 U	177 U

	ACF w/ Kyphosis	PCF w/ Kyphosis
1-2 level myelopathy	154	160
>2 level myelopathy	155	161
1-2 level with radiculopathy	156	162
>2 level with radiculopathy	157	163
1-2 level axial pain	158	164
>2 level axial pain	159	165

No signal change in cord

154. ACF with decompression is appropriate for patients with central stenosis and myelopathy with regional kyphosis and 1-2 level disease. RATING=A,A
155. ACF with decompression is appropriate for patients with central stenosis and myelopathy with regional kyphosis and greater than 2 level disease. RATING=A,A
156. ACF with decompression is appropriate for patients with central stenosis and radiculopathy with regional kyphosis and 1-2 level disease. RATING=A,A
157. ACF with decompression is appropriate for patients with central stenosis and radiculopathy with regional kyphosis and greater than 2 level disease. RATING=A,A
158. ACF with decompression is appropriate for patients with central stenosis and axial pain only with regional kyphosis and 1-2 level disease. RATING=U
159. ACF with decompression is appropriate for patients with central stenosis and axial pain only with regional kyphosis and greater than 2 level disease. RATING=U
160. PCF with decompression is appropriate for patients with central stenosis and myelopathy with regional kyphosis and 1-2 level disease. RATING=A,A
161. PCF with decompression is appropriate for patients with central stenosis and myelopathy with regional kyphosis and greater than 2 level disease. RATING=A,A

162. PCF with decompression is appropriate for patients with central stenosis and radiculopathy with regional kyphosis and 1-2 level disease. RATING=A,A
163. PCF with decompression is appropriate for patients with central stenosis and radiculopathy with regional kyphosis and greater than two level disease. RATING=A,A
164. PCF with decompression is appropriate for patients with central stenosis and axial pain only with regional kyphosis and 1-2 level disease. RATING=U
165. PCF with decompression is appropriate for patients with central stenosis and axial pain only with regional kyphosis and greater than two level disease. RATING=U

Key

ACF anterior cervical fusion
PCF posterior cervical fusion
APCF anterior and posterior cervical fusion
L laminectomy
LF laminoforaminotomy
FS foraminal stenosis
CS central stenosis
PC psychosocial comorbidities
MC medical comorbidities
SC signal change in the cord

A,A Appropriate with Agreement
A,D Appropriate with Disagreement
U Uncertain
RA Rarely Appropriate

Note: Agreement or disagreement only applies to appropriate ratings.

	ACF w/Lordosis	PCF w/Lordosis
1-2 level myelopathy	166	172
>2 level myelopathy	167	173
1-2 level with radiculopathy	168	174
>2 level with radiculopathy	169	175
1-2 level axial pain	170	176
>2 level axial pain	171	177

No signal change in cord

166. ACF with decompression is appropriate for patients with central stenosis and myelopathy with regional lordosis and 1-2 level disease. RATING=A,A
167. ACF with decompression is appropriate for patients with central stenosis and myelopathy with regional lordosis and greater than 2 level disease. RATING=A,A
168. ACF with decompression is appropriate for patients with central stenosis and radiculopathy with regional lordosis and 1-2 level disease. RATING=A,A
169. ACF with decompression is appropriate for patients with central stenosis and radiculopathy with regional lordosis and greater than 2 level disease. RATING=A,A
170. ACF with decompression is appropriate for patients with central stenosis and axial pain only with regional lordosis and 1-2 level disease. RATING=U
171. ACF with decompression is appropriate for patients with central stenosis and axial pain only with regional lordosis and greater than 2 level disease. RATING=U
172. PCF with decompression is appropriate for patients with central stenosis and myelopathy with regional lordosis and 1-2 level disease. RATING=A,A
173. PCF with decompression is appropriate for patients with central stenosis and myelopathy with regional lordosis and greater than 2 level disease. RATING=A,A
174. PCF with decompression is appropriate for patients with central stenosis and concordant radiculopathy with regional lordosis and 1-2 level disease. RATING=A,A
175. PCF with decompression is appropriate for patients with central stenosis and concordant radiculopathy with regional lordosis and greater than 2 level disease. RATING=A,A
176. PCF with decompression is appropriate for patients with central stenosis and axial pain only with regional lordosis and 1-2 level disease. RATING=U
177. PCF with decompression is appropriate for patients with central stenosis and axial pain only with regional lordosis and greater than 2 level disease. RATING=U

Summary. This section addresses decisions on anterior or posterior approaches for fusion in the setting of either kyphosis or lordosis, considering patients either with or without cord signal change. The first set of scenarios all include patients with central stenosis **with** signal change in their cord. For those with myelopathy or pure radiculopathy regardless of the number of levels of stenosis or the sagittal alignment, either anterior or posterior fusion was appropriate. If patients had only axial pain, there was some uncertainty, particularly for posterior fusion with lordosis or anterior fusion with kyphosis. As long as there was central stenosis with cord changes, fusion was never considered rarely appropriate.

For the same scenarios but **without** signal change in the cord, fusion remained appropriate for myelopathy or radiculopathy. For axial pain, all scenarios were uncertain.

In summary, fusion, either anterior or posterior, was always considered appropriate in the presence of central stenosis with or without signal change in the cord regardless of number of levels or the sagittal alignment as long as patients presented with myelopathy or radiculopathy. If they presented with axial pain, there was some uncertainty in the presence of cord changes, and this uncertainty became ubiquitous if signal change was absent.

Key

ACF anterior cervical fusion
PCF posterior cervical fusion
APCF anterior and posterior cervical fusion
L laminectomy
LF laminoforaminotomy
FS foraminal stenosis
CS central stenosis
PC psychosocial comorbidities
MC medical comorbidities
SC signal change in the cord

A,A Appropriate with Agreement
A,D Appropriate with Disagreement
U Uncertain
RA Rarely Appropriate

Note: Agreement or disagreement only applies to appropriate ratings.

SECTION VII

Cervical fusion for central stenosis with signal change in cord for all scenarios 178-210.

ALL SCENARIOS assume PRESENCE of SIGNAL CHANGE IN CORD

	Smoking	MC Poorly Controlled	MC Controlled	PC Mild	PC Severe	Pseudo
1-2 level with radiculopathy	178 A,A	184 U	190 A,A	196 A,A	202 U	208 A,A
>2 level with radiculopathy	179 A,A	185 U	191 A,A	197 A,A	203 U	
1-2 level with axial pain	180 U	186 RA	192 U	198 U	204 RA	209 A,A
>2 level with axial pain	181 U	187 RA	193 U	199 U	205 RA	
1-2 level with myelopathy	182 A,A	188 A,A	194 A,A	200 A,A	206 A,A	210 A,A
>2 level with myelopathy	183 A,A	189 A,A	195 A,A	201 A,A	207 A,A	

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178. In patients who are actively smoking, it is appropriate to offer fusion for 1-2 level cervical central stenosis with radiculopathy. RATING=A,A
179. In patients who are actively smoking, it is appropriate to offer fusion for greater than 2 level cervical central stenosis with radiculopathy. RATING=A,A
180. In patients who are actively smoking, it is appropriate to offer fusion for 1-2 level cervical central stenosis with axial pain. RATING=U
181. In patients who are actively smoking, it is appropriate to offer fusion for greater than 2 level cervical central stenosis with axial pain. RATING=U
182. In patients who are actively smoking, it is appropriate to offer fusion for 1-2 level cervical central stenosis with myelopathy. RATING=A,A
183. In patients who are actively smoking, it is appropriate to offer fusion for greater than 2 level cervical central stenosis with myelopathy. RATING=A,A

	MC Poorly Controlled	MC Controlled
1-2 level with radiculopathy	184	190
>2 level with radiculopathy	185	191
1-2 level with axial pain	186	192
>2 level with axial pain	187	193
1-2 level with myelopathy	188	194
>2 level with myelopathy	189	195

With signal change in cord

184. Patients with medical comorbidity(ies) **poorly controlled** are appropriate for fusion for 1-2 level cervical central stenosis with radiculopathy. RATING=U

185. Patients with medical comorbidity(ies) **poorly controlled** are appropriate for fusion for greater than 2 level cervical central stenosis with radiculopathy. RATING=U
186. Patients with medical comorbidity(ies) **poorly controlled** are appropriate for fusion for 1-2 level cervical central stenosis with axial pain. RATING=RA
187. Patients with medical comorbidity(ies) **poorly controlled** are appropriate for fusion for greater than 2 level cervical central stenosis with axial pain. RATING=RA
188. Patients with medical comorbidity(ies) **poorly controlled** are appropriate for fusion for 1-2 level cervical central stenosis with myelopathy. RATING=A,A
189. Patients medical comorbidity(ies) **poorly controlled** are appropriate for fusion for greater than 2 level cervical central stenosis with myelopathy. RATING=A,A
190. Patients with medical comorbidity(ies) **controlled** are appropriate for fusion for 1-2 level cervical central stenosis with radiculopathy. RATING=A,A
191. Patients with medical comorbidity(ies) **controlled** are appropriate for fusion for greater than 2 level cervical central stenosis with radiculopathy. RATING=A,A
192. Patients with medical comorbidity(ies) **controlled** are appropriate for fusion for 1-2 level cervical central stenosis with axial pain. RATING=U
193. Patients with medical comorbidity(ies) **controlled** are appropriate for fusion for greater than 2 level cervical central stenosis with axial pain. RATING=U
194. Patients with medical comorbidity(ies) **controlled** are appropriate for fusion for 1-2 level cervical central stenosis with myelopathy. RATING=A,A
195. Patients with medical comorbidity(ies) **controlled** are appropriate for fusion for greater than 2 level cervical central stenosis with myelopathy. RATING=A,A

Key

ACF	anterior cervical fusion
PCF	posterior cervical fusion
APCF	anterior and posterior cervical fusion
L	laminectomy
LF	laminoforaminotomy
FS	foraminal stenosis
CS	central stenosis
PC	psychosocial comorbidities
MC	medical comorbidities
SC	signal change in the cord

A,A	Appropriate with Agreement
A,D	Appropriate with Disagreement
U	Uncertain
RA	Rarely Appropriate

Note: Agreement or disagreement only applies to appropriate ratings.

	PC Mild	PC Severe
1-2 level with radiculopathy	196	202
>2 level with radiculopathy	197	203
1-2 level with axial pain	198	204
>2 level with axial pain	199	205
1-2 level with myelopathy	200	206
>2 level with myelopathy	201	207

With signal change in cord

196. Patients with **mild** psychosocial comorbidity(ies) are appropriate for fusion for 1-2 level cervical central stenosis with radiculopathy. RATING=A,A
197. Patients with **mild** psychosocial comorbidity(ies) are appropriate for fusion for greater than 2 level cervical central stenosis with radiculopathy. RATING=A,A
198. Patients with **mild** psychosocial comorbidity(ies) are appropriate for fusion for 1-2 level cervical central stenosis with axial pain. RATING=U

199. Patients with **mild** psychosocial comorbidity(ies) are appropriate for fusion for greater than 2 level cervical central stenosis with axial pain. RATING=U
200. Patients with **mild** psychosocial comorbidity(ies) are appropriate for fusion for 1-2 level cervical central stenosis with myelopathy. RATING=A,A
201. Patients with **mild** psychosocial comorbidity(ies) are appropriate for fusion for greater than 2 level cervical central stenosis with myelopathy. RATING=A,A
202. Patients with **severe** psychosocial comorbidity(ies) are appropriate for fusion for 1-2 level cervical central stenosis with radiculopathy. RATING=U
203. Patients with **severe** psychosocial comorbidity(ies) are appropriate for fusion for greater than 2 level cervical central stenosis with radiculopathy. RATING=U
204. Patients with **severe** psychosocial comorbidity(ies) are appropriate for fusion for 1-2 level cervical central stenosis with axial pain. RATING=RA
205. Patients with **severe** psychosocial comorbidity(ies) are appropriate for fusion for greater than 2 level cervical central stenosis with axial pain. RATING=RA
206. Patients with **severe** psychosocial comorbidity(ies) are appropriate for fusion for 1-2 level cervical central stenosis with myelopathy. RATING=A,A
207. Patients with **severe** psychosocial comorbidity(ies) are appropriate for fusion for greater than 2 level cervical central stenosis with myelopathy. RATING=A,A

Pseudarthrosis

208. Patients with pseudarthrosis with persistent central stenosis and radiculopathy are appropriate for re-do fusion at that level. RATING=A,A
209. Patients with pseudarthrosis with persistent central stenosis and axial pain are appropriate for re-do fusion at that level. RATING=A,A
210. Patients with pseudarthrosis with persistent central stenosis and myelopathy are appropriate for re-do fusion at that level. RATING=A,A

211. Patients with pseudarthrosis who are **asymptomatic** with persistent central stenosis are appropriate for re-do fusion at that level. RATING=U

Corpectomy

212. Addition of posterior fusion is appropriate to improve fusion rate following **one level** anterior cervical **corpectomy** and fusion for degenerative central stenosis. RATING=U
213. Addition of posterior fusion is appropriate to improve fusion rate following **greater than one level** anterior cervical **corpectomy** and fusion for degenerative central stenosis. RATING=A,A

Key

ACF anterior cervical fusion
PCF posterior cervical fusion
APCF anterior and posterior cervical fusion
L laminectomy
LF laminoforaminotomy
FS foraminal stenosis
CS central stenosis
PC psychosocial comorbidities
MC medical comorbidities
SC signal change in the cord

A,A Appropriate with Agreement
A,D Appropriate with Disagreement
U Uncertain
RA Rarely Appropriate

Note: Agreement or disagreement only applies to appropriate ratings.

Cervical fusion for central stenosis **with NO signal change in cord for all scenarios 214-246.**

ALL SCENARIOS assume ABSENCE of SIGNAL CHANGE IN CORD

	Smoking	MC Poorly Controlled	MC Controlled	PC Mild	PC Severe	Pseudo
1-2 level with radiculopathy	214 A,A	220 U	226 A,A	232 A,A	238 U	244 A,A
>2 level with radiculopathy	215 U	221 U	227 A,A	233 A,A	239 U	
1-2 level with axial pain	216 U	222 RA	228 U	234 U	240 RA	245 A,A
>2 level with axial pain	217 U	223 RA	229 U	235 RA	241 RA	
1-2 level with myelopathy	218 A, D	224 A,A	230 A,A	236 A,A	242 A,A	246 A,A
>2 level with myelopathy	219 A, D	225 A,A	231 A,A	237 A,A	243 A,A	

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214. In patients who are actively smoking, it is appropriate to offer fusion for 1-2 level cervical central stenosis with radiculopathy. RATING=A,A
215. In patients who are actively smoking, it is appropriate to offer fusion for greater than 2 level cervical central stenosis with radiculopathy. RATING=U
216. In patients who are actively smoking, it is appropriate to offer fusion for 1-2 level cervical central stenosis with axial pain. RATING=U
217. In patients who are actively smoking, it is appropriate to offer fusion for greater than 2 level cervical central stenosis with axial pain. RATING=U
218. In patients who are actively smoking, it is appropriate to offer fusion for 1-2 level cervical central stenosis with myelopathy. RATING=A,D
219. In patients who are actively smoking, it is appropriate to offer fusion for greater than 2 level cervical central stenosis with myelopathy. RATING=A,D

	MC Poorly Controlled	MC Controlled
1-2 level with radiculopathy	220	226
>2 level with radiculopathy	221	227
1-2 level with axial pain	222	228
>2 level with axial pain	223	229
1-2 level with myelopathy	224	230
>2 level with myelopathy	225	231

No signal change in cord

220. Patients with medical comorbidity(ies) **poorly controlled** are appropriate for fusion for 1-2 level cervical central stenosis with radiculopathy. RATING=U
221. Patients with medical comorbidity(ies) **poorly controlled** are appropriate for fusion for greater than 2 level cervical central stenosis with radiculopathy. RATING=U

222. Patients with medical comorbidity(ies) **poorly controlled** are appropriate for fusion for 1-2 level cervical central stenosis with axial pain. RATING=**RA**
223. Patients with medical comorbidity(ies) **poorly controlled** are appropriate for fusion for greater than 2 level cervical central stenosis with axial pain. RATING=**RA**
224. Patients with medical comorbidity(ies) **poorly controlled** are appropriate for fusion for 1-2 level cervical central stenosis with myelopathy. RATING=A,A
225. Patients medical comorbidity(ies) **poorly controlled** are appropriate for fusion for greater than 2 level cervical central stenosis with myelopathy. RATING=A,A
226. Patients with medical comorbidity(ies) **controlled** are appropriate for fusion for 1-2 level cervical central stenosis with radiculopathy. RATING=A,A
227. Patients with medical comorbidity(ies) **controlled** are appropriate for fusion for greater than 2 level cervical central stenosis with radiculopathy. RATING=A,A
228. Patients with medical comorbidity(ies) **controlled** are appropriate for fusion for 1-2 level cervical central stenosis with axial pain. RATING=U
229. Patients with medical comorbidity(ies) **controlled** are appropriate for fusion for greater than 2 level cervical central stenosis with axial pain. RATING=U
230. Patients with medical comorbidity(ies) **controlled** are appropriate for fusion for 1-2 level cervical central stenosis with myelopathy. RATING=A,A
231. Patients medical comorbidity(ies) **controlled** are appropriate for fusion for greater than 2 level cervical central stenosis with myelopathy. RATING=A,A

Key

ACF anterior cervical fusion
PCF posterior cervical fusion
APCF anterior and posterior cervical fusion
L laminectomy
LF laminoforaminotomy
FS foraminal stenosis
CS central stenosis
PC psychosocial comorbidities
MC medical comorbidities
SC signal change in the cord

A,A Appropriate with Agreement
A,D Appropriate with Disagreement
U Uncertain
RA Rarely Appropriate

Note: Agreement or disagreement only applies to appropriate ratings.

	PC Mild	PC Severe
1-2 level with radiculopathy	232	238
>2 level with radiculopathy	233	239
1-2 level with axial pain	234	240
>2 level with axial pain	235	241
1-2 level with myelopathy	236	242
>2 level with myelopathy	237	243

No signal change in cord

232. Patients with **mild** psychosocial comorbidity(ies) are appropriate for fusion for 1-2 level cervical central stenosis with radiculopathy. RATING=A,A
233. Patients with **mild** psychosocial comorbidity(ies) are appropriate for fusion for greater than 2 level cervical central stenosis with radiculopathy. RATING=A,A
234. Patients with **mild** psychosocial comorbidity(ies) are appropriate for fusion for 1-2 level cervical central stenosis with axial pain. RATING=U

235. Patients with **mild** psychosocial comorbidity(ies) are appropriate for fusion for greater than 2 level cervical central stenosis with axial pain. RATING=**RA**
236. Patients with **mild** psychosocial comorbidity(ies) are appropriate for fusion for 1-2 level cervical central stenosis with myelopathy. RATING=A,A
237. Patients with **mild** psychosocial comorbidity(ies) are appropriate for fusion for greater than 2 level cervical central stenosis with myelopathy. RATING=A,A
238. Patients with **severe** psychosocial comorbidity(ies) are appropriate for fusion for 1-2 level cervical central stenosis with radiculopathy. RATING=U
239. Patients with **severe** psychosocial comorbidity(ies) are appropriate for fusion for greater than 2 level cervical central stenosis with radiculopathy. RATING=U
240. Patients with **severe** psychosocial comorbidity(ies) are appropriate for fusion for 1-2 level cervical central stenosis with axial pain. RATING=**RA**
241. Patients with **severe** psychosocial comorbidity(ies) are appropriate for fusion for greater than 2 level cervical central stenosis with axial pain. RATING=**RA**
242. Patients with **severe** psychosocial comorbidity(ies) are appropriate for fusion for 1-2 level cervical central stenosis with myelopathy. RATING=A,A
243. Patients with **severe** psychosocial comorbidity(ies) are appropriate for fusion for greater than 2 level cervical central stenosis with myelopathy. RATING=A,A

Pseudarthrosis

244. Patients with pseudarthrosis with persistent central stenosis and radiculopathy are appropriate for re-do fusion at that level. RATING=A,A
245. Patients with pseudarthrosis with persistent central stenosis and axial pain are appropriate for re-do fusion at that level. RATING=A,A
246. Patients with pseudarthrosis with persistent central stenosis and myelopathy are appropriate for re-do fusion at that level. RATING=A,A

247. Patients with pseudarthrosis who are asymptomatic with persistent central stenosis are appropriate for re-do fusion at that level. RATING=RA

Corpectomy

248. Addition of posterior fusion is appropriate to improve fusion rate following one level anterior cervical corpectomy and fusion for degenerative central stenosis. RATING=U
249. Addition of posterior fusion is appropriate to improve fusion rate following greater than one level anterior cervical corpectomy and fusion for degenerative central stenosis. RATING=A,A

Summary. This section looks at the effect of comorbidities on decision-making for conditions with central stenosis. The first group of scenarios look at central stenosis with signal change in the cord. For patients with myelopathy, fusion was always appropriate, regardless of number of levels treated, severity of medical or psychosocial problems, or smoking. For patients with radiculopathy, if patients had severe medical or psychosocial problems, there was uncertainty. Otherwise, fusion was still appropriate for all remaining scenarios. In contrast, for patients with axial pain only, fusion was considered rarely appropriate for those with severe medical or psychosocial conditions, and uncertain for all other scenarios. No scenarios were considered appropriate if the patient presented with axial pain only and any of these comorbidities.

For symptomatic pseudarthrosis fusion again was appropriate for all scenarios, whether the associated problem was myelopathy, radiculopathy or axial pain. If the patient was asymptomatic, in contrast to prior scenarios of degenerative disease without stenosis or foraminal stenosis only where indications were rarely appropriate (Sections II and IV), for these patients with central stenosis and cord changes, fusion was uncertain.

To improve the fusion rate for one level corpectomy, the need to add posterior fusion to the anterior fusion was uncertain, while it was appropriate for greater than one level corpectomy.

If cord changes were absent, recommendations for fusion were generally weaker. Fusion remained appropriate for myelopathy for all scenarios, although there was disagreement for smoking. For radiculopathy without cord signal change, fusion was appropriate for one or 2 level involvement, but uncertain for greater than 2 levels. Fusion was also rated as uncertain if either medical or psychosocial problems were severe, but remained appropriate if they were mild. For axial pain, fusion was uncertain with smoking, as well as mild medical or psychosocial problems across all scenarios except psychosocial problems with greater than 2 level disease which was considered rarely appropriate. For poorly controlled medical or psychosocial problems, fusion was considered rarely appropriate for all scenarios.

The recommendations for fusion for pseudarthrosis in the absence of cord signal change were identical to those patients with signal change present with the exception of the asymptomatic patients where it was thought to be rarely appropriate rather than uncertain. The

recommendations for addition of posterior surgery to improve fusion rate after anterior corpectomy remained the same regardless of the presence or absence of cord signal change.

Key	
ACF	anterior cervical fusion
PCF	posterior cervical fusion
APCF	anterior and posterior cervical fusion
L	laminectomy
LF	laminoforaminotomy
FS	foraminal stenosis
CS	central stenosis
PC	psychosocial comorbidities
MC	medical comorbidities
SC	signal change in the cord
A,A	Appropriate with Agreement
A,D	Appropriate with Disagreement
U	Uncertain
RA	Rarely Appropriate
Note: Agreement or disagreement only applies to appropriate ratings.	

■ SECTION VIII

Soft cervical disc herniation, 1 or 2 levels

	Axial pain	Radiculopathy	Myelopathy
ACF	250 U	252 A,A	254 A,A
PCF	251 RA	253 U	255 U

250. One or 2 level anterior cervical fusion (ACF) with decompression is appropriate for the patient with a soft disc herniation resulting in stenosis and axial pain only. RATING=U

251. One or 2 level posterior cervical fusion (PCF) in addition to laminoforaminotomy and discectomy is appropriate for the patient with a soft disc herniation resulting in stenosis and axial pain only. RATING=RA

252. One or 2 level ACF with decompression is appropriate for the patient with a soft disc herniation resulting in stenosis and radiculopathy. RATING=A,A

253. One or 2 level PCF in addition to laminoforaminotomy and discectomy is appropriate for the patient with a soft disc herniation resulting in stenosis and radiculopathy. RATING=U

254. One or 2 level ACF with decompression is appropriate for the patient with a soft disc herniation resulting in stenosis and myelopathy. RATING=A,A

255. One or 2 level PCF in addition to laminoforaminotomy and discectomy is appropriate for the patient with a soft disc herniation resulting in stenosis and myelopathy. RATING=U

Summary. This section relates to conditions that arise from soft cervical disc herniations. In general, myelopathy and radiculopathy are more appropriate indications for fusion than axial pain, and anterior fusion is favored over posterior fusion.

Key

ACF anterior cervical fusion
PCF posterior cervical fusion
APCF anterior and posterior cervical fusion
L laminectomy
LF laminoforaminotomy
FS foraminal stenosis
CS central stenosis
PC psychosocial comorbidities
MC medical comorbidities
SC signal change in the cord

A,A Appropriate with Agreement
A,D Appropriate with Disagreement
U Uncertain
RA Rarely Appropriate

Note: Agreement or disagreement only applies to appropriate ratings.

SECTION IX

Presence or absence of plate for ACF

	Plate	No plate
1 level anterior cervical discectomy	256 A,A	260 A,A
>1 level anterior cervical discectomy	257 A,A	261 RA
1 level anterior cervical corpectomy	258 A,A	262 RA
>1 level anterior cervical corpectomy	259 A,A	263 RA

Anterior cervical fusion

256. When doing a one level anterior cervical discectomy with anterior cervical fusion, it is appropriate to include a cervical plate. RATING=A,A
257. When doing a 2 or more level anterior cervical discectomy with anterior cervical fusion, it is appropriate to include a cervical plate. RATING=A,A
258. When doing a one level anterior cervical corpectomy with anterior cervical fusion, it is appropriate to include a cervical plate. RATING=A,A
259. When doing a 2 or more level anterior cervical corpectomy with anterior cervical fusion, it is appropriate to include a cervical plate. RATING=A,A
260. When doing a one level anterior cervical discectomy with anterior cervical fusion, it is appropriate to exclude a cervical plate. RATING=A,A
261. When doing a 2 or more level anterior cervical discectomy with anterior cervical fusion, it is appropriate to exclude a cervical plate. RATING=RA
262. When doing a one level anterior cervical corpectomy with anterior cervical fusion, it is appropriate to exclude a cervical plate. RATING=RA
263. When doing a 2 or more level anterior cervical corpectomy with anterior cervical fusion, it is appropriate to exclude a cervical plate. RATING=RA

Summary. This section looks at utilization of anterior cervical plates for fusion. The use of anterior plating was always appropriate for discectomy or corpectomy regardless of number of levels fused. On the contrary, excluding a plate was considered rarely appropriate for a corpectomy of any sort or a multilevel discectomy. It was only considered appropriate to exclude an anterior plate for a one level discectomy.

APPENDIX

Author Disclosures (As of 10.16.12)

Daniel K. Resnick

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Christopher P. Kauffman

Speaking and/or teaching arrangements: NASS (Financial, Course Director/Instructor NASS Coding Course, Travel/lodging reimbursed). (9/24/12)

Zoher Ghogawala

Board of Directors: American Association of Neurological Surgeons - Neuropoint Alliance, Congress of Neurological Surgeons, Collaborative Spine Research Foundation (Nonfinancial, I serve on the Board of Directors for the Neuropoint Alliance for the AANS. I also serve on the Executive Committee for the Congress of Neurological Surgeons. I also serve on the Board of Directors for the Collaborative Spine Research Foundation. I receive no compensation for any of these positions.); Research Support (Staff/Materials): Wallace Foundation (Level F, Private Research Foundation, Paid directly to institution/employer); Grants: National Institute of Health (Level C, UL1 RR024146 CTSA Grant (Yale University), Paid directly to institution/employer). (7/6/12)

Christopher Bono

Royalties: Wolters Kluwer (Level B, royalties for edited book), Informa Healthcare (Level B, royalties for edited book); Consulting: Harvard Clinical Research Institute (Financial, Reimbursed for time as part of the Trial Design Team, developing and implementing protocols for spine research); Other Office: Barricaid (Financial, data safety monitoring board, no remuneration yet, for prospective study of new device), JAAOS (Financial, Level B, Deputy Editor), The Spine Journal (Nonfinancial, Deputy Editor). (1/23/12)

Christopher Standaert

Consulting: Washington State Health Care Authority Health Technology Clinical Committee (Financial, Level A per meeting (one day), 4-5 meetings per year), Blue Cross Blue Shield Association (Financial, Level A for serving as Expert Panelist regarding the Blue Cross Blue Shield Association Blue Distinction Centers for Spine Surgery August 2011). (9/28/11)

William Mitchell

Stock Ownership: Johnson & Johnson (100, 0, own 100 shares of common stock); Private Investments: South Jersey Cyberknife (1, 0, Level C purchase of 1 share, no patient referrals to center, no profit seen in 4 years); Speaking and/or teaching arrangements: NASS

(Financial, Level B/year honoraria Speaker NASS Coding Update courses); Trips/Travel: NASS (Both, NASS Coding Update courses Level B travel expenses incurred for 2 days (coach airfare, lodging, food, tolls, mileage)- 2 meetings/year NASS CPT Advisor (Level B travel expenses incurred for AMA CPT meetings-3 meetings/year); Board of Directors: NASS (Nonfinancial, Health Policy Council, Director (Level B travel expenses (coach airfare, meals, tolls). (4/30/12)

Alok Sharan

Consulting: Paradigm Spine (Financial, Level D); Speaking and/or teaching arrangements: Synthes Spine (Financial, Level B); Trips/Travel: Stryker Spine (Nonfinancial, Level A). (8/13/11)

Ray M. Baker

Board of Directors: ISIS (Nonfinancial, President of the International Spine Intervention Society). (9/15/11)

Heidi Prather

Board of Directors: North American Spine Society (Nonfinancial, Only reimbursed for travel to board meeting); Other Office: American Academy of Physical Medicine and Rehabilitation (Nonfinancial, Level B per quarter for Senior Editor on PMR Journal. Paid to Washington University Orthopedics., Paid directly to institution/employer); Research Support (Investigator Salary): Scott Nadler PASSOR Musculoskeletal Research Award (Level C is total amount from the Nadler award. This is split between Dr. Prather and staff., Paid directly to institution/employer); Research Support (Staff/Materials): Scott Nadler PASSOR Musculoskeletal Research Award (Level C is total amount from Nadler award. This is split between Dr. Prather and staff., Paid directly to institution/employer); Grants: ICTS Just In Time Core Usage Funding (Level B, This funding is for statistical analysis for research projects. The money is paid to the bio-statistics department, not to Dr. Heidi Prather., Paid directly to institution/employer). (4/26/12)

William L. Tontz, Jr.

Stock Ownership: Phygen (1, 6, Physician owned implant company involved in development and distribution of spinal implants., Paid directly to institution/employer); Other Office: Board of Managers (Paid Level B for board of manager term from 2009-2010). (5/9/12)

Michael H. Heggeness

Royalties: Relievent Medsystems (Level C, My institution has licensed technology that I invented. A royalty distribution was made to my employer, the Baylor College of medicine, the legal owner of the patent. A percentage of the royalty is shared with me, as the inventor, in the amount stated, according to institutional policy, Paid directly to institution/employer), K2M (Level C, Minimum royalty for assigned patent. I am the sole inventor of the patented IP, which was developed without commercial support. The technology was assigned to K2M four years ago. A "minimum royalty" was paid to my employer, the Baylor College of Medicine, who share some of the royalty with me,

per College policy. There is no product on the market using this technology. I own no stock in K2M, and do not consult for them, Paid directly to institution/employer); Stock Ownership: Relievant Medsystems (45000, 1, 1.6% of stock ownership in this company, which is developing a minimally invasive method for the treatment of axial pain, based in my IP.); Research Support (Investigator Salary): Department of Defense (Level E, Salary support for research efforts is provided by peer review federal grants. This supports (offsets) my salary from my medical school, but does not result in any change in my actual pay., Paid directly to institution/employer); Grants: Department of Defense (Level I, I am Principal investigator on a large grant awarded for the tissue engineering of bone for the healing of long bone fractures. The awarded funding is distributed to support multiple investigators at Baylor College of Medicine, Rice University, the University of Texas, and the University of Georgia. The work is not directly related to the spine, and has not changed my salary, Paid directly to institution/employer). (9/1/11)

William C. Watters, III

Royalties: Stryker Corporation (Level B, Royalties paid at 0.5% on Dynatrans Cervical Plate); Board of Directors: North American Spine Society (Nonfinancial), World Spine Care (Nonfinancial), American College of Spine Surgeons (Nonfinancial); Scientific Advisory Board: Intrinsic Therapeutics (Nonfinancial, Stock Options (No current value), Palladian Health (Financial, Level A/hour for 2 meetings/year equaling Level B/year); Other: The Spine Journal (Nonfinancial, Assistant Editor), Spine Arthroplasty Journal (Nonfinancial, Assistant Editor), Spine (Nonfinancial, Reviewer), Kirby Glenn Surgical Center (formerly Med Center Surgery Center) (Financial, 1/22nd minority interest ownership). (1/26/12)

Paul A. Anderson

Royalties: Stryker (Level C); Stock Ownership: Pioneer (250000, 1); Consulting: Pioneer (Level C), Medtronic (Level F); Scientific Advisory Board: SI bone (Financial, Stock option); Other: Aesculap (Level C). (1/30/12)

Sanford E. Emery

Board of Directors: Cervical Spine Research Society (Nonfinancial), American Orthopaedic Association (Nonfinancial), American Board of Orthopaedic Surgery (Nonfinancial). (5/23/12)

James S. Harrop

Stock Ownership: Axiomed (0, 0, I have the option to buy 15,000 shares); Consulting: DePuy Spine (Financial, Level C travel, serving on educational board and consulting. This money is actually directed to department of Neurosurgery into a research fund which I do not directly control, Paid directly to institution/employer); Speaking and/or teaching arrangements: Medtronic (Financial, 0, No longer a consultant for this company); Trips/Travel: Stryker (Nonfinancial, Paid for travel to resident meeting); Board of Directors: Jefferson Medical College Physician Board (Nonfinancial); Scientific Advisory Board:

Axiomed (Nonfinancial, Medical advisory board), Geron (Financial, Scientific advisory board with remuneration going to TJUH research funds, Paid directly to institution/employer), DePuy (Financial, resident/fellow education board, Paid directly to institution/employer), CNS (Nonfinancial, on Executive Board, Chairman of Publication Com, Editor of CNSQ, Chairman for Neurosimulation project); Other Office: Penn Neurologic Society (Nonfinancial, Board of Pennsylvania Neurosurgical Society); Research Support (Staff/Materials): NACTN (Level E, Spinal cord injury trial network. No money to me but funds research support for database and riluzole trial and administrators for studies. This is part of a Department of Defense Grant, Paid directly to institution/employer). (8/17/11)

Mark A. Lorenz

Royalties: Orthofix (Level E); Consulting: Orthofix (Financial, 0); Scientific Advisory Board: Orthofix (Financial, Level A/h of specifically defined and documented work). (6/12/12)

Jeffrey M. Spivak

Royalties: Titan Spine (Level C, TLIF and PLIF cages); Stock Ownership: Titan Spine (60000, 5), Etex Corp. (15000, 1), Paradigm Spine (157500, 5); Consulting: Titan Spine (Less than Level B for past 12 months); Speaking and/or teaching arrangements: Synthes Spine (Financial, Paid per course for Prodisc Cervical and Lumbar surgeon teaching (Level B per course plus travel expenses); Scientific Advisory Board: Titan Spine (Nonfinancial, 15,000 warrants (approximately)vested over 5 years. No active remuneration.). (1/31/12)

William C. Welch

Grants: Synthes (Level E, Grant and fellowship support, Paid directly to institution/employer). (6/13/12)

Raj D. Rao

Board of Directors: North American Spine Society (Financial, Receive reimbursement for travel/expenses on behalf of NASS. No remuneration for participating on board); Scientific Advisory Board: US Food and Drug Administration Scientific Advisory Panel on Orthopaedic and Rehabilitation Devices (Both, Receive reimbursement for travel/expenses on behalf on United States FDA. Hourly rate for time spent at panel meetings @ approximately Level A/hour. Received Level A in 2010 from US FDA, and additional Level A for travel reimbursement); Other Office: American Academy of Orthopaedic Surgeons (Nonfinancial, Chairman, Diversity Advisory Board. No remuneration. Travel reimbursement); Grants: United States Department of Defense - Navy (Level G, Paid directly to institution/employer), United States Department of Defense - Army Medical Research Acquisition (Level F, Paid directly to institution/employer), National Highway Traffic Safety Administration (Level F, Paid directly to institution/employer), U.S. Department of Education, National Institute on Disability and Rehabilitation Research (Level G, Paid directly to institution/employer); Other: The Spine

Journal (Nonfinancial), Seminars in Spine Surgery (Level A).
(10/7/11)

William J. Sullivan

Trips/Travel: Emerging Technologies Education Summit (Financial, Travel expenses and honorarium: Level B (yearly 2006-2012), Maadi Military Hospital, Egypt (Financial, Travel expenses December 2011: Level B); Other Office: AAPM&R (Both, Reimbursement and Policy Review Committee Chair Coding and Billing Workshop Course Director (honorarium/expenses Level B), NASS (Both, RUC Advisor (travel reimbursement) Coding Committee Co-Chair (travel reimbursement/honorarium) NASS Registry Committee (none) SpineLine Editorial Committee (none). (1/9/12)

David A. Wong

Royalties: Lippincott Williams and Wilkins (Level A); Stock Ownership: Neurotech/CervIOM (20, 20), Denver Integrated Imaging North (20, 1), Huron Shores LLC (50, 50); Consulting: Anulex (Level B), Allosource (Level A), Deroyal (Financial, 0), United Healthcare (Level A); Speaking and/or teaching arrangements: Anulex (Financial, 0); Trips/Travel: Deroyal (Level A); Scientific Advisory Board: United Healthcare (Level A); Research Support (Staff/Materials): Abbott (Level B), Anulex (Level B), Cervitech/Nuvasive (Level A).
(12/17/11)

K. Daniel Riew

Royalties: Biomet (Level F, Royalty for C-Tek & Maxan Anterior Cervical Plate), Osprey (Level C, Cervical Interbody Graft Royalty. Royalties are less than Level B), Medtronic Sofamor Danek (Level G, Posterior Cervical Instrumentation); Stock Ownership: Osprey (10, 0, Stock options are 1% of all Stock options granted but there is no ownership of company), Expanding Orthopedics (10000, 1, No viable products. Exact # of shares is not known so the number is made up), Spineology (5000, 01, Level B purchased. Also, stock options that are negatively valued. Exact # of shares is not known so the number is made up. Total ownership is 0.1% of company), Spinal Kinetics (10000, 01, Level C purchased. Exact # of shares is not known so the number is made up. Total ownership is 0.1% of company), Nexgen Spine (10000, 01, Level B purchased. Exact # of shares is not known so the number is made up. Total ownership is 0.1% of company), Amedica (10000, 01, Purchased Level B. Exact # of shares is not known so the number is made up. Total ownership is 0.1% of company), Vertiflex (10000, 01, Purchased Level B. Exact # of shares is not known so the number is made up. Total ownership is 0.1% of company), Benvenue (10000, 01, Purchased Level C. Exact # of shares is not known so the number is made up. Total ownership is 0.1% of company), Paradigm Spine (10000, 01, Purchased Level B. Exact # of shares is not known so the number is made up. Total ownership is 0.1% of company), PSD (10000, 01, Purchased Level B. Exact # of shares is not known so the number is made up. Total ownership is 0.1% of company); Board of Directors: Korean Association of Spinal Surgeons (Nonfinancial), Cervical Spine Research

Society (Nonfinancial); Scientific Advisory Board: Journal of Bone and Joint Surgery (Nonfinancial), Spine Journal (Nonfinancial); Grants: Medtronic (Level C, For IDE participation, Paid directly to institution/employer). (7/25/12)

Jeffrey C. Wang

Royalties: Medtronic (Level C), Stryker (Level C), Seaspine (Level E), Osprey (Level C), Aesculap (Level B), Biomet (Level F), Amedica (Level D), Zimmer (Level E), Synthes (Level F); Stock Ownership: Fziomed (2500, 1, less than 1%); Private Investments: Promethean Spine (1, 1, Level B investment, less than 1% of entity, unknown amount of shares), Paradigm spine (1, 1, Level B investment, less than 1% of entity, unknown amount of shares), Benevenue (1, 1, Level C investment, less than 1% of entity, unknown amount of shares), NexGen (1, 1, Level B investment, less than 1% of entity, unknown amount of shares), K2 medical (1, 1, Level B investment, less than 1% of entity, unknown amount of shares), Pioneer (1, 1, Level B investment, less than 1% of entity, unknown amount of shares), Amedica (1, 1, Level D investment, less than 1% of entity, unknown amount of shares), Vertiflex (1, 1, Level B investment, less than 1% of entity, unknown amount of shares), Electrocore (1, 1, Level C investment, less than 1% of entity, unknown amount of shares), Surgitech (1, 1, Level C investment, less than 1% of entity, unknown amount of shares), Axiomed (25000, 1, less than 1% of entity); Board of Directors: North American Spine Society (Nonfinancial, reimbursement for travel for board meetings), Cervical Spine Research Society (Nonfinancial, reimbursement for travel for board meetings), AO Spine/AO Foundation (Both, Level D combined for honorariums for educational activities and reimbursements for international travel for this nonprofit foundation), Collaborative Spine Research Foundation (Nonfinancial, reimbursement for travel for board meetings); Scientific Advisory Board: VG Innovations (Financial, 5,000 options valued at less than 1% of company), Corespine (Financial, 2,000 options valued at less than 1% of company), Expanding Orthopaedics (Financial, 33,000 options valued at less than 1% of company), Syndicom (Financial, 66,125 shares valued at less than 1% of company), Osprey (Financial, 10 options, less than 1% of company), Amedica (Financial, 35,416 options, less than 1% of company), Bone Biologics (Financial, 51,255 shares, less than 1% of company), Curative Biosciences (Financial, 1875 options, less than 1% of company), PearlDiver (Financial, 25,000 options, less than 1% of company), Pioneer (Financial, 3,636 options, less than 1% of company), Seaspine (Financial, 11 options, less than 1% of company). (5/7/12)

Charles A. Reitman

Nothing to disclose. (9/20/12)

Charles A. Mick

Nothing to disclose. (9/18/12)

Jamie Baisden

Nothing to disclose. (8/14/12)

Christopher G. Furey

Nothing to disclose. (7/13/12)

Jerome Schofferman

Nothing to disclose. (9/18/12)

Range Key:

Level A. \$100 to \$1,000

Level B. \$1,001 to \$10,000

Level C. \$10,001 to \$25,000

Level D. \$25,001 to \$50,000

Level E. \$50,001 to \$100,000

Level F. \$100,001 to \$500,000

Level G. \$500,001 to \$1M

Level H. \$1,000,001 to \$2.5M

Level I. Greater than \$2.5M

Literature Search Parameters

Time Frames for Searches: 1946-Present

Foreign and/or English Language: English

Age Range: 18-80 Years of Age

Human Studies, Animal Studies or Cadaver Studies Included: Human Studies Only

Databases: PubMed, EMBASE, Cochrane and Web of Science

Key Search Terms and Connectors, With or Without MeSH Terms to be Employed:

Cervical Fusion and Degenerative Disc Disease (31)-June 2011

((("Cervical Vertebrae"[Mesh] AND "Spinal Fusion"[Mesh]) OR (cervical[title] AND fusion[title]) OR "cervical fusion"[All Fields] AND ((Meta-Analysis[ptyp] OR Randomized Controlled Trial[ptyp] OR systematic review[title] OR randomized controlled trial[title]) AND English[lang] AND ("1946"[PDAT] : "3000"[PDAT]))) AND ("intervertebral disc degeneration"[MeSH Terms] OR ("intervertebral"[All Fields] AND "disc"[All Fields] AND "degeneration"[All Fields]) OR "intervertebral disc degeneration"[All Fields] OR ("degenerative"[All Fields] AND "disc"[All Fields] AND "disease"[All Fields]) OR "degenerative disc disease"[All Fields])

Cervical Fusion and Spondylosis (42)-June 2011

((("Cervical Vertebrae"[Mesh] AND "Spinal Fusion"[Mesh]) OR (cervical[title] AND fusion[title]) OR "cervical fusion"[All Fields] AND ((Meta-Analysis[ptyp] OR Randomized Controlled Trial[ptyp] OR systematic review[title] OR randomized controlled trial[title]) AND English[lang] AND ("1946"[PDAT] : "3000"[PDAT]))) AND ("spondylosis"[MeSH Terms] OR "spondylosis"[All Fields])

Cervical Fusion and Myelopathy (48)-June 2011

((("Cervical Vertebrae"[Mesh] AND "Spinal Fusion"[Mesh]) OR (cervical[title] AND fusion[title]) OR "cervical fusion"[All Fields] AND ((Meta-Analysis[ptyp] OR Randomized Controlled Trial[ptyp] OR systematic review[title] OR randomized controlled trial[title]) AND English[lang] AND ("1946"[PDAT] : "3000"[PDAT]))) AND (("myelitis"[MeSH Terms] OR "myelitis"[All Fields]) OR ("spinal cord diseases"[MeSH Terms] OR ("spinal"[All Fields] AND "cord"[All Fields] AND "diseases"[All Fields]) OR "spinal cord diseases"[All Fields] OR "myelopathy"[All Fields] OR "bone marrow diseases"[MeSH Terms] OR ("bone"[All Fields] AND "marrow"[All Fields] AND "diseases"[All Fields]) OR "bone marrow diseases"[All Fields]))

Cervical Fusion and Radiculopathy (60)-June 2011

((("Cervical Vertebrae"[Mesh] AND "Spinal Fusion"[Mesh]) OR (cervical[title] AND fusion[title]) OR "cervical fusion"[All Fields] AND ((Meta-Analysis[ptyp] OR Randomized Controlled Trial[ptyp] OR systematic review[title] OR randomized controlled trial[title]) AND English[lang] AND ("1946"[PDAT] : "3000"[PDAT]))) AND (("radiculopathy"[MeSH Terms] OR "radiculopathy"[All Fields]) OR ("polyradiculopathy"[MeSH Terms] OR "polyradiculopathy"[All Fields] OR "polyradiculitis"[All Fields]) OR ("polyradiculopathy"[MeSH Terms] OR "polyradiculopathy"[All Fields]) OR ("radiculopathy"[MeSH Terms] OR "radiculopathy"[All Fields] OR "radiculitis"[All Fields]))

Cervical Fusion and Stenosis (7)-June 2011

((("Cervical Vertebrae"[Mesh] AND "Spinal Fusion"[Mesh]) OR (cervical[title] AND fusion[title]) OR "cervical fusion"[All Fields] AND ((Meta-Analysis[ptyp] OR Randomized Controlled Trial[ptyp] OR systematic review[title] OR randomized controlled trial[title]) AND English[lang] AND ("1946"[PDAT] : "3000"[PDAT]))) AND (("constriction, pathologic"[MeSH Terms] OR ("constriction"[All Fields] AND "pathologic"[All Fields]) OR "pathologic constriction"[All Fields] OR "stenosis"[All Fields]) OR "pathological constriction"[All Fields] OR ("constriction, pathologic"[MeSH Terms] OR ("constriction"[All Fields] AND "pathologic"[All Fields]) OR "pathologic constriction"[All Fields] OR ("constriction"[All Fields] AND "pathological"[All Fields]))))

Cervical Fusion and Herniated Disc (56)-June 2011

((("Cervical Vertebrae"[Mesh] AND "Spinal Fusion"[Mesh]) OR (cervical[title] AND fusion[title]) OR "cervical fusion"[All Fields] AND ((Meta-Analysis[ptyp] OR Randomized Controlled Trial[ptyp] OR systematic review[title] OR randomized controlled trial[title]) AND English[lang] AND ("1946"[PDAT] : "3000"[PDAT]))) AND ("herniated disc"[All Fields] OR "herniated disk"[All Fields]))

Cervical Fusion and Axial Pain (5)-June 2011

All Cervical Fusion 1946-, Systematic Reviews, Meta-Analysis and RCTs (102)-June 2011

("Cervical Vertebrae"[Mesh] AND "Spinal Fusion"[Mesh]) OR (cervical[title] AND fusion[title]) OR "cervical fusion"[All Fields] AND ((Meta-Analysis[ptyp] OR Randomized Controlled Trial[ptyp] OR systematic review[title] OR randomized controlled trial[title]) AND English[lang] AND ("1946"[PDAT] : "3000"[PDAT]))

Cervical Fusion or Cervical Arthrodesis Limited to Systematic Reviews, Meta-Analyses, and RCTS (233)-October 2011

("Cervical Vertebrae"[Mesh] OR cervical[title]) AND #"arthrodesis"[Mesh] OR fusion[title]# AND ##Meta-Analysis[ptyp] OR Randomized Controlled Trial[ptyp] OR "systematic review"[title] OR "Randomized Controlled Trials as Topic"[mesh]# AND English[lang]#

Clinical Guidelines Search Parameters

Source: National Guidelines Clearinghouse

Date: November 2011

Term: Cervical fusion

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Evidentiary Tables

For the purpose of recording and reporting the data, the evidentiary table format used for NASS Evidence Based Guideline reviews was adopted. All work group members were trained in evidence analysis, were familiar with the tables, and this facilitated documentation and interpretation of the data.

**Appropriateness Criteria Work Group
Group One Evidentiary Table Treatment**

Article (Alpha by Author)	Explanation of failure to meet guideline inclusion criteria (when applicable)	Level of evidence	Description of study	Conclusion
Anderson, P. A., P. G. Matz, et al. (2009). "Laminectomy and fusion for the treatment of cervical degenerative myelopathy." <i>Journal of Neurosurgery: Spine</i> 11(2): 150-156.	Justification: <input type="checkbox"/> Level V (expert consensus) <input type="checkbox"/> Level IV in presence of higher quality studies <input type="checkbox"/> Subgroup analysis data not available <input type="checkbox"/> Not relevant to question.	Level III Type of evidence therapeutic Notes: Review article only; level III studies identified/ discussed	<input type="checkbox"/> Prospective <input checked="" type="checkbox"/> Retrospective Study design: systematic review Stated objective of study: To use evidence-based medicine to examine the efficacy of cervical laminectomy and fusion for the treatment of cervical spondylotic myelopathy. Type of treatment(s): Laminectomy with various types of fusion, laminoplasty with fusion. Total number of patients: 362 Number of patients in relevant subgroup(s): L+F=217, FDL+F=97, ODL=13, Lamy alone=35 Consecutively assigned? Duration of follow-up: 6 months - 3.5 years Validated outcome measures used (list): Nurick, SF-36, Japanese Orthopaedic Association score Nonvalidated outcome measures used (list): Diagnosis made by: <input type="checkbox"/> Clinical exam/history	<i>Critique of methodology:</i> <input type="checkbox"/> Nonconsecutive patients <input type="checkbox"/> Nonrandomized <input type="checkbox"/> Nonmasked reviewers <input type="checkbox"/> Nonmasked patients <input type="checkbox"/> No validated outcome measures used <input type="checkbox"/> Small sample size <input type="checkbox"/> <80% follow-up <input type="checkbox"/> Lacked subgroup analysis <input type="checkbox"/> Diagnostic method not stated <input checked="" type="checkbox"/> Other: Level III and IV studies--low level of evidence <i>Work group conclusions</i> <i>Potential Level: III</i> <i>Downgraded Level:</i> <i>Conclusions relative to question</i> <i>This paper provides evidence that:</i> Cervical laminectomy with fusion improves outcomes in patients with cervical spondylotic myelopathy. Functional improvement is similar to laminectomy or laminoplasty for cervical spondylotic myelopathy and ossification of the posterior longitudinal ligament. In contrast to laminectomy, cervical laminectomy with fusion is not associated with late deformity. All 11 studies showed the results of laminectomy and

			<input type="checkbox"/> Electromyography <input type="checkbox"/> Myelogram <input type="checkbox"/> MRI <input type="checkbox"/> CT <input type="checkbox"/> CT/Myelogram <input type="checkbox"/> Other: Results/subgroup analysis (relevant to question): All 11 studies showed laminectomy and fusion demonstrated significant improvement in neurologic function in the vast majority of patients (>70%). Author conclusions (relative to question): All 11 studies that retrospectively reviewed the results of laminectomy and fusion demonstrated significant improvement of neurologic function in the vast majority of patients (>70%). Notes:	fusion demonstrated significant improvement of neurologic function in the vast majority of patients (>70%). Notes:
Cho, D. Y., W. Y. Lee, et al. (2004). "Treatment of multilevel cervical fusion with cages." <i>Surg Neurol</i> 62(5): 378-85, discussion 385- 6.	Justification: <input type="checkbox"/> Level V (expert consensus) <input type="checkbox"/> Level IV in presence of higher quality studies <input type="checkbox"/> Subgroup analysis data not available <input type="checkbox"/> Not relevant to question.	Level III Type of evidence therapeutic Notes:	<input checked="" type="checkbox"/> Prospective <input type="checkbox"/> Retrospective Study design: RCT Stated objective of study: Anterior cervical discectomy (ACD) with comparison of polyetheretherketone (PEEK) cages to autogenous iliac crest graft (AICG) fusion with plate and AICG fusion without plate. To compare effect of using PEEK cages in multilevel cervical fusion to the use of iliac crest grafting with or without anterior plating. Type of treatment(s): ACD's with PEEK, AICG with plate, AICU without plate; fusion	<i>Critique of methodology:</i> <input type="checkbox"/> Nonconsecutive patients <input type="checkbox"/> Nonrandomized <input checked="" type="checkbox"/> Nonmasked reviewers <input checked="" type="checkbox"/> Nonmasked patients <input type="checkbox"/> No validated outcome measures used <input type="checkbox"/> Small sample size <input type="checkbox"/> <80% follow-up <input checked="" type="checkbox"/> Lacked subgroup analysis <input checked="" type="checkbox"/> Diagnostic method not stated <input checked="" type="checkbox"/> Other: Levels and number of levels not matched; inclusion criteria, randomization, blinding, pre-op functional levels all not included in this study.

This content of this document 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.

ACF and radiculopathy or myelopathy	Notes:	<p>Total number of patients: 180 Number of patients in relevant subgroup(s): PEEK 60, AICG with plate 50, AICU without plate 70</p> <p>Consecutively assigned? Yes</p> <p>Duration of follow-up: 12 months</p> <p>Validated outcome measures used (list): Prolo</p> <p>Nonvalidated outcome measures used (list): Spinal curvature</p> <p>Diagnosis made by: <input type="checkbox"/> Clinical exam/history <input type="checkbox"/> Electromyography <input type="checkbox"/> Myelogram <input type="checkbox"/> MRI <input type="checkbox"/> CT <input type="checkbox"/> CT/Myelogram <input type="checkbox"/> Other: Not specified</p> <p>Results/subgroup analysis (relevant to question): Complication rates 3.3% A, 16% B, 54.3% C. Fusion rates were better and time to fusion sooner in Groups A and B than C, $p < 0.01$. PEEK had less complications than plating, $p < 0.05$. Group A had a statistically better PROLO scale than C, $p < 0.0001$.</p> <p>There was no subgroup analysis for radiculopathy vs. myelopathy; results were grouped.</p> <p>Author conclusions (relative to question): PEEK preferred due to lower complication rate and less EBL.</p> <p>Cages had better functional outcomes than iliac crest bone graft (ICBG) without plating, but qualitative scale without any prep data.</p>	<p>Work group conclusions Potential Level: II Downgraded Level: III</p> <p>Conclusions relative to question This paper provides evidence that: In patients with radiculopathy, myelopathy or myeloradiculopathy, both PEEK cage without plating and AICG with plating are good methods for interbody fusion in multi-level cervical degenerative disease. They increase spinal lordosis and graft fusion rate and cause fewer surgical complications. Prolo scores improved in all groups postoperatively.</p> <p>Notes:</p>
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<p>Cunningham MR, Hershman S, Bendo J. Systematic review of cohort studies comparing surgical treatments for cervical spondylotic myelopathy. Spine (Phila Pa 1976). 2010 Mar 1;35(5):537-43. Review. PubMed PMID: 20190625.</p> <p>Notes: ACF vs PCF and myelopathy</p>	<p>Justification: <input type="checkbox"/> Level V (expert consensus) <input type="checkbox"/> Level IV in presence of higher quality studies <input type="checkbox"/> Subgroup analysis data not available <input type="checkbox"/> Not relevant to question.</p> <p>Notes:</p>	<p>Level IV</p> <p>Type of evidence therapeutic</p> <p>Notes: Only cohort studies; (level III found in review)</p> <p>Notes:</p> <p><input type="checkbox"/> Prospective <input checked="" type="checkbox"/> Retrospective</p> <p>Study design: systematic review</p> <p>Stated objective of study:</p> <p>STUDY DESIGN: Systematic review of retrospective cohort studies.</p> <p>Stated objective of study: To compare anterior cervical discectomy and fusion (ACDF), corpectomy, laminoplasty, laminectomy results and complications.</p> <p>To compare results for corpectomy and fusion, discectomy and fusion, laminectomy and fusion and laminoplasty for multi-level surgery for spondylitic myelopathy.</p> <p>Type of treatment(s):</p> <p>Total number of patients: Number of patients in relevant subgroup(s):</p> <p>Consecutively assigned?</p> <p>Duration of follow-up: 40 months - 15 years</p> <p>Validated outcome measures used (list): Japanese Orthopaedic Association score, Nurick, NRS for neck pain</p> <p>Nonvalidated outcome measures used (list): Recovery rate, sagittal alignment, range of motion, fusion rate, rate of secondary spondylosis</p> <p>Diagnosis made by: <input checked="" type="checkbox"/> Clinical exam/history</p>	<p>Notes:</p> <p>Critique of methodology: <input type="checkbox"/> Nonconsecutive patients <input type="checkbox"/> Nonrandomized <input type="checkbox"/> Nonmasked reviewers <input type="checkbox"/> Nonmasked patients <input type="checkbox"/> No validated outcome measures used <input type="checkbox"/> Small sample size <input type="checkbox"/> <80% follow-up <input type="checkbox"/> Lacked subgroup analysis <input type="checkbox"/> Diagnostic method not stated <input checked="" type="checkbox"/> Other: Review of level III studies with primary focus on comparison of outcomes with limited subgroup analysis of individual techniques and their respective outcomes.</p> <p>Work group conclusions Potential Level: III Downgraded Level: IV</p> <p>Conclusions relative to question This paper provides evidence that: Several approaches were evaluated for ACDF, and laminectomy and fusion for multi-level disease with myelopathy resulted in significant improvement and results were similar.</p> <p>Notes:</p>
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			<input type="checkbox"/> Electromyography <input type="checkbox"/> Myelogram <input type="checkbox"/> MRI <input type="checkbox"/> CT <input type="checkbox"/> CT/Myelogram <input checked="" type="checkbox"/> Other: ?MRI or other imaging--varied and not fully specified for included studies.	
			<p>Results/subgroup analysis (relevant to question): Four studies compared multi-level corpectomy to laminoplasty; one study compared laminectomy and laminoplasty; two studies compared ACDF and laminoplasty; three studies had 10 year follow-up. Laminoplasty has fewer complications, possibly better range of motion, similar neurologic recovery compared to ACDF, corpectomy and laminectomy.</p> <p>Author conclusions (relative to question): The lack of conclusive data indicating one procedure as being superior to the other reiterates the fact that many good options exist; each with its own set of rewards and failures.</p> <p>All approaches showed similar improvements in neurological function, although the significance of this is not well described and the data are not pooled, laminoplasty had fewer complications but a higher rate of postoperative neck pain.</p> <p>Notes:</p>	
Fouyas, I. P., P. F. X. Statham, et al. (2002). "Cochrane review on the role of surgery	Justification: <input type="checkbox"/> Level V (expert consensus) <input type="checkbox"/> Level IV in presence of higher quality	Level III Type of evidence therapeutic	<input type="checkbox"/> Prospective <input type="checkbox"/> Retrospective Study design: systematic review Stated objective of study: To assess whether surgical treatment of patients with cervical radiculopathy or	Critique of methodology: <input type="checkbox"/> Nonconsecutive patients <input type="checkbox"/> Nonrandomized <input type="checkbox"/> Nonmasked reviewers <input type="checkbox"/> Nonmasked patients <input type="checkbox"/> No validated outcome measures used

in cervical spondylotic radiculomyelopathy." <i>Spine</i> 27(7): 736-747.	studies <input type="checkbox"/> Subgroup analysis data not available <input type="checkbox"/> Not relevant to question.	Notes:	myelopathy results in improved outcomes over nonop care STUDY DESIGN: Cochran Review Type of treatment(s): mixed surgical approaches vs. PT/collar, meds, relative rest Total number of patients: 130 Number of patients in relevant subgroup(s): Consecutively assigned? Duration of follow-up: Validated outcome measures used (list): Visual Analog Scale (VAS) pain, Japanese Orthopedic Association (JOA) Nonvalidated outcome measures used (list): NRS for paresthesias in arm Diagnosis made by: <input type="checkbox"/> Clinical exam/history <input type="checkbox"/> Electromyography <input type="checkbox"/> Myelogram <input checked="" type="checkbox"/> MRI <input type="checkbox"/> CT <input checked="" type="checkbox"/> CT/Myelogram <input type="checkbox"/> Other: Results/subgroup analysis (relevant to question): Results separated out by treatment for radiculopathy or myelopathy, but only one study for each Author conclusions (relative to question): For cervical radiculopathy, surgical care resulted in better improvements in pain and sensory loss than nonop care, but differences not significant by one year, more	<input checked="" type="checkbox"/> Small sample size <input type="checkbox"/> <80% follow-up <input checked="" type="checkbox"/> Lacked subgroup analysis <input type="checkbox"/> Diagnostic method not stated <input type="checkbox"/> Other: Work group conclusions Potential Level: I Downgraded Level: III Conclusions relative to question This paper provides evidence that: As of the time of publication (2002) there was no level I or level II data showing that operative was superior to nonoperative care long term in the management of spondylitic cervical myelopathy or radiculopathy. There was a potential for type II error in the available studies due to small sample sizes. Notes:
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			complications in surgery group, ?type 2 error For myelopathy, the nonop group had better functional (JOA) and gait scores, but there was not difference by two years ~~~~~ Notes:	
Ghogawala, Z., B. Martin, et al. "Comparative Effectiveness of Ventral vs Dorsal Surgery for Cervical Spondylotic Myelopathy." <i>Neurosurgery</i> 68(3): 622-630.	Justification: <input type="checkbox"/> Level V (expert consensus) <input type="checkbox"/> Level IV in presence of higher quality studies <input type="checkbox"/> Subgroup analysis data not available <input type="checkbox"/> Not relevant to question.	Level III Type of evidence therapeutic ~~~~~ Notes:	<input checked="" type="checkbox"/> Prospective <input type="checkbox"/> Retrospective Study design: comparative Stated objective of study: To compare the effectiveness of anterior vs. posterior surgery for the treatment of cervical spondylotic myelopathy. STUDY DESIGN: Non-randomized prospective clinical trial Type of treatment(s): Anterior vs. posterior fusion-- anterior cervical discectomy and fusion (ACDF) & P vs. laminectomy and fusion multi-level. Total number of patients: 50 Number of patients in relevant subgroup(s): 28 ventral fusion, 22 dorsal fusion Consecutively assigned? No Duration of follow-up: 1 year Validated outcome measures used (list): SF-36 physical component, modified Japanese Orthopaedic Association scale (mJOA), EuroQual5D (EQ5D), Oswestry Neck Disability Index (NDI) Nonvalidated outcome measures used (list): Length of	Critique of methodology: <input type="checkbox"/> Nonconsecutive patients <input checked="" type="checkbox"/> Nonrandomized <input checked="" type="checkbox"/> Nonmasked reviewers <input checked="" type="checkbox"/> Nonmasked patients <input type="checkbox"/> No validated outcome measures used <input checked="" type="checkbox"/> Small sample size <input type="checkbox"/> <80% follow-up <input checked="" type="checkbox"/> Lacked subgroup analysis <input type="checkbox"/> Diagnostic method not stated <input type="checkbox"/> Other: Work group conclusions Potential Level: II Downgraded Level: III Conclusions relative to question This paper provides evidence that: Surgery for treating cervical spondylotic myelopathy was followed by significant improvement in disease-specific symptoms and in health related quality of life (HR-QOL). Greater improvement in HR-QOL was observed after ventral surgery. Dorsal fusion surgery was associated with longer length of hospital stay and higher hospital costs. Fusion either dorsally or ventrally improved symptoms and HR-QOL.

			stay, cost, complication rate Diagnosis made by: <input checked="" type="checkbox"/> Clinical exam/history <input type="checkbox"/> Electromyography <input type="checkbox"/> Myelogram <input checked="" type="checkbox"/> MRI <input checked="" type="checkbox"/> CT <input type="checkbox"/> CT/Myelogram <input type="checkbox"/> Other: Results/subgroup analysis (relevant to question): Baseline demographics and health related quality of life (HR-QOL) were comparable between the two groups; however, dorsal surgery patients had significantly more severe myelopathy (p<0.01). Greater HR-QOL improvement was seen on ventral surgery. Complication rate was comparable. Significant improvement in the modified JOA was observed in both groups (p<0.01). Dorsal fusions had increased hospital costs and longer stays. Author conclusions (relative to question): Both groups showed "significant" improvement in health related quality of life and symptoms, more so in those undergoing anterior surgery, although the minimal clinically important differences (MCIDs) for the outcome measures not addressed, concluded that a larger study of this issue is feasible. ~~~~~ Notes:	~~~~~ Notes:
Grob, D., J. V. Peyer, et al. (2001). "The use of plate fixation in anterior surgery	Justification: <input type="checkbox"/> Level V (expert consensus) <input type="checkbox"/> Level IV in presence of higher quality	Level III Type of evidence therapeutic	<input checked="" type="checkbox"/> Prospective <input type="checkbox"/> Retrospective Study design: comparative Stated objective of study:	Critique of methodology: <input type="checkbox"/> Nonconsecutive patients <input checked="" type="checkbox"/> Nonrandomized <input type="checkbox"/> Nonmasked reviewers <input checked="" type="checkbox"/> Nonmasked patients <input type="checkbox"/> No validated outcome measures used

<p>of the degenerative cervical spine: A comparative prospective clinical study." <i>European Spine Journal</i> 10(5): 408-413.</p> <p>Notes: ACF. Diagnostic group not defined; ? axial vs. radicular vs. myelopathy</p>	<p>studies <input type="checkbox"/> Subgroup analysis data not available <input type="checkbox"/> Not relevant to question.</p> <p>Notes: All patients were anterior cervical discectomy and fusion (ACDF) with or without plate.</p>	<p>Notes: Designed as an RCT of plating vs. no plating in patients undergoing anterior single or multilevel fusion for "degenerative conditions," but essentially descriptive case series with poor details as to the underlying diagnoses and pathology.</p>	<p>STUDY DESIGN: Prospective comparative</p> <p>Stated objective of study: To compare the use of plate fixation in anterior surgery of the degenerative cervical spine using bone graft for one or two level fusions.</p> <p>Type of treatment(s): Plate ACDF & P; ACDF - no plate</p> <p>Total number of patients: 50 Number of patients in relevant subgroup(s): ACDF & P 24; ACDF-no plate 26</p> <p>Consecutively assigned? Yes</p> <p>Duration of follow-up: min 22 months</p> <p>Validated outcome measures used (list): Visual analog scale (VAS) pain</p> <p>Nonvalidated outcome measures used (list): Disturbances in sensory, motor weakness, cervical flexion/extension, pain medication, radiographic outcome, motion restriction</p> <p>Diagnosis made by: <input checked="" type="checkbox"/> Clinical exam/history <input type="checkbox"/> Electromyography <input type="checkbox"/> Myelogram <input checked="" type="checkbox"/> MRI <input type="checkbox"/> CT <input type="checkbox"/> CT/Myelogram <input checked="" type="checkbox"/> Other: Plain films</p> <p>Results/subgroup analysis (relevant to question): The reduction in pain and improvement in neurology and functional assessment showed a significant improvement in both ACDF and ACDF & P for one and two level degenerative conditions of the cervical spine.</p>	<p><input checked="" type="checkbox"/> Small sample size <input type="checkbox"/> <80% follow-up <input checked="" type="checkbox"/> Lacked subgroup analysis <input type="checkbox"/> Diagnostic method not stated <input checked="" type="checkbox"/> Other: Mix of single and two-level cervical fusions. Unclear what they were treating--no mention of neck pain vs. radicular pain vs. myelopathy.</p> <p>Work group conclusions Potential Level: II Downgraded Level: III</p> <p>Conclusions relative to question This paper provides evidence that: The reduction in pain, improvement in neurology, and functional assessment showed a significant improvement in both groups compared to the pre-op values. No significant difference between the groups for fusion rating, but bone graft quality was better in the plated group (i.e., graft height). Cervical fusion with or without plating for one or two level cervical disc degeneration was beneficial.</p> <p>Notes:</p>
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			<p>No difference in outcomes between plating vs. no plating except graft quality better with plate, pain reduced equally in both groups.</p> <p>Author conclusions (relative to question): The overall data do not suggest better results with plating in one or two level anterior spine fusions.</p> <p>Relatively poor study from the standpoint of any clinical assessment. No control group not receiving surgery, poor description of patient population/diagnoses, likely underpowered even for primary aim of study.</p> <p>Notes:</p>	
<p>Hacker, R. J., J. C. Cauthen, et al. (2000). "A prospective randomized multicenter clinical evaluation of an anterior cervical fusion cage." <i>Spine (Phila Pa 1976)</i> 25(20): 2646-54; discussion 2655.</p> <p>Notes: ACF and radiculopathy</p>	<p>Justification: <input type="checkbox"/> Level V (expert consensus) <input type="checkbox"/> Level IV in presence of higher quality studies <input type="checkbox"/> Subgroup analysis data not available <input type="checkbox"/> Not relevant to question.</p> <p>Notes: All underwent anterior cervical fusion either with cage or traditional ACDF.</p>	<p>Level III</p> <p>Type of evidence therapeutic</p> <p>Notes: Level I study of cages vs. ACDF, but essentially a case series for surgical fusion for radiculopathy.</p>	<p><input checked="" type="checkbox"/> Prospective <input type="checkbox"/> Retrospective</p> <p>Study design: comparative</p> <p>Stated objective of study:</p> <p>STUDY DESIGN: Prospective comparative</p> <p>Stated objective of study: To compare ACDF with BAK vs. ACDF-bone only in patients with symptomatic cervical discogenic radiculopathy.</p> <p>To assess the efficacy of threaded cages in anterior fusion vs. ACDF without instrumentation in the treatment of cervical radiculopathy.</p> <p>Type of treatment(s): 488 --390 one level; 98 two level, ACDF-BAK, ACDF-bone only</p> <p>Total number of patients: 344 one year; 180 two year Number of patients in relevant subgroup(s): BAK-1 level 142, two level 37; HA-BAK 1-129, 2-38; ACDF 1-119, 2-23? 390 one level, 98 two level?</p>	<p>Critique of methodology: <input type="checkbox"/> Nonconsecutive patients <input type="checkbox"/> Nonrandomized <input checked="" type="checkbox"/> Nonmasked reviewers <input checked="" type="checkbox"/> Nonmasked patients <input type="checkbox"/> No validated outcome measures used <input type="checkbox"/> Small sample size <input checked="" type="checkbox"/> <80% follow-up <input type="checkbox"/> Lacked subgroup analysis <input type="checkbox"/> Diagnostic method not stated <input checked="" type="checkbox"/> Other: Mixed Smith-Robinson and Cloward, both allograft and autograft used. Degree of blinding in process unclear.</p> <p>Work group conclusions Potential Level: II Downgraded Level: III</p> <p>Conclusions relative to question This paper provides evidence that: For patients with radiculopathy and 1-2 level disease ACDF resulted in significant improvement in clinical outcomes at two</p>

			<p>Consecutively assigned?</p> <p>Duration of follow-up: 344 at 1 year, 180 at 2 year</p> <p>Validated outcome measures used (list): SF-36, VAS for neck and for radicular pain</p> <p>Nonvalidated outcome measures used (list): Patient perception of overall outcome, duration of surgery, hospital stay, composite pain relief scale, fusion, complications</p> <p>Diagnosis made by:</p> <p><input checked="" type="checkbox"/> Clinical exam/history</p> <p><input type="checkbox"/> Electromyography</p> <p><input type="checkbox"/> Myelogram</p> <p><input checked="" type="checkbox"/> MRI</p> <p><input checked="" type="checkbox"/> CT</p> <p><input type="checkbox"/> CT/Myelogram</p> <p><input checked="" type="checkbox"/> Other: Plain films</p> <p>Results/subgroup analysis (relevant to question): Both groups showed improvements in SF-36, neck and arm pain, and patients perceptions at one and two years. Fusion rates were higher in single level BAK, 97.9% vs. ACDF, 89.7% ($p<0.05$) and ACDF had a higher complication rate 20.4% vs. BAK=11.8%.</p> <p>Author conclusions (relative to question): Both ACDF and ACDF with BAK showed positive outcomes at one and two years when treating cervical discogenic radiculopathy.</p> <p>Statistically significant and equivalent reductions in neck and arm pain in both groups, higher rate of fusion in cages than bone-only ACDF, no difference on SF-36 physical or mental scales.</p>	<p>years.</p> <p>~~~~~</p> <p>Notes:</p>
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<p>Hermansen, A., R. Hedlund, et al. "A comparison between the carbon fiber cage and the cloward procedure in cervical spine surgery: A ten- to thirteen-year follow-up of a prospective randomized study." <i>Spine</i> 36(12): 919-925.</p> <p>~~~~~</p> <p>Notes:</p> <p>ACF and radiculopathy</p>	<p>Justification:</p> <p><input type="checkbox"/> Level V (expert consensus)</p> <p><input type="checkbox"/> Level IV in presence of higher quality studies</p> <p><input type="checkbox"/> Subgroup analysis data not available</p> <p><input type="checkbox"/> Not relevant to question.</p> <p>~~~~~</p> <p>Notes:</p>	<p>Level III</p> <p>Type of evidence therapeutic</p> <p>~~~~~</p> <p>Notes:</p>	<p><input checked="" type="checkbox"/> Prospective <input type="checkbox"/> Retrospective</p> <p>Study design: RCT</p> <p>Stated objective of study: To compare the 10 to 13 year outcomes of anterior cervical decompression and fusion with a cervical intervertebral fusion cage (CIFC) and the Cloward procedure, CP.</p> <p>To compare the long-term results of anterior cervical fusion with ICBG only vs bone graft with a carbon-fiber cage.</p> <p>Type of treatment(s): CIFC, CP</p> <p>Total number of patients: 103 ----- 95</p> <p>Number of patients in relevant subgroup(s): 49 CIFC; 46 CP</p> <p>Consecutively assigned? Yes</p> <p>Duration of follow-up: 10-13 years</p> <p>Validated outcome measures used (list): VAS, NDI, EuroQOL, self-sufficiency scale</p> <p>Nonvalidated outcome measures used (list): Fusion/healing status</p> <p>Diagnosis made by:</p> <p><input checked="" type="checkbox"/> Clinical exam/history</p> <p><input type="checkbox"/> Electromyography</p> <p><input type="checkbox"/> Myelogram</p> <p><input checked="" type="checkbox"/> MRI</p> <p><input type="checkbox"/> CT</p>	<p>Critique of methodology:</p> <p><input type="checkbox"/> Nonconsecutive patients</p> <p><input type="checkbox"/> Nonrandomized</p> <p><input type="checkbox"/> Nonmasked reviewers</p> <p><input type="checkbox"/> Nonmasked patients</p> <p><input type="checkbox"/> No validated outcome measures used</p> <p><input type="checkbox"/> Small sample size</p> <p><input checked="" type="checkbox"/> <80% follow-up</p> <p><input checked="" type="checkbox"/> Lacked subgroup analysis</p> <p><input type="checkbox"/> Diagnostic method not stated</p> <p><input checked="" type="checkbox"/> Other: Degree of blinding in process unclear.</p> <p>Work group conclusions</p> <p>Potential Level: II</p> <p>Downgraded Level: III</p> <p>Conclusions relative to question</p> <p>This paper provides evidence that The outcomes of the two anterior cervical decompression and fusion using the CIFC and CP methods were equal to 10-13 years follow-up, and there was no deterioration in outcome after the two year follow-up. Pain intensity improved more than disability. Pain intensity was improved in both CIFC and CP groups compared to preop ($p<0.0001$).</p> <p>70/73 were one to two level fusions.</p> <p>~~~~~</p> <p>Notes:</p> <p>77% follow-up</p>

			<input type="checkbox"/> CT/Myelogram <input type="checkbox"/> Other:	<p>Results/subgroup analysis (relevant to question): Apart from greater fulfillment of preop expectation ($p=0.01$) and less headache ($p=0.0005$) in the CIFC group compared with the CP group, there were no significant differences in the outcomes between the two methods. Pain intensity improved in both compared to preop. There was no deterioration in pain intensity or NDI after the two year follow-up. Fusion rate was 86% CP vs 62% CIFC.</p> <p>Author conclusions (relative to question): Both procedures did well at 10 and 13 years.</p> <p>Neck pain lower in both groups at two years and rates stable at 10 years, the improvement as measure by NDI was less robust and noted only in the cage group.</p> <p>Notes:</p>
<p>Kaiser, M. G., P. V. Mummaneni, et al. (2009). "Management of anterior cervical pseudarthrosis." <i>Journal of Neurosurgery, Spine</i> 11(2): 228-237.</p> <p>Notes: ACF or</p>	<p>Justification:</p> <p><input type="checkbox"/> Level V (expert consensus)</p> <p><input type="checkbox"/> Level IV in presence of higher quality studies</p> <p><input type="checkbox"/> Subgroup analysis data not available</p> <p><input type="checkbox"/> Not relevant to question.</p> <p>Notes:</p>	<p>Level IV</p> <p>Type of evidence therapeutic studies</p> <p>Notes: Only level III studies available</p>	<p><input type="checkbox"/> Prospective <input checked="" type="checkbox"/> Retrospective</p> <p>Study design: systematic review</p> <p>Stated objective of study: To identify the best methodology for diagnosis and treatment of anterior pseudarthrosis.</p> <p>Type of treatment(s): Anterior and posterior surgery/revision</p> <p>Total number of patients: 12 studies reviewing total of 240 patients</p> <p>Number of patients in relevant subgroup(s): 240</p>	<p>Critique of methodology:</p> <p><input type="checkbox"/> Nonconsecutive patients</p> <p><input type="checkbox"/> Nonrandomized</p> <p><input type="checkbox"/> Nonmasked reviewers</p> <p><input type="checkbox"/> Nonmasked patients</p> <p><input type="checkbox"/> No validated outcome measures used</p> <p><input type="checkbox"/> Small sample size</p> <p><input type="checkbox"/> <80% follow-up</p> <p><input type="checkbox"/> Lacked subgroup analysis</p> <p><input type="checkbox"/> Diagnostic method not stated</p> <p><input type="checkbox"/> Other:</p> <p>Work group conclusions</p> <p>Potential Level: III</p>

<p>PCF and pseudoarthrosis</p>	<p>Deals with management of anterior cervical pseudarthrosis rather than the overall benefit of cervical fusion.</p>		<p>Consecutively assigned? No</p> <p>Duration of follow-up: Variable and most, but not all, reported. Of those reported, minimum average of 18 months.</p> <p>Validated outcome measures used (list): They used a variety of outcomes and were not consistent across studies.</p> <p>Nonvalidated outcome measures used (list): Most used surrogate radiographic measures of outcomes. Also included were a variety of non-validated outcomes scales.</p> <p>Diagnosis made by:</p> <p><input checked="" type="checkbox"/> Clinical exam/history</p> <p><input type="checkbox"/> Electromyography</p> <p><input type="checkbox"/> Myelogram</p> <p><input type="checkbox"/> MRI</p> <p><input checked="" type="checkbox"/> CT</p> <p><input type="checkbox"/> CT/Myelogram</p> <p><input checked="" type="checkbox"/> Other:</p> <p>Results/subgroup analysis (relevant to question):</p> <p>Author conclusions (relative to question): Reviewed 12 studies with a total of 240 patients who had pseudoarthrosis believed to be symptomatic. These were very heterogeneous data. Not all patients with pseudoarthrosis were symptomatic, and no conclusions could be drawn regarding predictors for pain in the presence of a pseudoarthrosis, nor predictors for favorable outcomes in the presence of a successful radiographic fusion following revision surgery. In these series, the majority of patients improved clinically, although results were vulnerable to bias, non-validated outcome measures, and poor study designs in general.</p>	<p>Downgraded Level: IV</p> <p>Conclusions relative to question</p> <p>This paper provides evidence that: If suspected, pseudoarthrosis should be investigated because there may be an association between arthrodesis and outcome. However, the strength of this association cannot be accurately determined. Anterior and posterior approaches have been successful. For clinical symptomatic pseudoarthrosis, both anterior and posterior fusion approaches have been successful.</p> <p>There is insufficient data on the diagnosis, treatment and clinical relevance of cervical pseudoarthroses.</p> <p>Notes:</p> <p>Review was limited to retrospective case series that are limited due to selection bias, use of nonvalidated clinical measures, subjective radiographic evaluations, reporting bias, and insufficient statistical analysis. The association of symptoms and pseudoarthrosis was usually not clear, but in the presence of symptoms and pseudoarthrosis in these studies, patients underwent revision fusion on the assumption that radiographic and clinical findings were related. Most patients ultimately obtained a solid arthrodesis, and most demonstrated clinical improvement. However, current studies have not been able to determine the prognostic factors that would indicate a favorable outcome. Reoperative anterior and posterior approaches both appear to be viable surgical alternatives. Valid conclusions regarding the</p>
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			<p>Radiographic fusion for revision surgery was obtained with both anterior and posterior fusion, and some even looked at revision 360 degree fusions. Again, due to limitations of the data, no definitive conclusions could be drawn, but there seemed to be trend towards higher success rate of radiographic fusion with posterior revision over anterior revision surgery.</p> <p>~~~~~</p> <p>Notes:</p>	<p>superiority of one approach over another are debatable; however, the limited data suggests that the posterior approach may have a greater potential for solid arthrodesis and clinical improvement.</p>
<p>Kast, E., S. Derakhshani, et al. (2009). "Subsidence after anterior cervical interbody fusion. A randomized prospective clinical trial." <i>Neurosurg Rev</i> 32(2): 207-14; discussion 214.</p> <p>Notes: ACF and radiculopathy or myelopathy</p>	<p>Justification: <input type="checkbox"/> Level V (expert consensus) <input type="checkbox"/> Level IV in presence of higher quality studies <input type="checkbox"/> Subgroup analysis data not available <input checked="" type="checkbox"/> Not relevant to question.</p> <p>~~~~~</p> <p>Notes: Deals with more cage design and subsidence in ACDF rather than the overall clinical improvement.</p> <p>~~~~~</p> <p>Authors studied 60 patients to determine relative loss of correction of lordosis/ subsidence with different cervical</p>	<p>Level III</p> <p>Type of evidence therapeutic</p> <p>~~~~~</p> <p>Notes:</p>	<p><input checked="" type="checkbox"/> Prospective <input type="checkbox"/> Retrospective</p> <p>Study design: RCT</p> <p>Stated objective of study: To assess whether the cage design influences the extent of correction loss during follow-up.</p> <p>Type of treatment(s): Solis cage (Group 1); Shell cage (Group 2)</p> <p>Total number of patients: 60 Number of patients in relevant subgroup(s): 30 Solis; 30 Shell</p> <p>Consecutively assigned?</p> <p>Duration of follow-up: 6 months</p> <p>Validated outcome measures used (list): Odom</p> <p>Nonvalidated outcome measures used (list): Radiographic</p> <p>Diagnosis made by: <input checked="" type="checkbox"/> Clinical exam/history <input type="checkbox"/> Electromyography <input type="checkbox"/> Myelogram <input type="checkbox"/> MRI</p>	<p>Critique of methodology: <input type="checkbox"/> Nonconsecutive patients <input type="checkbox"/> Nonrandomized <input type="checkbox"/> Nonmasked reviewers <input type="checkbox"/> Nonmasked patients <input type="checkbox"/> No validated outcome measures used <input type="checkbox"/> Small sample size <input type="checkbox"/> <80% follow-up <input type="checkbox"/> Lacked subgroup analysis <input type="checkbox"/> Diagnostic method not stated <input type="checkbox"/> Other:</p> <p>~~~~~</p> <p>Work group conclusions Potential Level: II Downgraded Level: III</p> <p>~~~~~</p> <p>Conclusions relative to question This paper provides evidence that:</p> <p>For single radiculopathy or myelopathy that ACDF for one level has good clinical outcomes at six months.</p> <p>~~~~~</p> <p>Notes:</p>

	cages.		<p><input type="checkbox"/> CT <input type="checkbox"/> CT/Myelogram <input checked="" type="checkbox"/> Other: Flexion/extension C-spine films</p> <p>Results/subgroup analysis (relevant to question): Statistically, the subsidence was significantly higher at three and six months in Group 1-Solis cage, than in Group 2-Shell cage; however, clinical results showed no significant difference.</p> <p>Author conclusions (relative to question): Although there was no significant difference in a short-term clinical result between the two treatment groups, we recommend the use of cages which preserve the determined segmental height and lordosis.</p> <p>~~~~~</p> <p>Notes:</p>	
<p>Lian XF, Xu JG, Zeng BF, Zhou W, Kong WQ, Hou TS. Noncontiguous anterior decompression and fusion for multilevel cervical spondylotic myelopathy: a prospective randomized control clinical study. <i>Eur Spine J</i>. 2010 May;19(5):713-9. Epub 2010 Feb 21.</p>	<p>Justification: <input type="checkbox"/> Level V (expert consensus) <input type="checkbox"/> Level IV in presence of higher quality studies <input type="checkbox"/> Subgroup analysis data not available <input type="checkbox"/> Not relevant to question.</p> <p>~~~~~</p> <p>Notes:</p>	<p>Level II</p> <p>Type of evidence therapeutic</p> <p>~~~~~</p> <p>Notes:</p>	<p><input checked="" type="checkbox"/> Prospective <input type="checkbox"/> Retrospective</p> <p>Study design: RCT</p> <p>Stated objective of study: To assess the relative effects of contiguous vs. non-contiguous fusion techniques in the surgical treatment on multi-level cervical spondylotic myelopathy.</p> <p>Type of treatment(s):</p> <p>Total number of patients: 105 Number of patients in relevant subgroup(s): Noncontiguous anterior decompression and fusion (NADF) 55; Contiguous corpectomies and fusion (CCF) 50</p> <p>Consecutively assigned? Yes</p> <p>Duration of follow-up: 24 - 48 months</p>	<p>Critique of methodology: <input type="checkbox"/> Nonconsecutive patients <input type="checkbox"/> Nonrandomized <input checked="" type="checkbox"/> Nonmasked reviewers <input checked="" type="checkbox"/> Nonmasked patients <input type="checkbox"/> No validated outcome measures used <input type="checkbox"/> Small sample size <input type="checkbox"/> <80% follow-up <input type="checkbox"/> Lacked subgroup analysis <input type="checkbox"/> Diagnostic method not stated <input type="checkbox"/> Other:</p> <p>~~~~~</p> <p>Work group conclusions Potential Level: Downgraded Level:</p> <p>~~~~~</p> <p>Conclusions relative to question This paper provides evidence that: Significant clinical improvement was</p>

<p>PubMed PMID: 20174838; PubMed Central PMCID: PMC2899955.</p> <p>~~~~~</p> <p>Notes: ACF and myelopathy and > 2 level disease</p>		<p>Validated outcome measures used (list): Visual Analog Scale (VAS pain), Japanese Orthopedic Association (JOA)</p> <p>Nonvalidated outcome measures used (list): Flexion/extension, fusion, neuro improvement</p> <p>Diagnosis made by: <input checked="" type="checkbox"/> Clinical exam/history <input type="checkbox"/> Electromyography <input type="checkbox"/> Myelogram <input checked="" type="checkbox"/> MRI <input type="checkbox"/> CT <input type="checkbox"/> CT/Myelogram <input checked="" type="checkbox"/> Other: Radiology - flexion/extension/lateral</p> <p>Results/subgroup analysis (relevant to question): In patients with multi-level cervical spondylotic myelopathy without developmental stenosis or ossification of posterior longitudinal ligament, NADF and CCF showed an identical effect of decompression. In terms of surgical time, estimated blood loss, VAS, fusion rate and cervical alignment, NADF was superior compared with CCF.</p> <p>Author conclusions (relative to question): JOA unchanged between groups. VAS favors NADF.</p> <p>Significant improvements in pain and function as measured by JOA in both groups, pain improvement greater in non-contiguous approach, fusion/OR outcomes better in non-contiguous patients, as well. Majority of patients in both groups reported subjective neurological improvement.</p> <p>~~~~~</p>	<p><i>noted in patients with greater than two level disease and cervical myelopathy following anterior cervical decompression and fusion at minimim two year follow-up.</i></p> <p>~~~~~</p> <p>Notes:</p>
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		<p>Notes: Study compared the two approaches--no controls without surgery</p>	
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**Appropriateness Criteria Work Group
Group Two Evidentiary Table Treatment-Final**

Article (Alpha by Author)	Explanation of failure to meet guideline inclusion criteria (when applicable)	Level of evidence	Description of study	Conclusion
Nunley, P. D., A. Jawahar, et al. (2009). "Choice of plate may affect outcomes for single versus multilevel ACDF: results of a prospective randomized single-blind trial." <i>Spine J</i> 9(2): 121-7. Notes: ACF and radiculopathy	Justification: <input type="checkbox"/> Level V (expert consensus) <input type="checkbox"/> Level IV in presence of higher quality studies <input type="checkbox"/> Subgroup analysis data not available <input type="checkbox"/> Not relevant to question. Notes:	Level II Type of evidence therapeutic Notes:	<input checked="" type="checkbox"/> Prospective <input type="checkbox"/> Retrospective Study design: RCT Stated objective of study: To compare fixed angle to dynamic plates for anterior cervical discectomy with fusion (ACDF) for degenerative disc disease (single and multi-level disease). To determine the clinical and radiologic efficacy of dynamic vs. static plates. Type of treatment(s): ACDF Total number of patients: 66 Number of patients in relevant subgroup(s): 66 Consecutively assigned? Yes Duration of follow-up: 12-24 months; mean 16 months Validated outcome measures used (list): Neck Disability Index (NDI), Visual Analog Scale (VAS) Nonvalidated outcome measures used (list): Diagnosis made by: <input checked="" type="checkbox"/> Clinical exam/history <input type="checkbox"/> Electromyography <input type="checkbox"/> Myelogram	<i>Critique of methodology:</i> <input type="checkbox"/> Nonconsecutive patients <input type="checkbox"/> Nonrandomized <input checked="" type="checkbox"/> Nonmasked reviewers <input type="checkbox"/> Nonmasked patients <input type="checkbox"/> No validated outcome measures used <input type="checkbox"/> Small sample size <input type="checkbox"/> <80% follow-up <input checked="" type="checkbox"/> Lacked subgroup analysis <input type="checkbox"/> Diagnostic method not stated <input type="checkbox"/> Other: <i>Work group conclusions</i> <i>Potential Level:</i> <i>Downgraded Level:</i> <i>Conclusions relative to question</i> <i>This paper provides evidence that: There is significant improvement in NDI and VAS in patients undergoing ACDF and plating for radiculopathy.</i> Notes:
			<input type="checkbox"/> MRI <input type="checkbox"/> CT <input type="checkbox"/> CT/Myelogram <input checked="" type="checkbox"/> Other: X-rays Results/subgroup analysis (relevant to question): Both subgroups were relevant. In single level disease, there is no difference between plate designs. In multi-level disease, a dynamic plate is more likely to lead to fusion. Author conclusions (relative to question): Authors concluded that dynamic plates should be considered for multi-level ACDF due to better clinical outcomes. There is no nonoperative arm to determine if cervical fusion leads to better clinical outcomes. Notes: Twenty-eight patients had single level fusion and 38 had 2-3 levels.	
Peolsson A. Investigation of clinically important benefit of anterior cervical decompression and fusion. <i>Eur Spine J</i> . 2007 Apr;16(4):507-14. Epub 2006 Dec 2. PubMed PMID: 17143633; PubMed Central PMCID: PMC2229815	Justification: <input type="checkbox"/> Level V (expert consensus) <input type="checkbox"/> Level IV in presence of higher quality studies <input type="checkbox"/> Subgroup analysis data not available <input type="checkbox"/> Not relevant to question. Notes:	Level II Type of evidence therapeutic Notes:	<input checked="" type="checkbox"/> Prospective <input type="checkbox"/> Retrospective Study design: RCT Stated objective of study: To compare anterior cervical discectomy with fusion (ACDF) with cage versus "cloward procedure." To determine minimal clinically important difference for ACDF. Evaluate effectiveness of ACDF over time. Type of treatment(s): Surgery; ACDF Total number of patients: 95 (89 at 2 years however);	<i>Critique of methodology:</i> <input checked="" type="checkbox"/> Nonconsecutive patients <input checked="" type="checkbox"/> Nonrandomized <input type="checkbox"/> Nonmasked reviewers <input checked="" type="checkbox"/> Nonmasked patients <input type="checkbox"/> No validated outcome measures used <input type="checkbox"/> Small sample size <input type="checkbox"/> <80% follow-up <input checked="" type="checkbox"/> Lacked subgroup analysis <input type="checkbox"/> Diagnostic method not stated <input checked="" type="checkbox"/> Other: no power analysis <i>Work group conclusions</i> <i>Potential Level:</i> <i>Downgraded Level:</i>

Notes: ACF and radiculopathy			<p>103</p> <p>Number of patients in relevant subgroup(s): 89</p> <p>Consecutively assigned? No</p> <p>Duration of follow-up: range of follow-up 56-94 months</p> <p>Validated outcome measures used (list): Neck Disability Index (NDI), Visual Analog Scale (VAS)</p> <p>Nonvalidated outcome measures used (list):</p> <p>Diagnosis made by:</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Clinical exam/history <input type="checkbox"/> Electromyography <input type="checkbox"/> Myelogram <input type="checkbox"/> MRI <input type="checkbox"/> CT <input type="checkbox"/> CT/Myelogram <input type="checkbox"/> Other: <p>Results/subgroup analysis (relevant to question):</p> <p>Seventy eight percent of patients had less pain than preop at the six year mark. "Clinically important difference" was defined by 50% reduction in pain or 20% improvement in NDI.</p> <p>Seventy eight percent of patients improved by ten points in their pain. At six year follow-up, 18% of patients had a 20% improvement in their NDI.</p> <p>Author conclusions (relative to question): Authors concluded that cervical fusion for radiculopathy improves pain but does not improve disability.</p> <p>There was a 50% chance of pain relief and little probability of functional improvement.</p>	<p>Conclusions relative to question</p> <p>This paper provides evidence that About half of patients with ACDF will feel that their preop pain is at least 50% improved at six years.</p> <p>After cervical fusion, patients can expect greater pain improvement than disability improvement at six year follow-up.</p> <p>Notes:</p>
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<p>Pitzen, T. R., J. Chrobok, et al. (2009). "Implant complications, fusion, loss of lordosis, and outcome after anterior cervical plating with dynamic or rigid plates: two-year results of a multicentric, randomized, controlled study." <i>Spine (Phila Pa 1976)</i> 34(7): 641-6</p> <p>Notes: ACF. No mention of diagnostic category. Goal was to compare dynamic vs. static plating</p>	<p>Justification:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Level V (expert consensus) <input type="checkbox"/> Level IV in presence of higher quality studies <input type="checkbox"/> Subgroup analysis data not available <input type="checkbox"/> Not relevant to question. <p>Notes:</p>	<p>Level II</p> <p>Type of evidence therapeutic</p> <p>Notes:</p>	<p>Notes:</p> <p>Neck pain and radiculopathy (no myelopathy) at least six months duration.</p> <p><input checked="" type="checkbox"/> Prospective <input type="checkbox"/> Retrospective</p> <p>Study design: RCT</p> <p>Stated objective of study: To compare anterior cervical discectomy with fusion (ACDF) with dynamic versus static plate.</p> <p>Type of treatment(s): dynamic vs. static plate ACDF</p> <p>Total number of patients: 132</p> <p>Number of patients in relevant subgroup(s):</p> <p>Consecutively assigned?</p> <p>Duration of follow-up: 2 years</p> <p>Validated outcome measures used (list): Visual Analog Scale (VAS), Neck Disability Index (NDI)</p> <p>Nonvalidated outcome measures used (list):</p> <p>Diagnosis made by:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Clinical exam/history <input type="checkbox"/> Electromyography <input type="checkbox"/> Myelogram <input type="checkbox"/> MRI <input type="checkbox"/> CT <input type="checkbox"/> CT/Myelogram <input type="checkbox"/> Other: <p>Results/subgroup analysis (relevant to question): There were more (4) implant failures (e.g., screw breakage) with fixed angle plate compared to dynamic plates (0), 1- and 2 -level surgery, no difference in clinical outcome.</p>	<p>Critique of methodology:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Nonconsecutive patients <input type="checkbox"/> Nonrandomized <input type="checkbox"/> Nonmasked reviewers <input type="checkbox"/> Nonmasked patients <input type="checkbox"/> No validated outcome measures used <input type="checkbox"/> Small sample size <input type="checkbox"/> <80% follow-up <input type="checkbox"/> Lacked subgroup analysis <input type="checkbox"/> Diagnostic method not stated <input checked="" type="checkbox"/> Other: No statistical analysis <p>Work group conclusions</p> <p>Potential Level:</p> <p>Downgraded Level:</p> <p>Conclusions relative to question</p> <p>This paper provides evidence that A dynamic plate may lessen the chance for hardware failure following 1- or 2-level ACDF. Looking at both groups together both the VAS and NDI improved; however, statistical analysis was not performed.</p> <p>Notes:</p>
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			<p>Author conclusions (relative to question): Authors concluded that dynamic plates were favored based on radiographic parameters.</p> <p>~~~~~</p> <p>Notes: Mixture of pathology, some compression fractures.</p>	
<p>Riew KD, Buchowski JM, Sasso R, Zdeblick T, Metcalf NH, Anderson PA. Cervical disc arthroplasty compared with arthrodesis for the treatment of myelopathy. J Bone Joint Surg Am. 2008 Nov;90(11):2354-64. PubMed PMID: 18978404.</p> <p>Notes: ACF and myelopathy</p>	<p>Justification: <input type="checkbox"/> Level V (expert consensus) <input type="checkbox"/> Level IV in presence of higher quality studies <input type="checkbox"/> Subgroup analysis data not available <input type="checkbox"/> Not relevant to question.</p> <p>Notes:</p>	<p>Level III</p> <p>Type of evidence therapeutic</p> <p>Notes:</p>	<p><input checked="" type="checkbox"/> Prospective <input type="checkbox"/> Retrospective</p> <p>Study design: comparative</p> <p>Stated objective of study: Analysis of cervical disc arthroplasty versus arthrodesis for myelopathy.</p> <p>Type of treatment(s): Anterior cervical discectomy with fusion (ACDF) versus disc replacement (Prestige & Bryan)</p> <p>Total number of patients: 199 Number of patients in relevant subgroup(s): 106 cervical; 93 ACDF</p> <p>Consecutively assigned? No</p> <p>Duration of follow-up: 24 months</p> <p>Validated outcome measures used (list): Neck Disability Index (NDI), SF-36, Nurick scale</p> <p>Nonvalidated outcome measures used (list):</p> <p>Diagnosis made by: <input checked="" type="checkbox"/> Clinical exam/history <input type="checkbox"/> Electromyography <input type="checkbox"/> Myelogram <input type="checkbox"/> MRI <input type="checkbox"/> CT <input type="checkbox"/> CT/Myelogram <input type="checkbox"/> Other:</p>	<p>Critique of methodology: <input type="checkbox"/> Nonconsecutive patients <input type="checkbox"/> Nonrandomized <input type="checkbox"/> Nonmasked reviewers <input type="checkbox"/> Nonmasked patients <input type="checkbox"/> No validated outcome measures used <input type="checkbox"/> Small sample size <input type="checkbox"/> <80% follow-up <input type="checkbox"/> Lacked subgroup analysis <input type="checkbox"/> Diagnostic method not stated <input type="checkbox"/> Other:</p> <p>Work group conclusions Potential Level: II Downgraded Level: III</p> <p>Conclusions relative to question This paper provides evidence that ACDF results in improvement in patients with cervical spondylotic myelopathy or herniated nucleus pulposus causing myelopathy.</p> <p>Notes:</p>

			<p>Results/subgroup analysis (relevant to question): ACDF and arthroplasty are equivalent for single level cervical spondylotic myelopathy or myelopathy from herniated nucleus pulposus.</p> <p>Author conclusions (relative to question): Arthroplasty and arthrodesis groups had improvement following surgery. Arthroplasty equivalent to arthrodesis for treatment of cervical myelopathy.</p> <p>~~~~~</p> <p>Notes:</p>	
<p>Steinmetz MP, Patel R, Traynelis V, Resnick DK, Anderson PA. Cervical disc arthroplasty compared with fusion in a workers' compensation population. Neurosurgery. 2008 Oct;63(4):741-7; discussion 747. PubMed PMID: 18981885</p> <p>Notes: ACF and work comp. No subgroup differentiation of radiculopathy and myelopathy</p>	<p>Justification: <input type="checkbox"/> Level V (expert consensus) <input type="checkbox"/> Level IV in presence of higher quality studies <input type="checkbox"/> Subgroup analysis data not available <input type="checkbox"/> Not relevant to question.</p> <p>Notes:</p>	<p>Level III</p> <p>Type of evidence therapeutic</p> <p>Notes:</p>	<p><input checked="" type="checkbox"/> Prospective <input type="checkbox"/> Retrospective</p> <p>Study design: comparative</p> <p>Stated objective of study: Return to work in workers' compensation population;</p> <p>Type of treatment(s): Anterior cervical discectomy with fusion (ACDF) versus arthroplasty.</p> <p>Total number of patients: 93 Number of patients in relevant subgroup(s): 46 fusion, 47 arthroplasty</p> <p>Consecutively assigned?</p> <p>Duration of follow-up: 24 months</p> <p>Validated outcome measures used (list): Neck Disability Index (NDI)</p> <p>Nonvalidated outcome measures used (list):</p> <p>Diagnosis made by: <input type="checkbox"/> Clinical exam/history <input type="checkbox"/> Electromyography</p>	<p>Critique of methodology: <input type="checkbox"/> Nonconsecutive patients <input type="checkbox"/> Nonrandomized <input type="checkbox"/> Nonmasked reviewers <input type="checkbox"/> Nonmasked patients <input type="checkbox"/> No validated outcome measures used <input type="checkbox"/> Small sample size <input type="checkbox"/> <80% follow-up <input checked="" type="checkbox"/> Lacked subgroup analysis <input type="checkbox"/> Diagnostic method not stated <input type="checkbox"/> Other:</p> <p>Work group conclusions Potential Level: Downgraded Level:</p> <p>Conclusions relative to question This paper provides evidence that ACDF in workers' compensation patients results in a return to work rate between 16 and 60% at two years following surgery.</p> <p>Fifty-three percent of patients return to work after ACDF at three months.</p>

			<input type="checkbox"/> Myelogram <input type="checkbox"/> MRI <input type="checkbox"/> CT <input type="checkbox"/> CT/Myelogram <input type="checkbox"/> Other: Results/subgroup analysis (relevant to question): Author conclusions (relative to question): Fifty-three percent of patients after ACDF returned to work. Notes:	<p>There was a 20 point improvement in NDI at two years.</p> <p>~~~~~</p> <p>Notes:</p>
<p>Ying Z, Xinwei W, Jing Z, Shengming X, Bitao L, Tao Z, Wen Y. Cervical corpectomy with preserved posterior vertebral wall for cervical spondylotic myelopathy: a randomized control clinical study. Spine (Phila Pa 1976). 2007 Jun 15;32(14):1482-7. PubMed PMID: 17572615</p> <p>Notes: ACF and myelopathy</p>	<p>Justification: <input type="checkbox"/> Level V (expert consensus) <input type="checkbox"/> Level IV in presence of higher quality studies <input type="checkbox"/> Subgroup analysis data not available <input type="checkbox"/> Not relevant to question.</p> <p>Notes:</p>	<p>Level II</p> <p>Type of evidence therapeutic</p> <p>Notes:</p>	<input checked="" type="checkbox"/> Prospective <input type="checkbox"/> Retrospective Study design: RCT Stated objective of study: To compare cervical corpectomy with preserved posterior wall (CPW) versus conventional corpectomy (CC.) Type of treatment(s): cervical corpectomy with preserved posterior wall; conventional corpectomy Total number of patients: 178 Number of patients in relevant subgroup(s): 89, 89 Consecutively assigned? Yes Duration of follow-up: 1 year Validated outcome measures used (list): Japanese Orthopedic Association score Nonvalidated outcome measures used (list): Diagnosis made by: <input checked="" type="checkbox"/> Clinical exam/history	<p>Critique of methodology: <input checked="" type="checkbox"/> Nonconsecutive patients <input checked="" type="checkbox"/> Nonrandomized <input checked="" type="checkbox"/> Nonmasked reviewers <input type="checkbox"/> Nonmasked patients <input type="checkbox"/> No validated outcome measures used <input type="checkbox"/> Small sample size <input type="checkbox"/> <80% follow-up <input type="checkbox"/> Lacked subgroup analysis <input type="checkbox"/> Diagnostic method not stated <input type="checkbox"/> Other:</p> <p>Work group conclusions Potential Level: Downgraded Level:</p> <p>Conclusions relative to question This paper provides evidence that Anterior corpectomy with or without preservation of the posterior vertebral body wall can result in good outcomes for cervical spondylotic myelopathy.</p> <p>JOA improves with anterior corpectomy</p>
			<input type="checkbox"/> Electromyography <input type="checkbox"/> Myelogram <input type="checkbox"/> MRI <input type="checkbox"/> CT <input type="checkbox"/> CT/Myelogram <input type="checkbox"/> Other: Results/subgroup analysis (relevant to question): Operation and estimated blood loss (EBL) was less in the CPW group with similar JOA improvement scores. Author conclusions (relative to question): Notes:	<p>and fusion.</p> <p>~~~~~</p> <p>Notes:</p>
<p>Yu, L., Y. Song, et al. "Systematic Review and Meta-analysis of Randomized Controlled Trials: Comparison of Total Disc Replacement With Anterior Cervical Decompression and Fusion." <i>Orthopedics</i> 34(10): e651-8</p> <p>Notes: ACF and radiculopathy</p>	<p>Justification: <input type="checkbox"/> Level V (expert consensus) <input type="checkbox"/> Level IV in presence of higher quality studies <input type="checkbox"/> Subgroup analysis data not available <input type="checkbox"/> Not relevant to question.</p> <p>Notes:</p>	<p>Level I</p> <p>Type of evidence therapeutic</p> <p>Notes:</p>	<input checked="" type="checkbox"/> Prospective <input type="checkbox"/> Retrospective Study design: meta-analysis Stated objective of study: Compare total disc replacement (TDR) to anterior cervical discectomy with fusion (ACDF); anterior cervical discectomy (ACD) versus single level ACDF. Type of treatment(s): surgery Total number of patients: Number of patients in relevant subgroup(s): 574 Consecutively assigned? No Duration of follow-up: 2 years Validated outcome measures used (list): Neck Disability Index (NDI), Visual Analog Scale (VAS), SF-36 Nonvalidated outcome measures used (list):	<p>Critique of methodology: <input type="checkbox"/> Nonconsecutive patients <input type="checkbox"/> Nonrandomized <input type="checkbox"/> Nonmasked reviewers <input type="checkbox"/> Nonmasked patients <input type="checkbox"/> No validated outcome measures used <input type="checkbox"/> Small sample size <input type="checkbox"/> <80% follow-up <input checked="" type="checkbox"/> Lacked subgroup analysis <input type="checkbox"/> Diagnostic method not stated <input type="checkbox"/> Other:</p> <p>Work group conclusions Potential Level: Downgraded Level:</p> <p>Conclusions relative to question This paper provides evidence that Patients who undergo ACDF for radiculopathy achieve clinical success (improvement in VAS, NDI and improved or sustained neurologic function).</p>

			<p>Diagnosis made by:</p> <p><input checked="" type="checkbox"/> Clinical exam/history</p> <p><input type="checkbox"/> Electromyography</p> <p><input type="checkbox"/> Myelogram</p> <p><input checked="" type="checkbox"/> MRI</p> <p><input type="checkbox"/> CT</p> <p><input type="checkbox"/> CT/Myelogram</p> <p><input type="checkbox"/> Other:</p> <p>Results/subgroup analysis (relevant to question): ACD was superior in overall success rate, reoperation rate and VAS.</p> <p>Author conclusions (relative to question): Sixty-eight percent of patients who received ACDF achieved clinical success.</p> <p>ACD was more beneficial compared to one level ACDF.</p> <p>Notes:</p>	<p>Notes:</p>
<p>Zoëga B, Karrholm J, Lind B. Plate fixation adds stability to two-level anterior fusion in the cervical spine: a randomized study using radiostereometry. Eur Spine J. 1998;7(4):302-7. PubMed PMID: 9765038</p> <p>Notes:</p>	<p>Justification:</p> <p><input type="checkbox"/> Level V (expert consensus)</p> <p><input type="checkbox"/> Level IV in presence of higher quality studies</p> <p><input type="checkbox"/> Subgroup analysis data not available</p> <p><input type="checkbox"/> Not relevant to question.</p> <p>Notes:</p>	<p>Level III</p> <p>Type of evidence: therapeutic</p> <p>Notes:</p>	<p><input checked="" type="checkbox"/> Prospective <input type="checkbox"/> Retrospective</p> <p>Study design: comparative</p> <p>Stated objective of study: To determine radiographic value of plate fixation in anterior cervical discectomy with fusion (ACDF).</p> <p>Type of treatment(s): ACDF with and without plate</p> <p>Total number of patients: 18</p> <p>Number of patients in relevant subgroup(s): 18</p> <p>Consecutively assigned? Yes</p> <p>Duration of follow-up: 12 months</p>	<p>Critique of methodology:</p> <p><input type="checkbox"/> Nonconsecutive patients</p> <p><input type="checkbox"/> Nonrandomized</p> <p><input type="checkbox"/> Nonmasked reviewers</p> <p><input type="checkbox"/> Nonmasked patients</p> <p><input type="checkbox"/> No validated outcome measures used</p> <p><input checked="" type="checkbox"/> Small sample size</p> <p><input type="checkbox"/> <80% follow-up</p> <p><input checked="" type="checkbox"/> Lacked subgroup analysis</p> <p><input type="checkbox"/> Diagnostic method not stated</p> <p><input type="checkbox"/> Other:</p> <p>Work group conclusions</p> <p>Potential Level:</p> <p>Downgraded Level:</p>
<p>ACF and radiculopathy and plate vs. no plate</p>			<p>Validated outcome measures used (list): Visual Analog Scale (VAS), Neck and Arm Pain</p> <p>Nonvalidated outcome measures used (list):</p> <p>Diagnosis made by:</p> <p><input type="checkbox"/> Clinical exam/history</p> <p><input type="checkbox"/> Electromyography</p> <p><input type="checkbox"/> Myelogram</p> <p><input type="checkbox"/> MRI</p> <p><input type="checkbox"/> CT</p> <p><input type="checkbox"/> CT/Myelogram</p> <p><input type="checkbox"/> Other:</p> <p>Results/subgroup analysis (relevant to question): Radiographic outcomes were inferior without a plate with ACDF.</p> <p>Patients who underwent ACDF had a 3.4 point improvement in the VAS arm pain.</p> <p>Author conclusions (relative to question): Mainly radiographic outcomes; patients who received a plate fixation had statistically less arm pain than patients without a plate.</p> <p>Notes:</p>	<p>Conclusions relative to question</p> <p>This paper provides evidence that VAS arm pain decreased 5.1 to 1.7 at one year follow-up in individuals who undergo ACDF with a plate.</p> <p>Notes:</p>

Appropriateness Criteria Work Group
Evidentiary Table Prognostic

Article (Alpha by Author)	Explanation of failure to meet guideline inclusion criteria (when applicable)	Level of evidence	Description of study	Conclusion
Anderson PA, Subach BR, Riew KD. Predictors of outcome after anterior cervical discectomy and fusion: a multivariate analysis. Spine (Phila Pa 1976). 2009 Jan 15;34(2):161-6. PubMed PMID: 19139666.	<input type="checkbox"/> Level V (expert consensus) <input type="checkbox"/> Level IV in presence of higher quality studies <input type="checkbox"/> Subgroup analysis data not available <input type="checkbox"/> Not relevant to question.	Level II Type of evidence prognostic Notes:	<input type="checkbox"/> Prospective <input checked="" type="checkbox"/> Retrospective Study Design: RCT Stated objective of study: To assess prognostic factors following anterior cervical discectomy with fusion (ACDF). Total number of patients in the study: 488 Number of patients in subgroup of relevance to the question: 488 Duration of follow-up: 2 years Validated outcome measures used: Clinical success (15 point improvement in NDA, no re-operation, no worsening of neurologic function), Visual Analog Scale (VAS) Nonvalidated outcome measures used: Diagnosis made or confirmed by (check all that apply): <input checked="" type="checkbox"/> Clinical exam/history <input type="checkbox"/> Electromyography <input type="checkbox"/> Myelogram <input type="checkbox"/> MRI <input type="checkbox"/> CT <input type="checkbox"/> CT/Myelogram <input type="checkbox"/> Other Results/subgroup analysis (relevant to question): Found	<i>Critique of methodology</i> <input type="checkbox"/> Patients not enrolled at same point in their disease <input type="checkbox"/> <80% follow-up <input type="checkbox"/> Follow-up not standardized <input type="checkbox"/> No validated outcome measures used <input type="checkbox"/> Small sample size <input type="checkbox"/> Lacked subgroup analysis <input type="checkbox"/> Diagnostic methods not described. <input type="checkbox"/> Other: <i>Work group conclusions</i> Potential Level: Downgraded Level: <i>Conclusions relative to question</i> This paper provides evidence that: Poor outcomes might be expected in patients with workers' compensation and pre- operative sensory loss following ACDF for radiculopathy or myelopathy. Notes:
			workers' compensation and weak narcotic usage poor prognostic factors; higher pre-operative Neck Disability Index (NDI) and normal sensory function were positive factors. Author conclusions (relative to question): Patients who did not achieve a positive score after ACDF include workers' compensation, weak use of narcotics, dermatomal sensory loss. Notes:	
Peolsson, A., R. Hedlund, et al. (2004). "Prediction of fusion and importance of radiological variables for the outcome of anterior cervical decompression and fusion." <i>Eur Spine J</i> 13(3): 229-34.	<input type="checkbox"/> Level V (expert consensus) <input type="checkbox"/> Level IV in presence of higher quality studies <input type="checkbox"/> Subgroup analysis data not available <input type="checkbox"/> Not relevant to question.	Level II Type of evidence prognostic Notes:	<input type="checkbox"/> Prospective <input checked="" type="checkbox"/> Retrospective Study Design: RCT Stated objective of study: To see if fusion is a predictor of success. To evaluate carbon fiber cage versus cloward procedure. Total number of patients in the study: 103 Number of patients in subgroup of relevance to the question: 103 Duration of follow-up: 1 year Validated outcome measures used: Neck Disability Index (NDI), Visual Analog Scale (VAS), Odorn criteria Nonvalidated outcome measures used: Diagnosis made or confirmed by (check all that apply): <input checked="" type="checkbox"/> Clinical exam/history <input type="checkbox"/> Electromyography <input type="checkbox"/> Myelogram <input checked="" type="checkbox"/> MRI <input type="checkbox"/> CT <input type="checkbox"/> CT/Myelogram <input type="checkbox"/> Other	<i>Critique of methodology</i> <input type="checkbox"/> Patients not enrolled at same point in their disease <input type="checkbox"/> <80% follow-up <input type="checkbox"/> Follow-up not standardized <input type="checkbox"/> No validated outcome measures used <input type="checkbox"/> Small sample size <input checked="" type="checkbox"/> Lacked subgroup analysis <input type="checkbox"/> Diagnostic methods not described. <input type="checkbox"/> Other: <i>Work group conclusions</i> Potential Level: Downgraded Level: <i>Conclusions relative to question</i> This paper provides evidence that: That predictions of successful fusion were male gender, single level ACDF and the cloward procedure, and that patients with solid fusion had less pain. Notes:

This content of this document 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.

			Results/subgroup analysis (relevant to question): Author conclusions (relative to question): Patients with either a carbon fiber cage or cloward procedure can be expected to achieve reductions in disability and VAS after anterior cervical discectomy with fusion (ACDF). Notes:	
Peolsson A, Hedlund R, Vavrouch L, Oberg B. Predictive factors for the outcome of anterior cervical decompression and fusion. Eur Spine J. 2003 Jun;12(3):274-80. Epub 2003 Apr 2. PubMed PMID: 12687444. Notes: ACF and radiculopathy and smoking	<input type="checkbox"/> Level V (expert consensus) <input type="checkbox"/> Level IV in presence of higher quality studies <input type="checkbox"/> Subgroup analysis data not available <input type="checkbox"/> Not relevant to question. Notes:	Level II Type of evidence prognostic Notes: Same study as above; different analysis	<input type="checkbox"/> Prospective <input checked="" type="checkbox"/> Retrospective Study Design: RCT Stated objective of study: To evaluate predictors of success after anterior cervical discectomy with fusion (ACDF) with carbon fiber cage or cloward procedure. Total number of patients in the study: Number of patients in subgroup of relevance to the question: Duration of follow-up: 1 year Validated outcome measures used: Visual Analog Scale (VAS), Neck Disability Index (NDI) Nonvalidated outcome measures used: Diagnosis made or confirmed by (check all that apply): <input checked="" type="checkbox"/> Clinical exam/history <input type="checkbox"/> Electromyography <input type="checkbox"/> Myelogram <input checked="" type="checkbox"/> MRI <input type="checkbox"/> CT <input type="checkbox"/> CT/Myelogram <input type="checkbox"/> Other Results/subgroup analysis (relevant to question):	<i>Critique of methodology</i> <input type="checkbox"/> Patients not enrolled at same point in their disease <input type="checkbox"/> <80% follow-up <input type="checkbox"/> Follow-up not standardized <input type="checkbox"/> No validated outcome measures used <input type="checkbox"/> Small sample size <input checked="" type="checkbox"/> Lacked subgroup analysis <input type="checkbox"/> Diagnostic methods not described. <input type="checkbox"/> Other: <i>Work group conclusions</i> <i>Potential Level:</i> <i>Downgraded Level:</i> <i>Conclusions relative to question</i> <i>This paper provides evidence that: That nonsmoking, male gender, low pain intensity, active range of motion were predictors of clinical success in short and long term.</i> Notes:

			<p>Author conclusions (relative to question): Male sex, nonsmoking, greater segmental kyphosis and a low pain and disability level are pre-operative predictors of a good outcome in ACDF.</p> <p>~~~~~</p> <p>Notes:</p>	
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			<p>Author conclusions (relative to question): Patients with low disability and pain intensity, male, nonsmoking status, good hand strength are more likely to achieve positive results after ACDF.</p> <p>~~~~~</p> <p>Notes:</p>	
<p>Peolsson, A. and M. Peolsson (2008). "Predictive factors for long-term outcome of anterior cervical decompression and fusion: a multivariate data analysis." <i>Eur Spine J</i> 17(3): 406-14.</p> <p>~~~~~</p> <p>Notes: ACF and radiculopathy</p>	<p><input type="checkbox"/> Level V (expert consensus) <input type="checkbox"/> Level IV in presence of higher quality studies <input type="checkbox"/> Subgroup analysis data not available <input type="checkbox"/> Not relevant to question.</p> <p>~~~~~</p> <p>Notes:</p>	<p>Level II</p> <p>Type of evidence prognostic</p> <p>~~~~~</p> <p>Notes: Other analysis of the above RCT.</p>	<p><input type="checkbox"/> Prospective <input checked="" type="checkbox"/> Retrospective</p> <p>Study Design: RCT</p> <p>Stated objective of study: To understand predictors of success after carbon fiber cage or cloward procedure.</p> <p>Total number of patients in the study: 103 Number of patients in subgroup of relevance to the question:</p> <p>Duration of follow-up: 1 and 2 year</p> <p>Validated outcome measures used: Visual Analog Scale (VAS), Neck Disability Index (NDI)</p> <p>Nonvalidated outcome measures used:</p> <p>Diagnosis made or confirmed by (check all that apply): <input checked="" type="checkbox"/> Clinical exam/history <input type="checkbox"/> Electromyography <input type="checkbox"/> Myelogram <input checked="" type="checkbox"/> MRI <input type="checkbox"/> CT <input type="checkbox"/> CT/Myelogram <input type="checkbox"/> Other</p> <p>Results/subgroup analysis (relevant to question):</p>	<p><i>Critique of methodology</i> <input type="checkbox"/> Patients not enrolled at same point in their disease <input type="checkbox"/> <80% follow-up <input type="checkbox"/> Follow-up not standardized <input type="checkbox"/> No validated outcome measures used <input type="checkbox"/> Small sample size <input checked="" type="checkbox"/> Lacked subgroup analysis <input type="checkbox"/> Diagnostic methods not described. <input type="checkbox"/> Other:</p> <p><i>Work group conclusions</i> <i>Potential Level:</i> <i>Downgraded Level:</i></p> <p><i>Conclusions relative to question</i> <i>This paper provides evidence that: Preoperative pain intensity best predictor of postoperative NDI improvement.</i></p> <p>~~~~~</p> <p>Notes:</p>

Cervical Fusion Appropriateness Criteria Evidence Review: Clinical Guidelines

The use of evidentiary tables in reviewing evidence in the form of clinical guidelines is inappropriate to this type of project. Instead, please complete the below tables for each guideline assigned. The tables are built to expand to the size of the comments entered. Tab to add new lines as needed.

Techniques for Anterior Cervical Decompression for Radiculopathy		
Matz PG, Ryken TC, Groff MW, et al. J Neurosurg Spine 11:183–197, 2009.		
Recommendation (Rec)	Strength of Rec	Comments (Quality of document, specific comments, etc.)
ACDF is efficacious for cervical radiculopathy.	B, C	

Cervical Surgical Techniques for the Treatment of Cervical Spondylotic Myelopathy		
Mummaneni PV, Kaiser MG, Matz PG. J Neurosurg Spine 11:130–141, 2009.		
Recommendation (Rec)	Strength of Rec	Comments (Quality of document, specific comments, etc.)
Anterior cervical fusion with discectomy or corpectomy is effective for treatment of cervical spondylotic myelopathy.	D	Large body of literature evaluated. All lower level studies, but all support efficacy of both anterior and posterior fusion.
Posterior fusion with laminectomy is effective for treatment of cervical spondylotic myelopathy.	D	

Diagnosis and Treatment of Cervical Radiculopathy from Degenerative Disorders		
Bono C, Ghiselli G, Gilbert T, et al. North American Spine Society, 2010.		
Recommendation (Rec)	Strength of Rec	Comments (Quality of document, specific comments, etc.)
ACDF results in good outcomes for treatment of radiculopathy.	B	A: Good evidence (Level I studies with consistent findings) B: Fair evidence (Level II or III studies with consistent findings) C: Poor quality evidence (Level IV or V studies)
Placement of interbody graft with ACF results in improved sagittal alignment.	B	
Outcomes are equivalent for one level ACDF with or without a plate for treatment of cervical radiculopathy.	B	
Use of a cervical plate for ACF results in improved sagittal alignment.	B	

Indications for Anterior Cervical Decompression for the Treatment of Cervical Degenerative Radiculopathy		
Matz PG, Holly LT, Groff MW, et al. J Neurosurg Spine 11:174–182, 2009		
Recommendation (Rec)	Strength of Rec	Comments (Quality of document, specific comments, etc.)
ACDF results in good outcomes for treatment of cervical radiculopathy.	Class I	

Laminectomy and Fusion for the Treatment of Cervical Degenerative Myelopathy		
Anderson PA, Matz PG, Groff, MW, et al. J Neurosurg Spine 11:150–156, 2009.		
Recommendation (Rec)	Strength of Rec	Comments (Quality of document, specific comments, etc.)
Posterior cervical laminectomy and fusion is effective in treating cervical myelopathy.	D	

Management of Anterior Cervical Pseudarthrosis		
Kaiser MG, Groff MW, Heary RF, et al. J Neurosurg Spine 11:228–237, 2009.		
Recommendation (Rec)	Strength of Rec	Comments (Quality of document, specific comments, etc.)
Strength of association between anterior pseudarthrosis and outcomes cannot be accurately determined.	D	
Posterior fusion for anterior pseudarthrosis is efficacious.	D	
Anterior fusion for anterior pseudarthrosis is efficacious.	D	
Limited data suggest posterior may have greater potential than anterior fusion when treating anterior cervical pseudarthrosis.	D	

Raw Rating Scores

Raw scores from the rating process can be found on the NASS website at www.spine.org for those interested in reviewing those scores.