Spinal Immobilization: How rigid do we need to be?

George Lindbeck, MD
Virginia State EMS and Trauma Systems Medical Director
Victim's prepped and ready for transport.

Whoo! All I did was smash my finger.
Spinal Immobilization

EMS gospel:
If there is clinical concern, immobilize
If in doubt immobilize
If you think someone will yell at you, immobilize
Sometimes seems to be the primary indication
Spinal Immobilization

What are we trying to prevent?
Aggravation of an existing axial spine injury that would either cause or worsen a spinal cord injury.

The theory is, then, that keeping the axial spine in a stable anatomic position will be protective.
Spinal Immobilization

Pros

Spinal column injuries will not be aggravated to the point that additional spinal cord injury results.
Spinal Immobilization

Cons

- Airway compromise
- Aspiration risk
- Increased intracranial pressure
- Cutaneous pressure ulcers
- Iatrogenic pain
- Increased difficulty in patient handling
- Combativeness/resistance
- Increased cost
Some material in the literature still perpetuates some of the time honored, but unsubstantiated foundations of spinal immobilization.
Spinal Immobilization

Historically, it is estimated that up to 25% of SCI may be aggravated after the initial insult, either during transport or early in the course of treatment [18,19]. It should be mentioned that these data are more than 20-years old, and no data are available from actual studies. Careful movement and the use of appropriate extrication techniques are crucial in all trauma patients with SCI or in mechanisms of injury with the potential to cause spinal injury and SCI. Immobilisation of the entire spine is a management priority and should be undertaken in a systematic fashion. The patient should be

The role of rapid sequence induction for intubation of the trachea in the prehospital trauma setting by trained EMS staff is crucial and may be used as an advanced airway management technique to improve the success of intubating the trachea [24]. Intubation of the trachea in patients suffering

Systems of immobilisation such as the Kendrick extrication device (KED) in combination with a rigid cervical collar are useful to provide almost complete immobilisation of the head and torso. These systems are often used to immobilise patients with suspected SCI during extrication after a motor
PRE-HOSPITAL CERVICAL SPINAL IMMOBILIZATION FOLLOWING TRAUMA

RECOMMENDATIONS

Standards: There is insufficient evidence to support treatment standards.

Guidelines: There is insufficient evidence to support treatment guidelines.

Options: 
- It is suggested that all trauma patients with a cervical spinal column injury or with a mechanism of injury having the potential to cause cervical spinal injury should be immobilized at the scene and during transport using one of several available methods.
- A combination of a rigid cervical collar and supportive blocks on a backboard with straps is very effective in limiting motion of the cervical spine and is recommended. The longstanding practice of attempted cervical spinal immobilization using sandbags and tape alone is not recommended.

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SUMMARY

Spinal immobilization can reduce untoward movement of the cervical spine and can reduce the likelihood of neurological deterioration in patients with unstable cervical spinal injuries following trauma. Immobilization of the entire spinal column is necessary in these patients until a spinal column injury (or multiple injuries) or a spinal cord injury has been excluded or until appropriate treatment has been initiated. While not supported by Class I or Class II medical evidence, this effective, time-tested practice is based on anatomic and mechanical considerations in attempt to prevent spinal cord injury and is supported by years of cumulative trauma and triage clinical experience.
Spinal Immobilization

Out-of-hospital Spinal Immobilization: Its Effect on Neurologic Injury
Mark Hauswald, MD, Gracie Ong, MBBS, Dan Tandberg, MD, Zaliha Omar, MBBS

ABSTRACT

Objective: To examine the effect of emergency immobilization on neurologic outcome of patients who have blunt traumatic spinal injuries.
Methods: A 5-year retrospective chart review was carried out at 2 university hospitals. All patients with acute blunt traumatic spinal or spinal cord injuries transported directly from the injury site to the hospital were entered. None of the 120 patients seen at the University of Malaya had spinal immobilization during transport, whereas all 334 patients seen at the University of New Mexico did. The 2 hospitals were comparable in physician training and clinical resources. Neurologic injuries were assigned to 2 categories, disabling or not disabling, by 2 physicians acting independently and blinded to the hospital of origin. Data were analyzed using multivariate logistic regression, with hospital location, patient age, gender, anatomic level of injury, and injury mechanism serving as explanatory variables.
Results: There was less neurologic disability in the unimmobilized Malaysian patients (OR 2.03; 95% CI 1.03–3.99; p = 0.04). This corresponds to a <2% chance that immobilization has any beneficial effect. Results were similar when the analysis was limited to patients with cervical injuries (OR 1.52; 95% CI 0.64–3.62; p = 0.34).
Conclusion: Out-of-hospital immobilization has little or no effect on neurologic outcome in patients with blunt spinal injuries.
Key words: injury; trauma; morbidity; spine; immobilization; back board; emergency medical services; spinal cord.

Spinal immobilization for trauma patients.

Kwan I, Bunn F, Roberts I.

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Abstract

BACKGROUND: Spinal immobilisation involves the use of a number of devices and strategies to stabilise the spinal column after injury and thus prevent spinal cord damage. The practice is widely recommended and widely used in trauma patients with suspected spinal cord injury in the pre-hospital setting.

OBJECTIVES: To quantify the effect of different methods of spinal immobilisation (including immobilisation versus no immobilisation) on mortality, neurological disability, spinal stability and adverse effects in trauma patients.

SEARCH STRATEGY: We searched the Cochrane Controlled Trial Register (CCTR), the specialised register of the Cochrane Injuries Group, MEDLINE, EMBASE, CINAHL, PubMed and the National Research Register. We checked reference lists of all articles and contacted experts in the field to identify eligible trials. Manufacturers of spinal immobilisation devices were also contacted for information.

SELECTION CRITERIA: Randomised controlled trials comparing spinal immobilisation strategies in trauma patients with suspected spinal cord injury. Trials in healthy volunteers were excluded.

DATA COLLECTION AND ANALYSIS: Two reviewers independently applied eligibility criteria to trial reports and extracted data.

MAIN RESULTS: We found no randomised controlled trials of spinal immobilisation strategies in trauma patients.

REVIEWER'S CONCLUSIONS: We did not find any randomised controlled trials that met the inclusion criteria. The effect of spinal immobilisation on mortality, neurological injury, spinal stability and adverse effects in trauma patients remains uncertain. Because airway obstruction is a major cause of preventable death in trauma patients, and spinal immobilisation, particularly of the cervical spine, can contribute to airway compromise, the possibility that immobilisation may increase mortality and morbidity cannot be excluded. Large prospective studies are needed to validate the decision criteria for spinal immobilisation in trauma patients with high risk of spinal injury. Randomised controlled trials in trauma patients are required to establish the relative effectiveness of alternative strategies for spinal immobilisation.
Effects of Prehospital Spinal Immobilization: A Systematic Review of Randomized Trials on Healthy Subjects

Irene Kwan, MSc; Frances Bunn, MSc

Results: Seventeen randomized, controlled trials compared different types of immobilization devices, including collars, backboards, splints, and body strapping. For immobilization efficacy, collars, spine boards, vacuum splints, and abdominal/torso strapping provided a significant reduction in spinal movement. Adverse effects of spinal immobilization included a significant increase in respiratory effort, skin ischemia, pain, and discomfort.

Pre-Hospital Care Management of a Potential Spinal Cord Injured Patient: A Systematic Review of the Literature and Evidence-Based Guidelines

Henry Ahn, Jeffrey Singh, Avery Nathens, Russell D. MacDonald, Andrew Travers, John Tallon, Michael G. Fehlings, and Albert Yee
Spinal Immobilization

Question 1. What is the optimal type and duration of pre-hospital spinal immobilization in patients with acute SCI?

- Immobilization of patients with SCI during the pre-hospital setting should include a cervical collar, head immobilization, and a spinal board.
- Patients should be transferred off the hardboard on admission to a facility as soon as is feasible to minimize time on the hardboard. If patients are awaiting transfer to another institution, they should be taken off the hardboard while awaiting transfer.

- Padded boards or inflatable bean bag boards should be utilized to reduce pressure on the occiput and sacrum.
- These recommendations are intended for adults and children over the age of 12 years.
Question 2. During airway manipulation in the pre-hospital setting, what is the ideal method of spinal immobilization?

- Airway management of acute SCI patients requiring intubation in the pre-hospital setting should include the use of manual in-line cervical spine traction.
- Intubation of patients with acute SCI in the pre-hospital setting should not rely solely on cervical collar neck immobilization.
- Indirect methods of intubation may cause less cervical movement than with direct laryngoscopy with a Miller blade.
Spinal Immobilization

Question 3. What is the impact of pre-hospital transport time to definitive care on the outcomes of patients with acute SCI?

- Transport of patients with acute traumatic SCI to the definitive hospital center for care should occur within 24 h of injury.
Question 4. What is the role for pre-hospital care providers in cervical spine clearance and immobilization?

- Emergency medical personnel in the pre-hospital setting can be trained to apply criteria to clear patients of cervical spinal injuries and immobilize patients suspected of having a cervical spinal injury.
- The implementation of this recommendation will likely be impacted by regional variations in law and health policy.
Spinal Immobilization

Pre-hospital spinal immobilization is a transport modality, not a therapeutic intervention.

Wear your backboard for a week, then follow-up with orthopedics.
Diffusion of Medical Progress: Early Spinal Immobilization in the Emergency Department

Mark Hauswald, MD, Darren Braude, MD, MPH

Abstract

Objectives: To examine the spread of new techniques of spinal care through one state’s emergency departments (EDs).

Methods: This was a telephone survey of all 36 EDs in a single state. One physician from each ED was contacted and given a short structured survey instrument to determine when patients who arrived at the ED on backboards were removed from the backboards. Removal was classified as “immediate” if it was done before clinical or radiographic exclusion of cervical spine injury and “delayed” if it was done only after interpretation of any indicated diagnostic radiologic procedures. Further questions were asked to determine if all physicians in the group used the same technique and how this technique had been adopted.

Results: In all but four hospitals, patients were removed from backboards in the same manner by all physicians, using a protocol or standard procedure. Fifteen of these did immediate and seventeen did delayed removal. In all but one case, the approach of immediate removal was initiated at the hospital by a physician trained or recently working at a university facility. Eight respondents stated that transport service requirements influenced their decision.

Conclusions: Although logic and the medical literature support removing all patients from a backboard immediately, physicians were unlikely to change their practice after their formal training had been completed until a new member of their group had done so.

ACADEMIC EMERGENCY MEDICINE 2007; 14:1087–1089 © 2007 by the Society for Academic Emergency Medicine

Keywords: spinal injuries, spinal immobilization, physician practice patterns, health knowledge, attitudes, practice
Spinal Immobilization

Are we as good as we think in getting patients off of spine boards in the ED?

Stagg and Lovell: A repeat audit of spinal board usage in the emergency department. Injury 2008;39:323-326

Remove immediately 21% (up from 5%)
Removal after clinical clearance 58% (up from 52%)
Removal only after radiographs 21% (down from 43%)
Place patients on boards after arrival 45% (down from 48%)
No changes in practice in 22% of the ED’s surveyed
Spinal Immobilization

The “time zero” myth in EMS

The time that the patient hits the ED door doesn’t mean that their evaluation and/or care begins at that point in time.

Patients who arrive immobilized may stay that way for significant periods of time until they are seen and removed from the board by someone authorized to do so.
Spinal Immobilization

Frequently is used for patient handling/carrying issues

“putting handles on the patient”
Should be discontinued as soon as no longer needed

Spinal immobilization is occasionally used for other purposes

Restraint
Should be used with caution if at all

Stabilization after intubation
To help prevent ET tube dislodgement
Spinal Immobilization

What is the incidence of spinal injury?

The National X-Radiography Utilization Study (NEXUS)

- 34,000 patients
- 2.4% suffered a cervical spine injury
  - Vertebral body injuries were most common
  - About a third of injuries were insignificant
- 6% suffered a thoracolumbar injury
- SCIWORA in 0.08%
Spinal Immobilization

NEXUS clinical criteria to avoid X-rays:
Midline cervical pain/tenderness on exam
Altered mental status
Evidence of intoxication
Neurologic abnormality
Presence of a painful distracting injury

Only 30% of injuries were identified if only one criterion was used
If all five were used, 99.8% of injuries were identified
Multicenter Prospective Validation of Prehospital Clinical Spinal Clearance Criteria

Robert M. Domeier, MD, Robert A. Swor, DO, Rawden W. Evans, MD, PhD, J. Brian Hancock, MD, William Fales, MD, Jon Krobmer, MD, Shirley M. Frederiksen, RN, MS, Edgardo J. Rivera-Rivera, MD, and M. Anthony Schork, PhD

Background: Spine immobilization is one of the most frequently performed prehospital procedures. If trauma patients without significant risk for spine injury complications can be identified, spine immobilization could be selectively performed. The purpose of this study was to evaluate five prehospital clinical criteria—altered mental status, neurologic deficit, spine pain or tenderness, evidence of intoxication, or suspected extremity fracture—the absence of which identify prehospital trauma patients without a significant spine injury.

Methods: Prospectively collected emergency medical services data items included the above-listed criteria. Outcome data include spine fracture or cord injury, and also the level and management of injuries.

Results: A total of 295 patients with spine injuries were present in 8,975 (3.3%) cases. Spine injury was identified by the prehospital criteria in 280 of 295 (94.9%) injured patients. The criteria missed 15 patients. Thirteen of 15 had stable injuries, the majority of which were stable compression or vertebral process injuries. The remaining two would have been captured by more accurate prehospital evaluation.

Conclusion: Absence of the study criteria may form the basis of a prehospital protocol that could be used to identify trauma patients who may safely have rigid spine immobilization withheld. Evaluation of such a protocol in practice should be performed.

Key Words: Prehospital, Spinal, Clearance.

J Trauma. 2002;53:744–750.
Spinal Immobilization

The purpose of this study was to evaluate five prehospital clinical criteria—altered mental status, neurologic deficit, spine pain or tenderness, evidence of intoxication, or suspected extremity fracture—the absence of which identify prehospital trauma patients without a significant spine injury.

<table>
<thead>
<tr>
<th>Table 6</th>
<th>Statistical Summary for the “Overall Study Criterion”: Has at Least One of the Five Prehospital Clinical Criteria Used in Detecting Spine Injury</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>94.9</td>
</tr>
<tr>
<td>Specificity</td>
<td>35.0</td>
</tr>
<tr>
<td>Positive predictive value</td>
<td>4.7</td>
</tr>
<tr>
<td>Negative predictive value</td>
<td>99.5</td>
</tr>
</tbody>
</table>
Spinal Immobilization

Spinal Immobilization in the Field: Clinical Clearance Criteria and Implementation
Prehospital Emergency Care 2001;5, 88-93

- No extremes of age
  - \( \leq 12 \) or \( \geq 65 \)
- No altered mental status
  - Alcohol or drug use
  - Head injury
  - Communication barrier
- No neurologic deficits
  - Fleeting or bizarre symptoms considered positive
- No midline or paraspinal pain or tenderness
Efficacy and compliance of a prehospital spinal immobilization guideline

Lucas A. Myers · Christopher S. Russi · Daniel G. Hankins · Kathleen S. Berns · Scott P. Zietlow
Spinal Immobilization

- No pain, stiffness, soreness, or tenderness in the neck or back
- No alteration in level of consciousness
- No intoxication from alcohol or other drugs
- No other painful or distracting condition that may interfere with the patient’s perception of spinal injury symptoms
- No signs or symptoms of shock
Spinal Immobilization

Results The study included 942 patients documented to have a traumatic injury. Of these, 43 (4.6%) had an acute spinal fracture. The guideline allowed 558 (59.2%) patients to be cleared, and 1.3% (7/558) had fractures. The remaining 384 did not meet clearance criteria and accounted for 36 (9.4%, 36/384) fractures. The guideline correctly predicted 36 of 43 fractures. The median age of the 7 fractures not immobilized was 82 years and of the 36 patients with fractures that were immobilized was 48 years. When immobilization was indicated, caregivers were 77.6% (298/384) compliant. Of the noncompliant 22.4% (86/384) there were 9 fractures.

Two patients had lasting paralysis after their injuries, both cervical fractures. Both were identified by the guideline and immobilized by ambulance staff. In all 43 fractures, 8 were cervical, 13 thoracic, and 22 lumbar. Of the seven that were not predicted by the guideline, four were lumbar and three thoracic. None of these seven patients had lasting neurologic deficits or cord injuries secondary to the fractures. Of
Spinal Immobilization

The Out-of-Hospital Validation of the Canadian C-Spine Rule by Paramedics

Christian Vaillancourt, MD, MSc
Ian G. Stiell, MD, MSc
Tammy Beaudoin, CHIM
Justin Maloney, MD
Andrew R. Anton, MD
Paul Bradford, MD
Ed Cain, MD
Andrew Travers, MD, MSc
Matt Stempien, MD
Martin Lees, MD
Doug Munkley, MD
Erica Battram, RN
Jane Banek, CHIM
George A. Wells, PhD

From the Department of Emergency Medicine (Vaillancourt, Stiell, Maloney) and the Department of Medicine (Wells), the Ottawa Health Research Institute (Vaillancourt, Stiell, Wells, Beaudoin, Battram, Banek), University of Ottawa, Ottawa, Ontario, Canada; the City of Calgary Emergency Medical Services, Calgary, Alberta, Canada (Anton); the Essex-Kent Base Hospital, Hotel Dieu Grace Hospital, Windsor, Ontario, Canada (Bradford); the Department of Emergency Medicine, Dalhousie University, Halifax, Nova Scotia, Canada (Cain); Emergency Health Services, Halifax, Nova Scotia, Canada (Travers); the Department of Emergency Medicine, Joseph Brant Hospital, Burlington, Ontario, Canada (Stempien); the Department of Emergency Medicine, Bluewater Health, Sarnia, Ontario, Canada (Lees); and the Niagara Base Hospital, Niagara Falls, Ontario, Canada (Munkley).

Figure 1. The Canadian C-Spine Rule for alert (Glasgow Coma Scale score 3-5) and stable trauma patients for whom cervical spine injury is a concern, including patients with either posterior neck pain with any blunt mechanism of injury or no neck pain but some visible injury above the clavicles. MVC, Motor vehicle crash.
Table 3. Sensitivity, specificity, and negative predictive value of the Canadian C-Spine Rule for 12 cases of clinically important injury among 1,629 patients* assessed by the study investigators and 1,947 patients† assessed by the participating paramedics.

<table>
<thead>
<tr>
<th>Result of Assessment</th>
<th>Investigators (95% CI)</th>
<th>Paramedics (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Injury</td>
<td>No Injury</td>
</tr>
<tr>
<td>Positive, No.</td>
<td>12</td>
<td>924</td>
</tr>
<tr>
<td>Negative, No.</td>
<td>0</td>
<td>693</td>
</tr>
<tr>
<td>Sensitivity, %</td>
<td>100 (74–100)</td>
<td>100 (74–100)</td>
</tr>
<tr>
<td>Specificity, %</td>
<td>42.9 (40–45)</td>
<td>37.7 (36–40)</td>
</tr>
<tr>
<td>Negative predictive value, %</td>
<td>100 (99–100)</td>
<td>100 (99–100)</td>
</tr>
</tbody>
</table>
A Statewide, Prehospital Emergency Medical Service Selective Patient Spine Immobilization Protocol

John H. Burton, MD, Matthew G. Dunn, DO, Nathan R. Harmon, DO, Tari A. Hermanson, MD, and Jay R. Bradshaw, EMT-P

**Background:** To evaluate the practices and outcomes associated with a statewide, emergency medical services (EMS) protocol for trauma patient spine assessment and selective patient immobilization.

**Methods:** An EMS spine assessment protocol was instituted on July 1, 2002 for all EMS providers in the state of Maine. Spine immobilization decisions were prospectively collected with EMS encounter data. Prehospital patient data were linked to a statewide hospital database that included all patients treated for spine fracture during the 12-month period following the spine assessment protocol implementation. Incidence of spine fractures among EMS-assessed trauma patients and the correlation between EMS spine immobilization decisions and the presence of spine fractures—stable and unstable—were the primary investigational outcomes.

**Results:** There were 207,545 EMS encounters during the study period, including 31,885 transports to an emergency department for acute trauma-related illness. For this cohort, there were 12,988 (41%) patients transported with EMS spine immobilization. Linkage of EMS and hospital data revealed 154 acute spine fracture patients; 20 (13.0%) transported without EMS-reported spine immobilization interventions. This nonimmobilized group included 19 stable spine fractures and one unstable thoracic spine injury. The protocol sensitivity for immobilization of any acute spine fracture was 87.0% (95% confidence interval [CI], 81.7–92.3) with a negative predictive value of 99.9% (95% CI, 99.8–100).

**Conclusions:** The use of this statewide EMS spine assessment protocol resulted in one nonimmobilized, unstable spine fracture patient in approximately 32,000 trauma encounters. Presence of the protocol affected a decision not to immobilize greater than half of all EMS-assessed trauma patients.

**Key Words:** Spine fracture, Emergency medical services, Trauma.

Spinal Immobilization

Mechanism of Injury: Axial load (diving), Blunt trauma, MVC* or bicycle, fall >3 ft, adult fall from standing ht.

Don’t Immobilize

Unreliable? ** (Intox/Alt LOC/ Acute Stress Reaction)

Immobilize

Spine Pain/ Tenderness?

Yes

No

Distracting Injury?***

No

Abnormal Sensory/Motor Exam?

Yes

Prehospital EMS spine assessment protocol. Mechanism of injury: axial load (diving), blunt trauma, MVC (crashes of all motorized vehicles: e.g. automobile, motorcycle, snowmobile, etc.) or bicycle, fall >3 ft, adult fall from standing height. Clearance of the spine requires the patient to be calm, cooperative, sober, and alert. Distracting injury includes any injury that produces clinically apparent pain that might distract the patient from the pain of a spine injury.
Spinal Immobilization

Spine Immobilization in Penetrating Trauma:
More Harm Than Good?

Elliott R. Haut, MD, Brian T. Kalish, BA, EMT-B, David T. Efron, MD, Adil H. Haider, MD, MPH,
Kent A. Stevens, MD, MPH, Alicia N. Kieninger, MD, Edward E. Cornwell, III, MD,
and David C. Chang, MBA, MPH, PhD

The Journal of TRAUMA® Injury, Infection, and Critical Care • Volume 68, Number 1, January 2010
Methods: We performed a retrospective analysis of penetrating trauma patients in the National Trauma Data Bank (version 6.2). Multiple logistic regression was used with mortality as the primary outcome measure. We compared patients with versus without prehospital spine immobilization, using patient demographics, mechanism (stab vs. gunshot), physiologic and anatomic injury severity, and other prehospital procedures as covariates. Subset analysis was performed based on Injury Severity Score category, mechanism, and blood pressure. We calculated a number needed to treat and number needed to harm for spine immobilization.

Results: In total, 45,284 penetrating trauma patients were studied; 4.3% of whom underwent spine immobilization. Overall mortality was 8.1%. Unadjusted mortality was twice as high in spine-immobilized patients (14.7% vs. 7.2%, \( p < 0.001 \)). The odds ratio of death for spine-immobilized patients was 2.06 (95% CI: 1.35–3.13) compared with nonimmobilized patients. Subset analysis showed consistent trends in all populations. Only 30 (0.01%) patients had incomplete spinal cord injury and underwent operative spine fixation. The number needed to treat with spine immobilization to potentially benefit one patient was 1,032. The number needed to harm with spine immobilization to potentially contribute to one death was 66.
Spinal Immobilization

Prehospital Spine Immobilization for Penetrating Trauma—Review and Recommendations From the Prehospital Trauma Life Support Executive Committee

Lance E. Stuke, MD, MPH, Peter T. Pons, MD, Jeffrey S. Guy, MD, MSc, MMHC, Will P. Chapleau, RN, EMT-P, Frank K. Butler, MD, Capt MC USN (Ret), and Norman E. McSwain, MD

The Journal of TRAUMA® Injury, Infection, and Critical Care • Volume 71, Number 3, September 2011
Spinal Immobilization

PHTLS Recommendations

• There are no data to support routine spine immobilization in patients with penetrating trauma to the neck or torso.
• There are no data to support routine spine immobilization in patients with isolated penetrating trauma to the cranium.
• Spine immobilization should never be done at the expense of accurate physical examination or identification and correction of life-threatening conditions in patients with penetrating trauma.
• Spinal immobilization may be performed after penetrating injury when a focal neurologic deficit is noted on physical examination although there is little evidence of benefit even in these cases.
DuBose et al: The role of routine spinal imaging and immobilisation in asymptomatic patients after gunshot wounds. Injury 2009;40:860-863

4204 patients with GSW’s to the head, neck, or torso

327 (7.8%) had spinal column injuries
173 (52.9%) had spinal cord injuries
2 (0.6%) patients required surgery
None had unstable spinal injuries
Are spinal precautions necessary in all seizure patients?

McArthur CL 3rd, Rooke CT.
Emergency Department, Riverside General Hospital, CA 92503, USA.

Abstract
The purpose of this retrospective chart review study was to evaluate the necessity of spinal precautions in uncomplicated seizure patients. The population was all patients from the Emergency Department with a primary diagnosis of seizure over a 10.5-year period. The setting was a university-affiliated county teaching hospital with an annual patient volume of over 58,000. The key outcome measure was an association of spinal injuries to uncomplicated seizures. A total of 1,656 cases were reviewed. No spinal injuries were found. Three nonspinal fractures were associated with seizure activity. Transportation costs increased approximately 113% and nursing costs increased approximately 57% for patients with seizure placed in spinal precautions. Quality Assurance and Risk Management files showed no complaints or litigation secondary to missed spinal injuries. This retrospective chart review study seriously questions routine use of spinal precautions in uncomplicated seizure cases. If spinal precautions were not used in this group, there would be a significant potential cost savings without increased morbidity. A prospective study is needed to confirm these findings.
Spinal Immobilization

What constitutes adequate spinal immobilization?

Collar alone?
Collar plus a short board/KED?
Collar plus long board?
Collar plus long board plus foam blocks?
Collar plus long board plus ?????
Spinal Immobilization

Kendrick Extrication Device?
Short spine boards?
Considered a mandatory part of extrication in many areas
Is there evidence that they are effective?
Spinal Immobilization

Title:
Cervical Spine Motion During Extrication: A Pilot Study

Journal Issue:
Western Journal of Emergency Medicine, 10(2)

Author:
Shafer, Jeffrey S. MD, EMTP, Washington University School of Medicine, Division of Emergency Department, St. Louis MO
Naunheim, Rosanne S MD, Washington University School of Medicine, Division of Emergency Department, St Louis, MO

Publication Date:
2009

Publication Info:
Western Journal of Emergency Medicine, Department of Emergency Medicine, UC Irvine

...bony prominences, were extricated by experienced paramedics. We found in this pilot study that allowing an individual to exit the car under his own volition with cervical collar in place may result in the least amount of motion of the cervical spine. Further research should be conducted to verify these findings and additional clinical studies should be utilized to establish standards for cervical spine patient care...
Are scoop stretchers suitable for use on spine-injured patients?

Gianluca Del Rossi PhD\textsuperscript{a,*}, Glenn R. Rechtine MD\textsuperscript{c}, Bryan P. Conrad ME\textsuperscript{b}, MaryBeth Horodyski EdD\textsuperscript{b}

Results: Although not statistically significant, the execution of the log roll maneuver created more motion in all directions than either the lift-and-slide technique or with scoop stretcher application. The scoop stretcher and lift-and-slide techniques were able to restrict motion to a comparable degree.
Spinal Immobilization

What should we do about ED walk-ins?

Anecdotal/case report level of evidence that people will occasionally walk into an ED with an unstable fracture (?)

No series published to establish incidence or outcomes

No evidence that c-collar and backboard immobilization of awake and alert walk-in patients is required
NAEMSP position paper

Historically mechanistic, not symptomatic

Has sequelae, both systematic and for patient care

Endorses clinical clearance in the field

References the NEXUS criteria
ists. In addition, there have been no reported cases of spinal cord injury developing during appropriate normal patient handling of trauma patients who did not have a cord injury incurred at the time of the trauma. Although early emergency medical literature identified mishandling of patients as a common cause of iatrogenic injury, these instances have not been identified anywhere in the peer-reviewed literature and probably represent anecdote rather than science. Mechanistically, it seems unlikely that, after a significant trauma, the proportionately small additional energy imparted to the spine by the EMS providers would cause a patient with a spine fracture to develop a cord injury not caused by the initial trauma.
Spinal Immobilization

Airway management

REVIEW

Potential cervical spine injury and difficult airway management for emergency intubation of trauma adults in the emergency department—a systematic review

J E Ollerton, M J A Parr, K Harrison, B Hanrahan, M Sugrue

Spinal Immobilization

180 articles from the C spine injury literature
25 included

472 articles from the difficult airway literature
22 included

RSI is the recommended technique in the ED (B)
Manual in line stabilization (MILS) during intubation (B)
An introducer (bougie) is recommended for routine use (B)
MacIntosh and McCoy blades (B)
LMA recommended as an adjunct/salvage airway (C)
Manual In-line Stabilization Increases Pressures Applied by the Laryngoscope Blade during Direct Laryngoscopy and Orotracheal Intubation

Brandon G. Santoni, Ph.D.,* Bradley J. Hindman, M.D.,† Christian M. Puttlitz, Ph.D.,‡ Julie B. Weeks, M.P.T.,§ Nathaniel Johnson, B.S.,|| Mazen A. Maktabi, M.D.,# Michael M. Todd, M.D.**

Conclusion: Pressures applied to airway tissues by the laryngoscope blade are secondarily transmitted to the cervical spine and result in cranio-cervical motion. In the presence of cervical instability, impaired glottic visualization and secondary increases in pressure application with MILS have the potential to increase pathologic cranio-cervical motion.
Spinal Immobilization

Motion of a Cadaver Model of Cervical Injury During Endotracheal Intubation With a Bullard Laryngoscope or a Macintosh Blade With and Without In-line Stabilization

Christopher R. Turner, MD, PhD, Jessica Block, Amy Shanks, MS, Michelle Morris, MS, Keith R. Lodhia, MD, and Sachin K. Gujar, MD

Results: MILS did not significantly affect maximal motion of this model in any of the three measures using either DL or BL. There were no clinically significant differences in maximal median motion in any of the three measures when comparing the two blades. However, there was significantly more variance in the subluxation caused by DL than by BL.
Bullard Laryngoscopes
Manual In-line Stabilization Increases Pressures Applied by the Laryngoscope Blade during Direct Laryngoscopy and Orotracheal Intubation

Brandon G. Santoni, Ph.D.,* Bradley J. Hindman, M.D.,† Christian M. Puttlitz, Ph.D.,‡ Julie B. Weeks, M.P.T.,§ Nathaniel Johnson, B.S.,∥ Mazen A. Maktabi, M.D.,# Michael M. Todd, M.D.**

Results: With MILS, glottic visualization was worse in six patients, and intubation failure occurred in two of these six patients. Maximum laryngoscope pressure at best glottic view was greater with MILS than without (717 ± 339 mmHg vs. 363 ± 121 mmHg, respectively; n = 8; P = 0.023). Other measures of pressure application also indicated comparable increases with MILS.
Spinal Immobilization

Potential cervical spine injury and difficult airway management for emergency intubation of trauma adults in the emergency department—a systematic review

J E Ollerton, M J A Parr, K Harrison, B Hanrahan, M Sugrue

Spinal Immobilization

Video Laryngoscopy in the Prehospital Setting


A review of available literature regarding different video laryngoscopes and prehospital use

Has potential, but little evidence available of superiority to direct laryngoscopy in terms of spinal stability
Cervical Spine Motion During Tracheal Intubation with Manual In-Line Stabilization: Direct Laryngoscopy versus GlideScope® Videolaryngoscopy

Arnaud Robitaille, MD*
Stephan R. Williams, MD*
Marie-Hélène Tremblay, MD*
François Guilbert, MD, FRCPC†
Mélanie Thériault, MD†
Pierre Drolet, MD, FRCPC‡

BACKGROUND: The optimal tracheal intubation technique for patients with potential cervical (C) spine injury remains controversial. Using continuous cinefluoroscopy, we conducted a prospective study comparing C-spine movement during intubation using direct laryngoscopy (DL) or GlideScope® videolaryngoscopy (GVL), with uninterrupted manual in-line stabilization of the head by an assistant.

METHODS: Twenty patients without C-spine pathology were studied. After induction of general anesthesia with neuromuscular blockade, both DL and GVL were performed on every patient in random order. Cinefluoroscopic images of C-spine movement during GVL and DL were acquired and divided into four stages: a baseline image before airway manipulation, glottic visualization, insertion of the endotracheal tube into the glottis, and tracheal intubation. Peak segmental motion from the occiput to C5 was measured offline for each patient and each stage; averages were calculated, and movements induced by each instrument were compared using a two-way ANOVA. Also studied were the proportion of patients with occiput-C1 rotation exceeding 10, 15, or 20 degrees, and the quality of glottic visualization.

RESULTS: No significant difference was found between DL and GVL regarding average segmental spine movement at any level (P values between 0.22 and 0.70). During both techniques, motion was mainly an extension concentrated in the rostral C-spine and occurred predominantly during glottic visualization. The proportion of patients with occiput-C1 extension of more than 10, 15, or 20 degrees was not significantly different. Glottic visualization was significantly better with GVL compared with DL.

CONCLUSION: During intubation under general anesthesia with neuromuscular blockade and manual in-line stabilization, the use of GVL produced better glottic visualization, but did not significantly decrease movement of the nonpathologic C-spine when compared with DL.

(Anesth Analg 2008;106:935-41)

CONCLUSION: During intubation under general anesthesia with neuromuscular blockade and manual in-line stabilization, the use of GVL produced better glottic visualization, but did not significantly decrease movement of the nonpathologic C-spine when compared with DL.
Spinal Immobilization
Comparison of four airway devices on cervical spine alignment in a cadaver model with global ligamentous instability at C5-6

Conclusion: In a cadaver model of C5-6 instability, the greatest amount of motion was caused by the most commonly used intubation device, the Macintosh blade. Intubation with the Lightwand resulted in significantly less motion in all tested parameters (other then ML translation) as compared to the Macintosh blade. It should also be noted that the Airtraq caused less motion than the Macintosh blade in three of the six tested planes. There were no significant differences in failure rate or the amount of time it took to successfully intubate in comparing these techniques. We therefore recommend the use of the Lightwand, followed by the Airtraq, in the setting of a presumed unstable cervical spine injury over the Macintosh Laryngoscope.
Spinal Immobilization

• Four techniques
Spinal Immobilization

Figure 4 – Graphical representation of the amount of flexion-extension at C5-6 during intubation trials.
Spinal Immobilization

Cervical Spine Motion During Airway Management: A Cinefluoroscopic Study of the Posteriorly Destabilized Third Cervical Vertebrae in Human Cadavers

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(Anesth Analg 2000;91:1274–8)
### Table 1. Maximum Displacement of C3 and Maximum Segmental Sagittal Motion of C2-C3

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Manual-in-line stabilization</th>
<th>Maximum displacement (mm)</th>
<th>Maximum sagittal rotation (degrees)</th>
<th>Phase of Maximum Motion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facemask and chin lift/jaw thrust</td>
<td>Yes</td>
<td>1.9 (1.2, −0.8−3.9)*</td>
<td>2.7 (3.2, −1.7−7.8)</td>
<td>Chin lift/jaw thrust</td>
</tr>
<tr>
<td>Laryngoscope-guided oral intubation</td>
<td>Yes</td>
<td>2.6 (1.6, −0.8−4.2)*</td>
<td>2.7 (3.3, −3.7−7.8)</td>
<td>Exposure of glottis</td>
</tr>
<tr>
<td>Fiberscope-guided nasal intubation</td>
<td>Yes</td>
<td>0.1 (0.7, −0.8−1.7)</td>
<td>0.2 (3.2, −5.2−7.8)</td>
<td>Advancing the tube</td>
</tr>
<tr>
<td>Esophageal tracheal combitube insertion</td>
<td>Yes</td>
<td>3.2 (1.6, 0.2−6.2)*</td>
<td>3.1 (3.0, −4.2−7.8)</td>
<td>Proximal cuff inflation</td>
</tr>
<tr>
<td>Intubating laryngeal mask airway insertion</td>
<td>Yes</td>
<td>1.7 (1.3, −0.8−5.2)*</td>
<td>1.1 (5.5, −5.8−7.8)</td>
<td>Intubation</td>
</tr>
<tr>
<td>Laryngeal mask airway insertion</td>
<td>Yes</td>
<td>1.7 (1.3, −0.8−4.2)*</td>
<td>2.4 (4.0, −8.8−7.3)</td>
<td>Insertion</td>
</tr>
<tr>
<td>Maximum head-neck flexion</td>
<td>No</td>
<td>3.7 (1.9, −0.8−6.5)*</td>
<td>−4.5 (4.0, −7.2−6.8)*</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Maximum head-neck extension</td>
<td>No</td>
<td>1.8 (1.7, −1.3−5.2)*</td>
<td>0.8 (1.9, −0.7−6.8)</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>

Positive values refer to posterior displacement and extension. Negative values to anterior displacement and flexion. Number are mean (SD, range).

* Significant difference compared with post destabilization values.
My summary:

There is no high level evidence that pre-hospital spinal immobilization positively impacts outcome after spinal injury

- In high risk patients, consensus is that it is prudent and may offer some benefit
- There is no evidence that immobilizing awake, alert patients without deficits/complaints provides benefit
- The multiply traumatized patient with altered mental status should be immobilized given our current level of understanding

No evidence to support immobilization of victims of penetrating trauma of the head, neck, or torso

In terms of managing the airway, any invasive airway technique will cause significant cervical spine motion

- Indirect methods of intubation (eg videolaryngoscopy) may help reduce motion during intubation

Prehospital providers can effectively use selective spinal immobilization protocols to identify patients at low risk for injury and avoid immobilization

- EMS systems should develop and implement selective immobilization protocols based on validated criteria