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National Survey of the Incidence of Cervical Spine Injury and Approach to Cervical Spine Clearance in U.S. Trauma Centers

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Abstract

Background: The overall incidence of cervical spine injury (CSI) has been estimated from small studies; the incidence of specific injury types is less well established. The approach to screening for CSI has not been well studied; variation may exist based on Trauma Center (TC) level and type (academic vs. nonacademic). We attempted to define the incidence of different types of CSI and determine whether a national standard for cervical spine clearance (CSC) could be identified. We hypothesized a significant variation in incidence of CSI and approach to CSC based on TC level and type.

Methods: In a survey of 615 TC, institutions were asked to describe themselves as academic/nonacademic and provide a Level I-IV. Questions concerned demographics, Injury Severity Score, incidence of CSI, clinical resources, and approach to CSC. Methods of CSC included protocols, use of flexion-extension films, computed tomography, magnetic resonance imaging, and cervical collars. Clinical scenarios examined indications and technique for CSC.

Results: A total of 637 surveys were sent to 615 TC (25 follow-ups), and 165 TC (25%) responded. A total of 156 TC provided data for type: academic 44 (28%), nonacademic 112 (72%). A total of 142 TC provided data for level: 49 (34%) Level I, 75 (53%), Level II, 18 (13%), Level III. A total of 111,219 patients were entered into the trauma registries of these TC. The overall incidence of all types of CSI was 4.3%, CSI without spinal cord injury was 3.0%, spinal cord injury without fracture was 0.70%, and delayed diagnosis of all types of CSI was 0.01%. There was no difference in the incidence of CSI overall or by subtype based on TC level or type. Injury Severity Score correlated with incidence of CSI without cord injury (r= 0.387, p< 0.01). Regarding approach to CSC, differences existed by TC level and type for responsibility for CSC and protocols for CSC (p< 0.05). Level II TC felt early flexion-extension views were potentially harmful (60%); Level I TC did not (39%) (p< 0.05). Regarding indications for CSC, there was agreement on 10 of 11 clinical scenarios. For three of five clinical scenarios examining radiographic approach to CSC there was a broad distribution of approaches to patients with normal radiographs and cervical pain, altered mental status, coma.

Conclusion: Incidence of CSI is uniform by TC level and type. Incidence of spinal cord injury without fracture is low: 0.7%. Reported rate of missed CSI is very low: 0.01%. There is good agreement (>78%) among TC on indications for CSC but less agreement on radiographic approach to CSC.

The recent publication of practice management guidelines for the identification of cervical spine instability after trauma acknowledges a lack of Level I evidence supporting given recommendations. 1 Nonetheless, the publication of these recommendations addresses a commonly encountered problem in the acute care of trauma patients, and the recommendations are likely to be influential.

The basic questions to be addressed by the clinician are who should undergo radiographic clearance of the cervical spine after trauma, and what radiographic evaluation should be undertaken? Each of these questions can be further segregated into the clinical components that are encountered daily in practice, i.e., what represents a “sufficient” mechanism of injury to warrant cervical spine clearance (CSC), what constitutes a “distracting” injury, when does “neck pain” in a patient with normal radiographs mandate further study, and how should the comatose or obtunded patient be screened? Many attempts have been made to answer these questions. Unfortunately, lack of a randomized, prospective trial establishing a definitive approach to CSC prevents the development of true clinical guidelines.

The cumulative effort and time spent attempting to resolve these issues may represent prevailing fear among clinicians with respect to specter of missed cervical spine injury. Nonetheless, the published incidence figures for all types of cervical spine injury (CSI) are 2 to 4% in a blunt trauma population 2 and the incidence of missed injury is believed to be much lower than this. 2,3 Because the incidence of missed or occult injury is so low, the identification of a "gold standard" screening procedure, which will miss *zero* cases of CSI with or without fracture would require the enrollment of enormous numbers of patients. The NEXIS study 4 which has been undertaken to examine only the subgroup of patients with no major risk factors for CSI, will enroll nearly 40,000 patients in an effort to estimate the sensitivity and specificity of clinical examination as an effective tool for CSC in this subgroup.

Absent evidenced-based guidelines, we believed it would be useful to attempt to determine a standard of practice. We conducted a large-scale clinical survey, which had two purposes. The first was to attempt to identify incidence figures for CSI as a whole and for subgroups of CSI. We also sought to determine whether the incidence figures would vary as a function of the trauma center's (TC) level of designation or academic/nonacademic status. The second purpose of our survey was to attempt to establish the presence or absence of a national practice standard for CSC. Practice standards are often invoked in areas in which precise clinical data are lacking and may be as useful for the clinician as recommendations based on limited data. We expected that significant differences in the incidence of CSI and the approach to CSC would be observed as a function of TC level and type.

MATERIALS AND METHODS

A list of trauma centers across the United States was obtained by means of a proprietary instrument (Lincoln Trauma Center Directory, Phoenix, Ariz) available for purchase. The catalogue attempts to list all trauma centers in the United States and includes all levels and types of designation. By using this instrument, 615 trauma centers in 50 states were identified. A questionnaire was constructed and mailed to each institution with a cover letter requesting that either the Trauma Program Medical Director or his or her designee complete the survey. Level of designation was requested, and each trauma center was asked to define itself as urban/rural and academic/nonacademic. The survey had three basic components. The first component included data that could be obtained from a trauma registry: number of admissions and average Injury Severity Score (ISS) from July of 1995 to July of 1996. The number of cervical spine injuries of varying types based on the presence of ICD codes 805.00-805.18, 806.00-806.19, and 952.00-952.09, and the number of delayed or missed injuries in these diagnostic groups during the same time period. The second component included institution-specific data regarding facilities, protocols, and basic approach to CSC as of January 1, 1998. The third component involved clinical scenarios. Indications for CSC were examined by providing 11 scenarios in which the institution was asked whether CSC would be warranted. Radiographic approach to CSC was examined by providing five scenarios in which a multitude of radiographic options or choices was provided for patients requiring CSC.

With respect to the incidence of CSI, a crude or overall incidence figure was calculated based on the total number of CSI and their subtypes divided by the total number of patients admitted to all TC. An institution-specific incidence was obtained for each TC providing data on total admissions and number of CSI. These data are used to derive correlation coefficients for ISS and incidence of CSI. The definition of missed or delayed diagnosis of CSI was institution specific based on each TC registry criteria for delay in diagnosis of the injuries corresponding to the ICD codes listed above.

Results were analyzed relative to trauma center level and type by using Pearson [chi]2 test to determine differences in facilities, protocols, and basic approach to CSC. For the initial 11 clinical scenarios examining indications for CSC, responses were recorded in terms of frequency of affirmative or negative response. The frequencies were compared between trauma center level and type by using Pearson [chi]2 analysis. For the five clinical scenarios with multiple solutions, responses are reported as a simple frequency distribution by trauma center level and type.

RESULTS

We surveyed 615 trauma centers by means of 637 questionnaires and received 165 (25%) responses. Not all responding centers supplied data for each element of the survey. Because the majority of data analysis focused on differences in incidence of CSI or approach to CSC based on TC level or type, these response frequencies are emphasized.

Demographics

Of the 165 respondents, 142 provided a description of TC level and 156 provided a description of TC type. Although the majority of responding TC were nonacademic Level II centers, the proportion of responding TC by level was fairly uniform: 49 of 189 Level I (26%), 75 of 320 Level II (23%), and 18 of 79 Level III (23%). For purposes of clarity, centers designated Level IV were combined with Level III; 18 Level III centers responded to the survey. A summary of this profile is provided in Table 1.

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TABLE 1. Distribution of trauma centers by level and type

Trauma center level	Academic (%)	Nonacademic (%)	Total (%)
I	34 (82.9)	15 (14.9)	49 (34.5)
II	7 (17.1)	68 (67.3)	75 (52.8)
III	0	18 (17.8)	18 (12.7)
Total by type	41 (100)	101 (100)	142 (100)

Table 1. Distribution of trauma centers by level and type

When asked for total TC admissions for the 1-year period, 106 respondents provided data. A total of 111,219 patients were admitted to these TC. When the data were sorted by TC level and type, approximately 103,000 and 105,000 patients, respectively, are available for analysis. When sorted by TC level, 57% of patients were admitted to Level I TC. When sorted by TC type, 51% of patients were admitted to nonacademic centers. These data are shown in Table 2.

TABLE 2. Trauma center admissions by level and type

Type	Academic	Nonacademic		Total
Mean	1,368	853		
Range	355–3,317	81–2,490		
Total (%)	51,998 (49)	53,737 (51)		105,735
Level	I	II	III	
Mean	1,397	922	394	
Range	355–3,317	81–2,383	116–957	
Total (%)	58,669 (57)	39,646 (38)	4,727 (5)	103,042

Table 2. Trauma center admissions by level and type

The average ISS for the TC annual admissions was requested, and data were obtained from 99 respondents. The mean ISS was 10.86 ± 3.7, and there were no significant differences in mean ISS based on differences in TC level or type.

Incidence of CSI

The survey asked each center to provide data on the number of annual admissions corresponding to ICD codes which include all descriptions of cervical spine injury. These codes were further segregated into CSI with fracture but no spinal cord injury, spinal cord injury without fracture, and delayed or missed diagnoses in any of these categories. One hundred and three TC provided data for analysis. When all CSI reported are divided by all admissions reported, there were 4,796 CSI in 111,219 patients (4.3%). Similarly, the aggregate incidence of CSI

without SCI was 3,403 of 111,219 cases (3.0%), and the incidence of SCI without fracture was 774 of 111,219 cases (0.70%). The aggregate incidence of delayed or missed diagnoses for all types of CSI was 164 of 111,219 cases (0.01%). These data are displayed in Table 3. Two TC are spinal cord referral centers and reported incidence figures of 18% and 30%, respectively. When these centers are excluded from analysis, there is no difference in the incidence of CSI among TC of differing level, type, or both.

TABLE 3. Aggregate incidence of CSI[a]

Parameter	Range	Mean	SD	Sum (%)
Admissions	81–3317	1,049.24	670.82	111,219
All CSI admissions	0–317	47.02	49.66	4,796 (4.3)
CSI without cord injury	0–213	33.36	35.49	3,403 (3.0)
CSI without fracture	0–72	7.51	11.70	774 (0.70)
Delayed or missed diagnosis of CSI	1–2	1.64	0.48	164 (0.01)

[a] n = 106.

Table 3. Aggregate incidence of CSI[aa] n = 106.

We also attempted to correlate the incidence of CSI with ISS. For the entire population studied, a positive correlation was observed between CSI without spinal cord injury and ISS (r= 0.387, p= 0.01). When the data are analyzed according to TC level, the incidence of all types of CSI is positively correlated with ISS in Level II but not Level I TC (r= 0.342, p= 0.01). We found no correlation between ISS and missed or "occult" injuries.

Approach to Cervical Spine Clearance: Clinical Resources

We obtained information on the basic clinical resources used in cervical spine clearance (CSC). With respect to diagnostic facilities, 148 TC provided information. Greater than 94% of TC reported 24 hour/7 day per week availability of both computed tomography (CT) and magnetic resonance imaging (MRI). Of interest, for the 19 TC that did not possess continuous availability of CT, 13 TC (68%) said that they would *not* transfer a patient to another facility to obtain computed tomographic images of an incompletely visualized cervical spine.

With respect to clinical resources, we obtained information about the presence or absence of a separate trauma service and the role of such a service in CSC. One hundred forty-five TC provided data. As shown in Table 4, significantly more Level I and academic TC have a separate trauma service (p< 0.01). When a trauma service is present, it has responsibility for clearance of the cervical spine in the vast majority of institutions irrespective of TC level or type.

TABLE 4. Presence of clinical resources

Parameter	Level			Type	
	I (%)	II (%)	III (%)	Academic (%)	Nonacademic (%)
Presence of trauma service	48 of 50 (96)	44 of 77 (57)	9 of 18 (50)	41 of 43 (95)	63 of 109 (58)
Trauma service responsible for CSC	41 of 44 (93)	35 of 43 (81)	6 of 9 (66)	33 of 41 (80)	54 of 63 (86)
CT available 24 hours/day	50 of 51 (98)	78 of 79 (98.7)	19 of 19 (100)	44 of 44 (100)	111 of 112 (99)
MRI available 24 hours/day	50 of 51 (98)	77 of 79 (98)	17 of 18 (94)	43 of 44 (98)	108 of 111 (97)

Table 4. Presence of clinical resources

Approach to CSC: General Approach to Radiographic Screening

There were six questions that addressed overall institutional approach to CSC independent of specific clinical scenarios. The questions and responses appear in Table 5. Of note, the majority of TC of all levels and types did not consider CT or MRI to be "gold standard" tests in screening for cervical spine injury. Protocols to determine indications for CSC and radiologic method of CSC were significantly more common in Level I and academic TC. With respect to the utility and safety of flexion-extension x-ray films of the cervical spine, there was less consensus among TC of a given level or type. More Level II and Level III centers believed that such x-ray films were potentially harmful (p< 0.05). Fewer Level III TC agreed that prolonged use of rigid cervical collars was potentially harmful (p< 0.05).

TABLE 5. Basic approach to CSC: affirmative resources by trauma center level and type

Parameter	Level			Type	
	I (%)	II (%)	III (%)	Academic (%)	Nonacademic (%)
Written protocol describes indications for CSC	37 of 51[a] (73)	29 of 78[a] (37)	5 of 19[a] (26)	31 of 44[a] (71)	43 of 68[a] (39)
Written protocol describes radiographic approach to CSC	39 of 50[a] (78)	28 of 77[a] (36)	6 of 19[a] (32)	28 of 43[a] (65)	48 of 110[a] (44)
Do you believe CT is standard of care in screening for CSI?	8 of 43 (19)	14 of 76 (18)	0 of 18	5 of 38 (13)	18 of 107 (17)
Do you believe MRI is standard of care in screening for CSI?	6 of 49 (12)	18 of 76 (24)	3 of 18 (17)	7 of 43 (16)	18 of 107 (17)
Do you believe flexion-extension films are potentially hazardous?	19 of 49[a] (39)	44 of 73[a] (60)	11 of 17[a] (65)	17 of 42 (41)	55 of 103 (53)
Do you believe prolonged use of rigid cervical collars is harmful?	48 of 50[a] (98)	60 of 75[a] (80)	15 of 19[a] (79)	40 of 43 (93)	90 of 108 (83)

[a] $p < 0.05$.

Table 5. Basic approach to CSC: affirmative resources by trauma center level and type[a]p< 0.05.

Clinical Scenarios

Respondents were asked which of the 11 listed clinical scenarios would warrant CSC. The questions were structured to assess practice standard with respect to indications for CSC in the context of four basic clinical situations: level of consciousness, distracting injury, severity of injury mechanism, and extremes of age. The responses are displayed in Table 6 and are grouped into the four basic clinical situations described above. With respect to level of consciousness, there was good agreement among TC of different level and type as to which patients should undergo CSC. With respect to distracting injuries, there was less consensus as to the type of injury that would be considered "distracting." With respect to injury mechanism there was good agreement regarding which injury mechanisms constitute indications for CSC. With respect to the elderly trauma patient, most TC would pursue CSC in an 80-year-old patient with a low-energy mechanism of injury.

TABLE 6. Indications for CSC

Scenario	Level			Type		Total (%)
	I (%)	II (%)	III (%)	Academic (%)	Nonacademic (%)	
Level of consciousness: CSC would be indicated in which of the following patient scenarios						
Restrained driver, 35-mph collision, no loss of consciousness, nonintoxicated, multiple abrasions, denies cervical pain, arrives in C-collar	5/51 (10)	17/79 (27)	3/19 (16)	6/44 (14)	19/112 (17)	25/156 (16)
Same patient as above, intoxicated	45/51 (88)	75/79 (95)	16/19 (84)	42/44 (98)	100/112 (89)	142/156 (91)
Patient with head injury in a coma following motor vehicle collision	51/51 (100)	79/79 (100)	18/19 (95)	44/44 (100)	111/112 (99)	155/156 (99)
Distracting injury: CSC would be indicated in which of the following patient scenarios						
Patient with closed tibia fracture, low-speed motor vehicle collision, arrives in C-collar, nonintoxicated, denies neck pain	9/51 (18)	23/78 (30)	4/19 (21)	9/35 (21)	30/111 (27)	39/155 (25)
Same patient as above, intoxicated	45/51 (88)	71/79 (90)	14/19 (73)	42/44 (96)	95/112 (85)	137/156 (88)
Patient with a femur fracture, low-speed motor vehicle collision, arrives in C-collar, nonintoxicated, severe lower extremity pain, denies neck pain	31/51 (61)	41/78 (53)	10/19 (53)	31/44 (71)	57/111[a] (51)	88/155 (57)
Mechanism of injury: CSC would be indicated for the following scenarios						
Patient who has been in a motor vehicle collision, has a extremity pain, denies neck pain	44/51 (86)	74/79 (94)	16/19 (84)	39/44 (87)	101/112 (90)	140/156 (90)
Patient with multiple injuries including chest, abdomen, extremities; ejected from vehicle, 40-mph rollover, no head injury, nonintoxicated, denies neck pain	44/51 (86)	74/79 (94)	18/19 (95)	40/44 (91)	102/112 (91)	142/150 (91)
Same patient as above, intoxicated	49/51 (90)	78/79 (99)	145/149 (97)	43/44 (98)	109/112 (97)	145/149 (97)
Assault victim, abrasions & contusions about the head and face, intoxicated, denies neck pain	47/51 (92)	70/79 (87)	14/19 (74)	41/44 (93)	96/112 (86)	137/156 (88)
Extremes of age: CSC would be indicated for this scenario						
An 80-year-old man falls from standing, large scalp laceration but denies neck pain	38/51 (75)	62/79 (79)	11/19 (58)	32/44 (73)	83/112 (74)	115/156 (74)

[a] $p < 0.05$.

Table 6. Indications for CSC[a] $p < 0.05$.

To assess the method of radiographic CSC, five clinical scenarios were provided with a list of choices of radiographic tests that could be applied to each scenario. There were 16 potential responses, which are listed in Table 7 (survey elements). The scenario and distribution of responses by TC level and type for each scenario are shown in Table 8. The initial approach to CSC is relatively uniform, although the use of a "five-view" series is moderately prevalent. The problem of visualizing the cervicothoracic junction is most often (>68% of all TC) initially dealt with using an axillary lateral view as opposed to cervical CT. For patients with persistent neck pain and normal radiographs, there is a broad range of response with some emphasis (51%) on flexion-extension films in academic and Level I TC. Of interest, 28% of Level III centers would discharge such patients in a soft collar and only 11% of such centers would obtain flexion extension films. For patients who have a head injury and are comatose or who have altered mental status with normal plain films, there was a broad range of response. The majority of TC favored some type of diagnostic study if sensorium did not clear after a specified period of time. Of interest, 21% of Level II and only 10% of Level I TC advocated removal of the cervical collar without further testing.

TABLE 7. Radiographic options for CSC for patients in whom CSC is warranted after trauma

A. Single cross-table lateral cervical spine film
B. "Three-view" cervical spine series: anteroposterior, lateral, and odontoid
C. "Five-view" cervical spine series: "three-view" plus obliques
D. "Spiral" or helical CT scan of the entire cervical spine

D. "Spiral" or helical CT scan of the entire cervical spine
E. Obtain "swimmers" or axillary lateral view
F. "Spiral" or helical CT through the cervicothoracic junction
G. Obtain an MRI of the cervical spine
H. Obtain flexion-extension films
I. Make no decision without conferring with a consultant
J. Remove cervical collar without further evaluation
K. Remove cervical collar if the patients seems to indicate that his or her neck does not hurt
L. Leave patient in cervical collar and re-evaluate clinically in 24 hours
M. Leave patient in cervical collar until sensorium cleared then re-evaluate clinically
N. Leave patient in cervical collar for a period of time, if sensorium clears re-evaluate clinically, if not perform a diagnostic study (flexion-extension, MRI)
O. Leave in cervical collar 4 to 6 weeks then remove
P. Discharge in soft collar

Table 7. Radiographic options for CSC for patients in whom CSC is warranted after trauma

TABLE 8. Radiographic approach to CSC: response by trauma center level and type[a]

Question/Response	Level			Type	
	I (%)	II (%)	III (%)	Academic (%)	Nonacademic (%)
For patients in whom radiographic clearance of the cervical spine is warranted, which choice corresponds most closely to the *initial* studies that would be obtained in your institution? (Assume all lateral cervical spine films include C7–T1 junction)					
A. Single cross-table lateral cervical spine film	19	27	26	15	26
B. "Three-view" cervical spine series: anteroposterior, lateral, and odontoid	54	44	53	68	43
C. "Five-view" cervical spine series: "three-view" plus obliques	25	28	21	17	29
All others	2.1				2.0
For patients in whom the cervicothoracic junction is not visualized during the initial radiographic evaluation, you would then					
E. Obtain a "swimmers" or axillary lateral view	72	69	74	76	72
F. Obtain a CT through the cervicothoracic junction	12	13	11	12	13
All others	16	18	15	12	15
For a patient who has been radiographically cleared but continues to have neck pain and who would otherwise be discharged you would					
H. Obtain flexion-extension films	51	31	11	50	35
P. Discharge in a soft collar	12	12	28	12	15
I. Make no decision without conferring with a consultant	8	8	28	12	15
D. "Spiral" or helical CT scan of the entire cervical spine	4	17	11	2	13
All others	25	32	22	24	22
For a patient who has altered mental status 24 hours after admission, has a normal radiographic evaluation of the C-spine, and is in a C-collar, you would					
N. Leave patient in a C-collar for a period of time, if sensorium cleared re-evaluate clinically, if not perform a diagnostic study (flexion-extension, MRI)	33	17	18	29	20
M. Leave the patient in a C-collar until their sensorium cleared, then reevaluate clinically	26	26	24	36	25
I. Make no decision without conferring with a consultant	10	17	15	10	17
All others	31	40	43	25	38
For a patient with a head injury in a coma with normal C-spine films you would					
N. Leave patient in a C-collar for a period of time, if sensorium cleared, re-evaluate clinically; if not, perform a diagnostic study (flexion-extension, MRI)	31	26	32	31	31
J. Remove the C-collar without further evaluation	10	21	16	10	17
M. Leave the patient in a C-collar until their sensorium cleared then reevaluate clinically	19	12	0	22	17
I. Make no decision without conferring with a consultant	6	17	26	5	17
All others	34	24	26	32	18

[a] Capital letters at left correspond to those on Table 7.

Table 8. Radiographic approach to CSC: response by trauma center level and type[aa] Capital letters at left correspond to those on Table 7.

DISCUSSION

Although the overall response rate of 25% is lower than desired, we believe this study is representative of a

cross-section of TC in the United States. Furthermore, the response rates were similar for TC of different levels. The best response rate was from Level I TC (26%), and the majority of CSI incidence data is also derived from Level I (57%) centers. The majority of Level I TC were also described as academic, and these centers supplied 49% of the patient data. These data reflect the demographics of the nonresponding institutions as well: there are more Level II TC across the country but more patient volume concentrated in Level I TC. There are fewer Level III and IV institutions.

Despite that more patient volume is concentrated in Level I centers, we sought to identify incidence figures and practice standards in *all* types of TC. We believed that comparisons between TC of the same level or between TC of different levels would reveal variation in the incidence of CSI and approach to CSC.

We were surprised to find no significant difference in the overall incidence of CSI between TC of different level and type The incidence of all types CSI in 111,219 patients is 4.3%. The majority of these CSI (70% of cases) were fractures without SCI. These figures are similar to those reported in the literature. 2-5 The only other study reporting on a very large number of patients 2 cited an overall incidence of CSI of 2.3% with 4.6% of these injuries described as “missed” or “delayed diagnosis.” We found that 1.3% of CSI were categorized as missed or delayed diagnoses. Although the exact definition of missed or delayed diagnosis is open to some interpretation, these data are registry based as were the results reported by Davis et al. 2 We observed a positive correlation between increasing incidence of cervical spine fracture and ISS in all TC. Thus, it seems that in addition to the factors enumerated by Cadoux et al. 3 increased suspicion for CSI is justified in more severely injured patients. Although associations between ISS and missed or occult CSI have been suggested 5,6 we did not observe this in our survey. It may be that TC are more vigilant in their approach to CSC in this patient group (see below).

We surveyed TC to determine how they approached the two fundamental questions surrounding CSI: who warrants CSC, and what radiographic studies should be performed in an effort to clear the cervical spine. The survey revealed interesting findings with respect to the clinical resources available for CSC. CT and MRI were widely available, but these modalities were not considered gold standard modalities for CSC. Protocols for CSC were common in Level I but not Level II TC. Separate trauma services were reported in place by most Level I and over half of Level II TC, and responsibility for CSC fell to the trauma service in the majority of cases (>80% of cases). Thus, it is reasonable for trauma surgeons to play a major role in the establishment of rationale guidelines for CSC. The initiation of a large scale prospective study evaluating sensitivity and specificity of clinical criteria 4 that will obviate the need for radiographic CSC emphasizes that Emergency Medicine physicians also plays a central role in the study of this problem.

The survey sampled attitudes regarding which patients should undergo CSC by describing clinical scenarios lumped into four broad categories. There seemed to be a strong consensus that patients who are awake and alert without neck pain or neurologic deficit would not require radiographic CSC. Whether the NEXIS study referred to above confirms the appropriateness of this practice standard remains to be seen. The addition of intoxication to a given clinical scenario warrants radiographic CSC even for low-energy events in which patients deny cervical pain. This practice pattern is apparently based on studies 5,7 that have demonstrated a higher incidence of CSI and missed or occult injury in intoxicated patients. For the patient with a low- to moderate-energy event, a distracting injury, no intoxication or neck pain, there was disagreement as to the definition of “distracting injury.” With respect to this question, the EAST recommendations suggest radiographic CSC is warranted in the presence of distracting injury, but there is no further definition of such injuries. In our survey, a tibia fracture was not believed to be distracting, whereas a femur fracture was. We suspect that this question is answered by most practitioners on a case by case basis by using clinical judgment to determine the patients “reliability” with respect to the presence of cervical pain. With respect to injury mechanism, we asked about a patient with a severe mandibular fracture but no neck pain and found most TC would pursue CSC. This finding is of interest because a large study by Beirne 8 demonstrated that facial fractures do not represent an independent risk factor for CSI in the absence of altered mental status. The EAST recommendations seem to support the conclusions reached by Beirne and, thus, are somewhat at odds with the standard of practice in over 85% of Level I and II TC. Similarly, for a patient ejected from a vehicle at 40 mph with chest and abdominal injuries but no intoxication or neck pain, most TC would pursue CSC based strictly on mechanism of injury. Finally, most TC would perform CSC on an elderly man with a scalp laceration who falls from standing but has no neck pain. The EAST recommendations do not specifically deal with the issue of the elderly patient, who may have significant degenerative disease. Lieberman and Webb 9 and Spivak, 10 in separate reports, suggest that such patients are at increased risk for CSI even in the absence of cervical pain.

For patients who require CSC, the recommendations provided by EAST suggest the use of a “three view” cervical spine series to include the cervicothoracic junction and the entire odontoid process as the initial approach to screening. Our survey indicates that the initial approach to CSC involved use of “three-view” cervical spine series in just over 50% of Level I TC. We were surprised to observe a relatively large proportion of centers that use either one- or five-view series as their initial approach to screening. In this area, the EAST document has its most substantial evidenced-based support and recommends a “three-view” series with no additional benefit expected from a “five-view” series.

Although most TC possess 24-hour access to CT and MRI, few TC consider them “gold standard” tests for CSC. We did not survey TC with regard to the imaging modality of choice for a patient in whom a fracture is suspected or identified, because our intention was to focus on screening. The EAST recommendations suggest performance of computed tomographic scans with sagittal reconstruction in these cases.

For the patient with normal x-ray films and persistent cervical pain, EAST recommends flexion-extension views, although there are only two specific references 11,12 meeting the compliance categories that support this recommendation, and one 11 refers to fluoroscopic examinations in obtunded patients. In our survey, 39% of Level I TC and 60% of Level II TC felt flexion-extension studies were potentially harmful. In a survey conducted by Boutin and colleagues, 74% of neurosurgeons and 41% of neuroradiologists favor use of flexion-extension films to evaluate persistent neck pain when radiographs are normal (Boutin RD, Hart BL, Benzel EC, Orrison WW, unpublished data). Our survey indicates that in Level I TC, flexion-extension films are the most common approach (51% of cases) to this problem on a percentile basis. There is considerably more “scatter” in Level II and II TC. Helical CT of the entire cervical spine was used for this patient group in 13 Level II TC (17%).

We found the approach to CSC in patients with altered mental status and coma quite divergent from the recommendations of EAST. Although studies have demonstrated an increased risk of CSI in association with traumatic coma 13,14 another study with just under 100 patients showed no association between traumatic intracranial hemorrhage and occult CSI. 15 Careful review of the accumulated literature compiled to create the EAST recommendations reveals that there is no class II data examining the ideal approach to such patients. A reasonable menu of approaches is outlined followed by the recommendation that the cervical collar can be removed in such patients provided plain films are adequate and show no evidence of fracture or dislocation. Certainly such an approach would be welcomed by most TC, which must contend with this problem on a regular basis. We found that the TC approach to this problem was highly variable. As can be seen from the data displayed in Table 8, the majority of Level I TC favor leaving a cervical collar in place until the patient could be evaluated clinically for pain and tenderness. If clinical evaluation remains impossible after some set period of time, a diagnostic test (flexion-extension or MRI) is favored. We were very interested to find that few Level I TC would remove the cervical collar without further testing. This approach was more prevalent in Level II (15–17%) and nonacademic (13–17%) TC.

The survey reported herein was not intended to discredit the important and difficult work performed by the Practice Parameter Work Group for Cervical Spine Clearance. In fact, this survey was conceptualized during a breakfast session of the AAST in 1996 when the recommendations and evidence supporting them were discussed. We believed then, as now, that it would be important to identify those areas of practice in which the recommendations differed most from the clinical approach used by TC. Although certain recommendations do not seem to be supported by clinical practice patterns, there is good agreement in other areas. Areas of consensus and lack thereof are summarized in Table 9.

TABLE 9. Agreement and disagreement between EAST recommendations and practice standards

Question/Response	EAST	Survey
Who requires CSC?		
Awake, alert, nonintoxicated, no neck pain	No	No
Presence of distracting injury	Yes	Yes (definition unclear)
Intoxication, altered levels of consciousness	Yes	Yes
Mechanism of injury predicts need	No	Yes
For patients requiring CSC		
Initial approach to screening	three-view	three- or five-view
Persistent neck pain, normal three-view	Flex-ex	No consensus
Incomplete visualization C7–T1	CT	Axillary lateral
Coma or persistent altered mental status	Remove collar	No consensus

Table 9. Agreement and disagreement between EAST recommendations and practice standards

Although it will be argued that guidelines should dictate rational practice patterns when evidence-based medicine is used, it must be remembered that the EAST recommendations are based on class II data. Furthermore, the weight of compiled data does not address all of the recommendations. We hope to survey the same group of TC 1 year after publication of the recommendations by using a more limited survey focusing only on the aforementioned areas of disagreement to ascertain whether the recommendations have altered the standard of practice.

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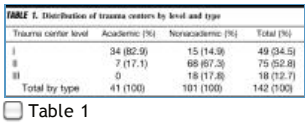


TABLE 1. Distribution of trauma centers by level and type

Trauma center level	Academic (%)	Nonacademic (%)	Total (%)
I	34 (82.9)	15 (14.9)	49 (34.5)
II	7 (17.1)	68 (67.3)	75 (52.8)
III	0	18 (17.8)	18 (12.7)
Total by type	41 (100)	101 (100)	142 (100)

Table 1

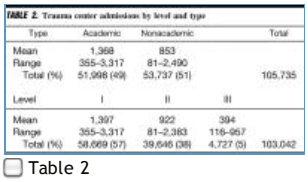
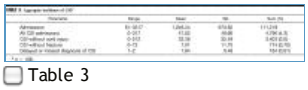


TABLE 2. Trauma center admissions by level and type

Type	Academic	Nonacademic	Total
Mean	1,368	853	
Range	355–3,317	81–2,490	
Total (%)	51,998 (49)	53,737 (51)	105,735
Level	I	II	III
Mean	1,397	922	394
Range	355–3,317	81–2,383	116–957
Total (%)	58,669 (57)	39,646 (38)	4,727 (5) 103,042

Table 2



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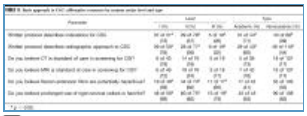

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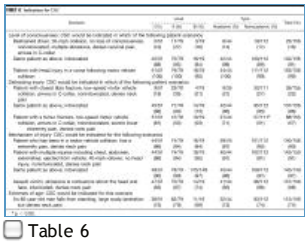

Table 6

TABLE 7. Radiographic options for CSC for patients in whom CSC is warranted after trauma

A. Single cross-table lateral cervical spine film
B. "Three-view" cervical spine series: anteroposterior, lateral, and odontoid
C. "Five-view" cervical spine series: "three-view" plus obliques
D. "Spiral" or helical CT scan of the entire cervical spine
E. Obtain "swimmers" or axillary lateral view
F. "Spiral" or helical CT through the cervicothoracic junction
G. Obtain an MRI of the cervical spine
H. Obtain flexion-extension films
I. Make no decision without conferring with a consultant
J. Remove cervical collar without further evaluation
K. Remove cervical collar if the patients seems to indicate that his or her neck does not hurt
L. Leave patient in cervical collar and re-evaluate clinically in 24 hours
M. Leave patient in cervical collar until sensorium cleared then re-evaluate clinically
N. Leave patient in cervical collar for a period of time, if sensorium clears re-evaluate clinically, if not perform a diagnostic study (flexion-extension, MRI)
O. Leave in cervical collar 4 to 6 weeks then remove
P. Discharge in soft collar

Table 7

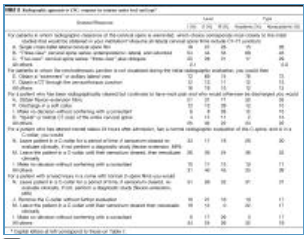

Table 8

Table 9

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