

Introduction to the Guidelines for the Management of Acute Cervical Spine and Spinal Cord Injuries

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Medical evidence-based guidelines, when properly produced, represent a contemporary scientific summary of accepted management, imaging, assessment, classification, and treatment strategies on a focused series of medical and surgical issues.¹⁻³ They are an evidence-based hierarchical ranking of the scientific literature produced to date. They record and rank the collective experiences of scientists and clinicians and are a comprehensive reference source on a given topic or group of topics.

Medical evidence-based guidelines are not meant to be restrictive or to limit a clinician's practice. They chronicle multiple successful treatment options (for example) and stratify the more successful and the less successful strategies based on scientific merit. They are not absolute, "must be followed" rules. This process may identify the most valid and reliable imaging strategy for a given injury, for example, but because of regional or institutional resources, or patient co-morbidity, that particular imaging strategy may not be possible for a patient with that injury. Alternative acceptable imaging options may be more practical or applicable in this hypothetical circumstance.

Guidelines documents are not tools to be used by external agencies to measure or control the care provided by clinicians. They are not medical-legal instruments or a "set of certainties" that must be followed in the assessment or treatment of the individual pathology in the individual patients we treat. While a powerful and comprehensive resource tool, guidelines and the recommendations contained therein do not necessarily represent "the answer" for the medical and surgical dilemmas we face with our many patients.

This second iteration of *Guidelines for the Management of Acute Cervical Spine and Spinal Cord Injuries* represents 15 months of diligent volunteer effort by the Joint Section on Disorders of the Spine and Peripheral Nerves author group to provide an up-to-date review of the medical literature on 22 topics germane to the care, assessment, imaging and treatment of

patients with acute cervical spine and/or spinal cord injuries. The medical evidence summarized within each guideline has been painstakingly analyzed and ranked according to rigorous evidence-based medicine criteria, and have been linked to 112 evidence-based recommendations for these topics.¹⁻³

There are many important differences in this iteration of these Guidelines compared to those we published 10 years ago. Regrettably, however, for some of the topics considered and included in this medical evidence-based compendium, little new evidence beyond Class III medical evidence has been offered in the last 10 years by investigators and surgeons who treat patients with these disorders. Our specialties and our patients desperately need comparative Class I and Class II medical evidence derived from properly designed analytical clinical studies to further our understanding on the best ways to assess, diagnose, image and treat patients with these acute traumatic injuries.

Good progress has been made in several clinical research areas since the original Guidelines publication in 2002. One hundred twelve evidence-based recommendations are offered in this contemporary review, compared to only 76 recommendations in 2002. There are 19 Level I recommendations in the current Guidelines; each supported by Class I medical evidence.

- Assessment of Functional Outcomes (1)
- Assessment of Pain After Spinal Cord Injuries (1)
- Radiographic Assessment (7)
- Pharmacology (2)
- Diagnosis of AOD (1)
- Cervical Subaxial Injury Classification Schemes (2)
- Pediatric Spinal Injuries (1)
- Vertebral Artery Injuries (1)
- Venous Thromboembolism (3)

There are an additional 16 Level II recommendations based on Class II medical evidence and 77 Level III recommendations based on Class III medical evidence.

TABLE. Comparison of Cervical Spine and Spinal Cord Injury Guidelines Recommendations Between 2 Iterations Where Differences in Recommendations Have Occurred. All Other Recommendations Remain as Previously Stated

Topic	Previous Level of Recommendation	Recommendation 2002	Current Level of Recommendation	Recommendation 2012
Immobilization	Option	<ul style="list-style-type: none"> All trauma patients with a cervical spinal column injury or with a mechanism of injury having the potential to cause cervical spine injury should be immobilized at the scene and during transport by using 1 of several available methods. 	Level II	<ul style="list-style-type: none"> Spinal immobilization of all trauma patients with a cervical spine or spinal cord injury or with a mechanism of injury having the potential to cause cervical spinal injury is recommended.
		<ul style="list-style-type: none"> A combination of a rigid cervical collar and supportive blocks on a backboard with straps is effective in limiting motion of the cervical spine and is recommended. 		<ul style="list-style-type: none"> Triage of patients with potential spinal injury at the scene by trained and experienced EMS personnel to determine the need for immobilization during transport is recommended. Immobilization of trauma patients who are awake, alert, and are not intoxicated, who are without neck pain or tenderness, who do not have an abnormal motor or sensory examination and who do not have any significant associated injury that might detract from their general evaluation is not recommended.
	None	Not addressed	Level III	<ul style="list-style-type: none"> Spinal immobilization in patients with penetrating trauma is not recommended due to increased mortality from delayed resuscitation.
Transportation	None	Not addressed	Level III	<ul style="list-style-type: none"> Whenever possible, the transport of patients with acute cervical spine or spinal cord injuries to specialized acute spinal cord injury treatment centers is recommended.
Clinical Assessment: Neurological status	Option	<ul style="list-style-type: none"> The ASIA international standards are recommended as the preferred neurological examination tool. 	Level II	<ul style="list-style-type: none"> New Class II medical evidence.
Clinical Assessment: Functional status	Guideline	<ul style="list-style-type: none"> The Functional Independence Measure is recommended as the functional outcome assessment tool for clinicians involved in the assessment and care of patients with acute spinal cord injuries. 	Level I	<ul style="list-style-type: none"> The Spinal Cord Independence Measure (SCIM III) is recommended as the preferred Functional Outcome Assessment tool for clinicians involved in the assessment, care, and follow-up of patients with spinal cord injuries.
	Option	<ul style="list-style-type: none"> The modified Barthel index is recommended as a functional outcome assessment tool for clinicians involved in the assessment and care of patients with acute spinal cord injuries. 	N.A. (Not included in current iteration)	N.A. (Not included in current iteration)
Clinical Assessment: Pain	None	Not addressed	Level I	<ul style="list-style-type: none"> The International Spinal Cord Injury Basic Pain Data Set (ISCI-PDS) is recommended as the preferred means to assess pain including pain severity, physical functioning and emotional functioning among SCI patients.

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TABLE. Continued

Topic	Previous Level of Recommendation	Recommendation 2002	Current Level of Recommendation	Recommendation 2012
Radiographic Assessment: Asymptomatic Patient	Standard	<ul style="list-style-type: none"> Radiographic assessment of the cervical spine is not recommended in trauma patients who are awake, alert, and not intoxicated, who are without neck pain or tenderness, and who do not have significant associated injuries that detract from their general evaluation. 	Level I	<ul style="list-style-type: none"> In the awake, asymptomatic patient who is without neck pain or tenderness, who has a normal neurological examination, is without an injury detracting from an accurate evaluation, and who is able to complete a functional range of motion examination; radiographic evaluation of the cervical spine is not recommended. Discontinuance of cervical immobilization for these patients is recommended without cervical spinal imaging.
	Option	<ul style="list-style-type: none"> It is recommended that cervical spine immobilization in awake patients with neck pain or tenderness and normal cervical spine x-rays (including supplemental CT as necessary) be discontinued after either a) normal and adequate dynamic flexion/extension radiographs, or b) a normal magnetic resonance imaging study is obtained within 48 hours of injury. 	Level III	<ul style="list-style-type: none"> In the awake patient with neck pain or tenderness and normal high-quality CT imaging or normal 3-view cervical spine series (with supplemental CT if indicated), the following recommendations should be considered: <ol style="list-style-type: none"> Continue cervical immobilization until asymptomatic, Discontinue cervical immobilization following normal and adequate dynamic flexion/extension radiographs, Discontinue cervical immobilization following a normal MRI obtained within 48 hours of injury (limited and conflicting Class II and Class III medical evidence), or, Discontinue cervical immobilization at the discretion of the treating physician.
		<ul style="list-style-type: none"> Cervical spine immobilization in obtunded patients with normal cervical spine x-rays (including supplemental CT as necessary) may be discontinued after dynamic flexion/extension studies performed under fluoroscopic guidance, or b) after a normal magnetic resonance imaging study is obtained within 48 hours of injury, or c) at the discretion of the treating physician. 		

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TABLE. Continued

Topic	Previous Level of Recommendation	Recommendation 2002	Current Level of Recommendation	Recommendation 2012
Radiographic Assessment: Symptomatic Patient	Standard	<ul style="list-style-type: none"> A 3-view cervical spine series (anteroposterior, lateral, and odontoid views) is recommended for radiographic evaluation of the cervical spine in patients who are symptomatic after traumatic injury. This should be supplemented with computed tomography (CT) to further define areas that are suspicious or not well visualized on the plain cervical x-rays. 	Level I	<ul style="list-style-type: none"> In the awake, symptomatic patient, high-quality computed tomographic (CT) imaging of the cervical spine is recommended.
	Option	<ul style="list-style-type: none"> It is recommended that cervical spine immobilization in awake patients with neck pain or tenderness and normal cervical spine x-rays (including supplemental CT as necessary) be discontinued after either a) normal and adequate dynamic flexion/extension radiographs, or b) a normal magnetic resonance imaging study is obtained within 48 hours of injury. 	Level III	<ul style="list-style-type: none"> If high-quality CT imaging is available, routine 3-view cervical spine radiographs are not recommended. If high-quality CT imaging is not available, a 3 view cervical spine series (AP, lateral, and odontoid views) is recommended. This should be supplemented with CT (when it becomes available) if necessary to further define areas that are suspicious or not well visualized on the plain cervical x-rays. In the awake patient with neck pain or tenderness and normal high-quality CT imaging or normal 3-view cervical spine series (with supplemental CT if indicated), the following recommendations should be considered: <ol style="list-style-type: none"> 1) Continue cervical immobilization until asymptomatic, 2) Discontinue cervical immobilization following normal and adequate dynamic flexion/extension radiographs, 3) Discontinue cervical immobilization following a normal MRI obtained within 48 hours of injury (limited and conflicting Class II and Class III medical evidence), or, 4) Discontinue cervical immobilization at the discretion of the treating physician.

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TABLE. Continued

Topic	Previous Level of Recommendation	Recommendation 2002	Current Level of Recommendation	Recommendation 2012
Radiographic evaluation in obtunded (or unevaluable) patients	Option	<ul style="list-style-type: none"> Cervical spine immobilization in obtunded patients with normal cervical spine x-rays (including supplemental CT as necessary) may be discontinued a) after dynamic flexion/extension studies performed under fluoroscopic guidance, or b) after a normal magnetic resonance imaging study is obtained within 48 hours of injury, or c) at the discretion of the treating physician. 	Level I	<ul style="list-style-type: none"> In the obtunded or un-evaluable patient, high-quality CT imaging is recommended as the initial imaging modality of choice. If CT imaging is available, routine 3-view cervical spine radiographs are not recommended. If high-quality CT imaging is not available, a 3 view cervical spine series (AP, lateral, and odontoid views) is recommended. This should be supplemented with CT (when it becomes available) if necessary to further define areas that are suspicious or not well visualized on the plain cervical x-rays.
Closed Reduction	Option	<ul style="list-style-type: none"> Early closed reduction is recommended. 	Level III	No changes in recommendations
Cardiopulmonary Management	Option	<ul style="list-style-type: none"> Management of patients with acute SCI in a monitored setting is recommended. Maintain mean arterial BP 85 to 90 mm Hg after SCI is recommended. 	Level III	No changes in recommendations
Pharmacology Management: Corticosteroids	Option	<ul style="list-style-type: none"> Treatment with methylprednisolone for either 24 or 48 hours is recommended as an option in the treatment of patients with acute spinal cord injuries that should be undertaken only with the knowledge that the evidence suggesting harmful side effects is more consistent than any suggestion of clinical benefit. 	Level I	<ul style="list-style-type: none"> Administration of methylprednisolone (MP) for the treatment of acute SCI is not recommended. Clinicians considering MP therapy should bear in mind that the drug is not FDA approved for this application. There is no Class I or Class II medical evidence supporting the clinical benefit of MP in the treatment of acute SCI. Scattered reports of Class III evidence claim inconsistent effects likely related to random chance or selection bias. However, Class I, II, and III evidence exists that high-dose steroids are associated with harmful side effects including death.
Pharmacology Management: GM-1 Ganglioside	Option	<ul style="list-style-type: none"> Treatment of patients with acute spinal cord injuries with GM-1 ganglioside is recommended as an option without demonstrated clinical benefit. 	Level I	<ul style="list-style-type: none"> Administration of GM-1 ganglioside (Sygen) for the treatment of acute SCI is not recommended.
Occipital Condylar Fractures: Diagnostic	Guidelines (CT)	<ul style="list-style-type: none"> CT recommended to diagnose OCF. 	Level II (CT)	No changes in recommendation
	Option (MRI)	<ul style="list-style-type: none"> MRI recommended to assess ligaments. 	Level III (MRI)	

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TABLE. Continued

Topic	Previous Level of Recommendation	Recommendation 2002	Current Level of Recommendation	Recommendation 2012
Occipital Condylar Fractures: Treatment	Option	<ul style="list-style-type: none"> Treatment with external cervical immobilization is recommended. 	Level III	<ul style="list-style-type: none"> External cervical immobilization is recommended for all types of occipital condyle fractures. More rigid external immobilization in a halo vest device should be considered for bilateral OCF. Halo vest immobilization or occipitocervical stabilization and fusion are recommended for injuries with associated AO ligamentous injury or evidence of instability.
AOD: Diagnostic	None	Not addressed	Level I	<ul style="list-style-type: none"> CT imaging to determine the CCI in pediatric patients with potential AOD is recommended.
	Option	<ul style="list-style-type: none"> If there is clinical suspicion of atlanto-occipital dislocation, and plain x-rays are non-diagnostic, computed tomography or magnetic resonance imaging is recommended, particularly for the diagnosis of non-Type II dislocations. 	Level III	<ul style="list-style-type: none"> If there is clinical or radiographic suspicion of AOD, and plain radiographs are non-diagnostic, CT of the craniocervical junction is recommended. The Condyle-C1 interval (CC1) determined on CT has the highest diagnostic sensitivity and specificity for AOD among all radiodiagnostic indicators.
AOD: Treatment	Option	<ul style="list-style-type: none"> Traction may be used in the management of patients with atlanto-occipital dislocation, but it is associated with a 10% risk of neurological deterioration. 	Level III	<ul style="list-style-type: none"> Traction is not recommended in the management of patients with AOD, and is associated with a 10% risk of neurological deterioration.
Atlas Fractures	Option	<ul style="list-style-type: none"> Treatment based on specific fracture type and integrity of transverse ligament. 	Level III	No changes in recommendations
Odontoid Fracture	Guideline	<ul style="list-style-type: none"> Treatment of Type II odontoid fractures based on 50 years of age. 	Level II	No change in recommendations
Axis Fractures: Odontoid	None	Not addressed	Level III	If surgical stabilization is elected, either anterior or posterior techniques are recommended.
Axis Fractures: Hangman's	Option	<ul style="list-style-type: none"> External immobilization is recommended. Surgery is recommended for angulation, instability. 	Level III	No changes in recommendations
Axis Fractures: Miscellaneous Body	Option	<ul style="list-style-type: none"> External immobilization is recommended for treatment of isolated fractures of the axis body. 	Level III	<ul style="list-style-type: none"> External immobilization for the treatment of isolated fractures of the axis body is recommended. Consideration of surgical stabilization and fusion in unusual situations of severe ligamentous disruption and/or inability to achieve or maintain fracture alignment with external immobilization is recommended. In the presence of comminuted fracture of the axis body, evaluation for vertebral artery injury is recommended.

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TABLE. Continued

Topic	Previous Level of Recommendation	Recommendation 2002	Current Level of Recommendation	Recommendation 2012
Atlas/Axis Combination Fractures	Option	<ul style="list-style-type: none"> Treatment based on characteristics of axis fracture. 	Level III	No changes in recommendations
Os Odontoideum: Diagnostic	Option	<ul style="list-style-type: none"> Plain radiographs with flex/ext \pm CT or MRI is recommended. 	Level III	No changes in recommendations
Os Odontoideum: Management	Option	<ul style="list-style-type: none"> Occipital-cervical fusion with or without C1 laminectomy may be considered in patients with os odontoideum who have irreducible dorsal cervicomedullary compression and/or evidence of associated occipital-atlantal instability. Transoral decompression may be considered in patients with os odontoideum who have irreducible ventral cervicomedullary compression. 	Level III	<ul style="list-style-type: none"> Occipital-cervical internal fixation and fusion with or without C1 laminectomy is recommended in patients with os odontoideum who have irreducible dorsal cervicomedullary compression and/or evidence of associated occipital-atlantal instability.
Classification of Subaxial Injuries	None	Not addressed	Level I	SLIC and CSISS
Subaxial Cervical Spinal Injuries	None	Not addressed	Level III	Harris and Allen <ul style="list-style-type: none"> The routine use of CT and MR imaging of trauma victims with ankylosing spondylitis is recommended, even after minor trauma. For patients with ankylosing spondylitis who require surgical stabilization, posterior long segment instrumentation and fusion, or a combined dorsal and anterior procedure is recommended. Anterior stand-alone instrumentation and fusion procedures are associated with a failure rate of up to 50% in these patients.
Central Cord Syndrome	Option	<ul style="list-style-type: none"> Aggressive multimodality management of patients with ATCCS is recommended. 	Level III	No changes in recommendations
Pediatric Injuries: Diagnostic	None	Not addressed	Level I	<ul style="list-style-type: none"> CT imaging to determine the condyle-C1 interval for pediatric patients with potential AOD is recommended.
	Guideline	<ul style="list-style-type: none"> In children who have experienced trauma and are alert, conversant, have no neurological deficit, no midline cervical tenderness, and no painful distracting injury, and are not intoxicated, cervical spine x-rays are not necessary to exclude cervical spine injury and are not recommended. 	Level II	<ul style="list-style-type: none"> Cervical spine imaging is not recommended in children who are <u>greater than</u> 3 years of age and who have experienced trauma and who:

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TABLE. Continued				
Topic	Previous Level of Recommendation	Recommendation 2002	Current Level of Recommendation	Recommendation 2012
		<ul style="list-style-type: none"> In children who have experienced trauma and who are either not alert, non-conversant, or have neurological deficit, midline cervical tenderness, or painful distracting injury, or are intoxicated, it is recommended that anteroposterior and lateral cervical spine x-rays be obtained. 		<ul style="list-style-type: none"> 1) are alert, 2) have no neurological deficit, 3) have no midline cervical tenderness, 4) have no painful distracting injury, 5) do not have unexplained hypotension, 6) and are not intoxicated. • Cervical spine imaging is not recommended in children who are <u>less than 3 years of age</u> who have experienced trauma and who: <ol style="list-style-type: none"> 1) have a GCS>13, 2) have no neurological deficit, 3) have no midline cervical tenderness, 4) have no painful distracting injury, 5) are not intoxicated, 6) do not have unexplained hypotension, 7) and do not have motor vehicle collision (MVC), 8) a fall from a height greater than 10 feet, 9) or non-accidental trauma (NAT) as a known or suspected mechanism of injury. • Cervical spine radiographs or high resolution computed tomography (CT) is recommended for children who have experienced trauma and who do not meet either set of criteria above. • Three-position CT with C1-C2 motion analysis to confirm and classify the diagnosis is recommended for children suspected of having atlanto-axial rotatory fixation (AARF).
	Options	<ul style="list-style-type: none"> In children younger than age 9 years who have experienced trauma, and who are non-conversant or haven an altered mental status, a neurological deficit, neck pain, or painful distracting injury, are intoxicated, or have unexplained hypotension, it is recommended that anteroposterior and lateral cervical spine x-rays be obtained. 	Level III	<ul style="list-style-type: none"> AP and lateral cervical spine radiography or high-resolution CT is recommended to assess the cervical spine in children less than 9 years of age.

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TABLE. Continued

Topic	Previous Level of Recommendation	Recommendation 2002	Current Level of Recommendation	Recommendation 2012
		<ul style="list-style-type: none"> In children age 9 years or older who have experienced trauma, and who are non-convulsant or have an altered mental status, a neurological deficit, neck pain, or painful distracting injury, are intoxicated, or have unexplained hypotension, it is recommended that anteroposterior, lateral, and open-mouth cervical spine x-rays be obtained. 		<ul style="list-style-type: none"> AP, lateral, and open-mouth cervical spine radiography or high-resolution CT is recommended to assess the cervical spine in children 9 years of age and older.
		<ul style="list-style-type: none"> Computed tomographic scanning with attention to the suspected level of neurological injury to exclude occult fractures or to evaluate regions not seen adequately on plain x-rays is recommended. 		<ul style="list-style-type: none"> High resolution CT scan with attention to the suspected level of neurological injury is recommended to exclude occult fractures or to evaluate regions not adequately visualized on plain radiographs.
		<ul style="list-style-type: none"> Flexion/extension cervical x-rays or fluoroscopy may be considered to exclude gross ligamentous instability when there remains a suspicion of cervical spine instability after static x-rays are obtained. <p>Magnetic resonance imaging of the cervical spine may be considered to exclude cord or nerve root compression, evaluate ligamentous integrity, or provide information regarding neurological prognosis.</p>		<ul style="list-style-type: none"> Flexion and extension cervical radiographs or fluoroscopy are recommended to exclude gross ligamentous instability when there remains a suspicion of cervical spinal instability following static radiographs or CT scan. Magnetic resonance imaging (MRI) of the cervical spine is recommended to exclude spinal cord or nerve root compression, evaluate ligamentous integrity, or provide information regarding neurological prognosis.
Pediatric Injuries: Treatment	None	Not addressed	Level III	<ul style="list-style-type: none"> Reduction with manipulation or halter traction is recommended for patients with acute AARF (less than 4 weeks duration) that does not reduce spontaneously. Reduction with halter or tong/halo traction is recommended for patients with chronic AARF (greater than 4 weeks duration). Internal fixation and fusion are recommended in patients with recurrent and/or irreducible AARF. Operative therapy is recommended for cervical spine injuries that fail non-operative management.
SCIWORA: Diagnosis	Option	<ul style="list-style-type: none"> Plain spinal x-rays of the region of injury and computed tomographic scanning with attention to the suspected level of neurological injury to exclude occult fractures are recommended. 	Level III	<ul style="list-style-type: none"> Magnetic resonance imaging (MRI) of the region of suspected neurological injury is recommended in a patient with SCIWORA.

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TABLE. Continued

Topic	Previous Level of Recommendation	Recommendation 2002	Current Level of Recommendation	Recommendation 2012
		<ul style="list-style-type: none"> Magnetic resonance imaging of the region of suspected neurological injury may provide useful diagnostic information Plain X-rays of the entire spinal column may be considered. 		<ul style="list-style-type: none"> Radiographic screening of the entire spinal column is recommended.
SCIWORA: Treatment	Option	<ul style="list-style-type: none"> External Immobilization is recommended until spinal stability is confirmed by flexion/extension x-rays. <p>External immobilization of the spinal segment of injury for up to 12 weeks may be considered.</p>	Level III	<ul style="list-style-type: none"> Assessment of spinal stability in a SCIWORA patient is recommended, using flexion-extension radiographs in the acute setting and at late follow-up, even in the presence of a MRI negative for extra-neural injury. External immobilization of the spinal segment of injury is recommended for up to 12 weeks. Early discontinuation of external immobilization is recommended for patients who become asymptomatic and in whom spinal stability is confirmed with flexion and extension radiographs.
SCIWORA: Prognosis	Option	<ul style="list-style-type: none"> Avoidance of "high risk" activities for up to 6 months after spinal cord injury without radiographic abnormality may be considered. Magnetic resonance imaging of the region of neurological injury may provide useful prognostic information about neurological outcome after spinal cord injury without radiographic abnormality. 	None	Not addressed (see Diagnosis)
Vertebral Artery Injury: Diagnostic	Option	<ul style="list-style-type: none"> Conventional angiography or magnetic resonance angiography is recommended for the diagnosis of vertebral artery injury after nonpenetrating cervical trauma in patients who have complete cervical spinal cord injuries, fracture through the foramen transversarium, facet dislocation, and/or vertebral subluxation. 	Level I	<ul style="list-style-type: none"> Computed tomographic angiography (CTA) is recommended as a screening tool in <u>selected</u> patients after blunt cervical trauma who meet the modified Denver Screening Criteria for suspected vertebral artery injury (VAI).
			Level III	<ul style="list-style-type: none"> Conventional catheter angiography is recommended for the diagnosis of VAI in <u>selected</u> patients after blunt cervical trauma, particularly if concurrent endovascular therapy is a potential consideration, and can be undertaken in circumstances in which CTA is not available. Magnetic resonance imaging is recommended for the diagnosis of VAI after blunt cervical trauma in patients with a complete spinal cord injury or vertebral subluxation injuries.

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TABLE. Continued

Topic	Previous Level of Recommendation	Recommendation 2002	Current Level of Recommendation	Recommendation 2012
Vertebral Artery Injury: Treatment	Option	<ul style="list-style-type: none"> Anticoagulation with intravenous heparin is recommended for patients with vertebral artery injury who have evidence of posterior circulation stroke. 	Level III	<ul style="list-style-type: none"> It is recommended that the choice of therapy for patients with VAI, anticoagulation therapy vs antiplatelet therapy vs no treatment, be individualized based on the patient's vertebral artery injury, their associated injuries and their risk of bleeding.
		<ul style="list-style-type: none"> Either observation or treatment with anticoagulation in patients with vertebral artery injuries and evidence of posterior circulation ischemia is recommended. 		<ul style="list-style-type: none"> The role of endovascular therapy in VAI has yet to be defined; therefore no recommendation regarding its use in the treatment of VAI can be offered.
		<ul style="list-style-type: none"> Observation in patients with vertebral artery injuries and no evidence of posterior circulation ischemia is recommended. 		
Venous Thromboembolism: Prophylaxis	None	Not addressed	Level II	<ul style="list-style-type: none"> Early administration of VTE prophylaxis (within 72 hours) is recommended.
	Option	<ul style="list-style-type: none"> Vena cava filters are recommended for patients who do not respond to anticoagulation or who are not candidates for anticoagulation therapy and/or mechanical devices. 	Level III	<ul style="list-style-type: none"> Vena cava filters are not recommended as a routine prophylactic measure, but are recommended for select patients who fail anticoagulation or who are not candidates for anticoagulation and/or mechanical devices.
Nutritional Support	Option	<ul style="list-style-type: none"> Nutritional support of patients with spinal cord injuries is recommended. Energy expenditure is best determined by indirect calorimetry in these patients because equation estimates of energy expenditure and subsequent caloric need tend to be inaccurate. 	Level II	<ul style="list-style-type: none"> Indirect calorimetry as the best means to determine the caloric needs of spinal cord injury patients is recommended.
			Level III	<ul style="list-style-type: none"> Nutritional support of SCI patients is recommended as soon as feasible. It appears that early enteral nutrition (initiated within 72 hours) is safe, but has not been shown to affect neurological outcome, the length of stay or the incidence of complications in patients with acute SCI.

The Table shows the differences in the recommendations between the 2 sets of guidelines. One key change is that in nomenclature: "Standards" has been replaced by "Level I," "Guidelines" has been replaced by "Level II," and "Options" has been replaced by "Level III," as described in detail in the Methodology section of these guidelines. Not every recommendation is listed since some have not changed, and the statement "No changes in recommendations" indicates that. When they have

changed, the recommendations previously made are compared to those being made currently. Where we have introduced new recommendations not included in the previous iteration of the guidelines, a statement is found indicating what the recommendations are alongside "None" and "Not addressed," which represents the lack of previous recommendations on a particular aspect or topic. This summary table highlighting the changes in the guidelines is not a substitute for reading and understanding this

new version of the recommendations that reviews and evaluates extant literature in detail.

This comprehensive guidelines update does not contain an evidence-based summary or recommendation on several topics important to the care of our patients, our profession, and our disciplines, simply because there is not enough definitive medical evidence in the literature on those topics to allow such a review. Emerging science in the repair and regeneration of spinal cord injuries,⁴ emerging technology in imaging, the use of electrophysiological monitoring during surgery for spinal cord injury, new engineering technology in surgical implants,⁵ hypothermia in the care of the spinal cord injured patient⁶ and new science on the issue of the timing of surgery after acute traumatic cervical spinal injury,^{7,8} are examples of topics we simply do not have enough meaningful or convincing medical evidence in our literature to be included in this scientific review of acute cervical spine and spinal cord injuries.

The author group and the Joint Section leadership hope that these guidelines will serve their intended valuable purpose. The issues addressed in this scientific compendium are germane to the assessment, management, treatment, and study of the growing population of acute traumatic cervical spine and spinal cord injury patients we see daily in our practices. These patients, their injuries, their care, and in many cases, their losses, personally and to society,

are a major and growing societal and healthcare burden in the United States and around the world.⁹

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