The Painful Truth about Spinal Immobilization

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Is it out of control?

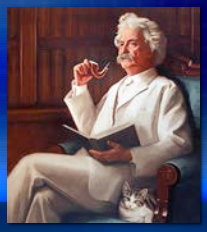
Dogma

Dogma

- An authoritative believe or principle that is considered to be valid regardless of the accuracy or validity.
- Oftentimes the origin of the belief or principle is lost to history.

Heretic

- Anyone who does not conform to an established attitude, doctrine, or principle.



Spinal Immobilization

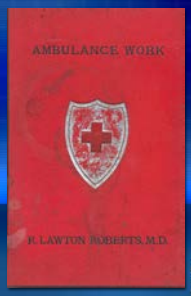
- Backboards have always been a part of "modern" EMS.

Spinal Immobilization

- But why?

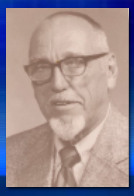
Spinal Immobilization

- Order of Saint John core textbook *Ambulance Work* (1891).
- No mention of spinal immobilization.



Spinal Immobilization

- "Survey of the accident victims, firm immobilization and in-line traction are the basic principles of extrication."



Farrington JD. Extrication of victims--surgical principles. *J Trauma.* 1968;8:493-512.

Spinal Immobilization

REFERENCES

1. Kossuth, L. C. Immediate care to vehicular accident victims. Postgrad. Med., *41:* 407–413, 1967.
2. Trade and Industrial Education Service Emergency Victim Care and Rescue. Instructional Materials Laboratory, Trade and Industrial Education, The Ohio State University College of Education, Columbus, Ohio, pp. 138-147.
3. Swedish Red Cross Manual, p. 7.
4. Young, C. B., Jr. *First Aid for Emergency Crews.* Springfield: Charles C Thomas, 1965, pp. 102-105.

Spinal Immobilization

Spinal Immobilization

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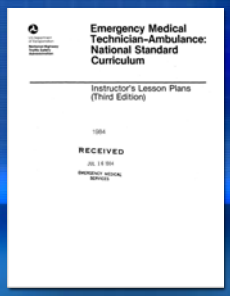


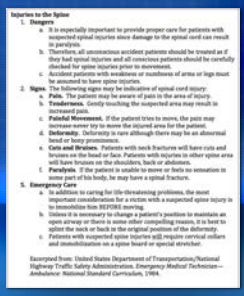
Emergency Medical Technician–Ambulance: National Standard Curriculum

Instructor's Lesson Plans (Third Edition)

1984

RECEIVED

Spinal Immobilization



Injuries to the Spine

1. Dangers
   a. It is especially important to provide proper care for patients with suspected spinal injuries since damage to the spinal cord can result in paralysis.
   b. Therefore, all unconscious accident patients should be treated as if they had spinal injuries and all conscious patients should be carefully checked for spine injuries prior to movement.
   c. Accident patients with weakness or numbness of arms or legs must be assumed to have spine injuries.
2. Signs. The following signs may be indicative of spinal cord injury:
   a. Pain. The patient may be aware of pain in the area of injury.
   b. Tenderness. Gently touching the suspected area may result in increased pain.
   c. Painful Movement. If the patient tries to move, the pain may increase–never try to move the injured area for the patient.
   d. Deformity. Deformity is rare although there may be an abnormal bend or bony prominence.
   e. Cuts and Bruises. Patients with neck fractures will have cuts and bruises on the head or face. Patients with injuries in other spine area will have bruises on the shoulders, back or abdomen.
   f. Paralysis. If the patient is unable to move or feels no sensation in some part of his body, he may have a spinal fracture.
3. Emergency Care
   a. In addition to caring for life-threatening problems, the most important consideration for a victim with a suspected spine injury is to immobilize him BEFORE moving.
   b. Unless it is necessary to change a patient's position to maintain an open airway or there is some other compelling reason, it is best to splint the neck or back in the original position of the deformity.
   c. Patients with suspected spine injuries will require cervical collars and immobilization on a spine board or special stretcher.

Excerpted from: United States Department of Transportation/National Highway Traffic Safety Administration. *Emergency Medical Technician–Ambulance: National Standard Curriculum*, 1984.

What is the truth?

Truths

1. There is no evidence that backboards immobilize the spine.
2. Backboards can cause pain, make airway management more difficult, impair the patient's respirations, and place the patient at increased risk of aspiration.
3. Spinal fractures are uncommon.
4. There is no evidence that backboards improve patient outcomes.

Truths

- If a medication had these same characteristics, use of the drug would be stopped immediately.

Spinal Immobilization

- So why do we keep subjecting our patients to the torture of the backboard?

Spinal Immobilization

No Evidence of Benefit

Immobilization Concepts

- **FRACTURES:** Immobilize from the joint above to the joint below.
- **DISLOCATIONS:** Immobilize from the bone above to the bone below.

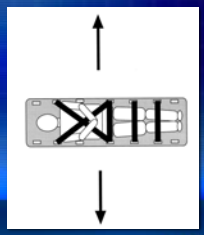
Spinal Immobilization

Spinal Immobilization

- It is difficult to determine, without imaging, the presence of an injury and the location of any injury.
- So, let's just immobilize the whole spine.

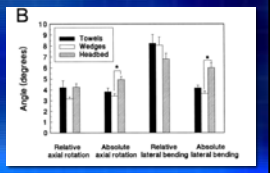
Spinal Immobilization

- Canadian study of 6 volunteers that simulated ambulance transport of immobilized patients.
- All wore c-collar.
- Compared:
  - Towels
  - Wedges
  - Headbed



Spinal Immobilization

- "None of the three immobilization techniques was successful in eliminating head motion or neck rotation. Movement of the trunk contributed substantially to the lateral bending that occurred across the neck."



Perry SD, McLellan B, McIlroy WE, Maki BE, Schwartz M, Fernie GR. The efficacy of head immobilization techniques during simulated vehicle motion. *Spine (Phila Pa 1976)*. 1999;24:1839-1844.

Spinal Immobilization

	Aspen Collar			Philadelphia Collar[a]		
	Unrestricted (degrees)	Restricted (degrees)	Percentage	Unrestricted	Restricted	Percentage
Flexion-extension	98.8 ± 12.4	31.1 ± 9.2	31.5 ± 8.7	N/A[b]	N/A	28.9 ± 4.7
Lateral bending	31.1 ± 4.2	15.9 ± 6.2	47.5 ± 14.3	N/A	N/A	66.4 ± 10.7
Overhead rotation	64.6 ± 4.7	26.8 ± 7.3	40.7 ± 9.9	N/A	N/A	43.7 ± 6.7

[a] Reproduced with permission from Johnson et al.[10].
[b] N/A, data not available. Although Johnson et al. quote figures for overall flexion-extension (occiput-C7), lateral bending, and overhead rotation, they give percentages rather than absolute values.

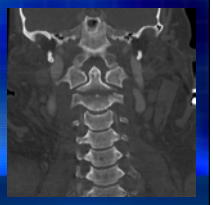
Hughes SJ. How effective is the Newport/Aspen collar? A prospective radiographic evaluation in healthy adult volunteers. *J Trauma*. 1998;45:374-378.

Spinal Immobilization

- "Cervical immobilization is a myth. Even the halo frame permits 4% motion."

Spinal Immobilization





Spinal Immobilization

University of Malaya

University of New Mexico

Spinal Immobilization

TABLE 1 Anatomic Distribution of Injuries

	Disability	No	Total
Cervical			
Immobilized (United States)	34 (30%)	79 (70%)	113 (100%)
Unimmobilized (Malaysia)	10 (25%)	30 (75%)	40 (100%)
Thoracic			
Immobilized (United States)	22 (21%)	85 (79%)	107 (100%)
Unimmobilized (Malaysia)	2 (6%)	31 (94%)	33 (100%)
Lumbosacral			
Immobilized (United States	14 (12%)	99 (88%)	113 (100%)
Unimmobilized (Malaysia)	1 (2%)	46 (98%)	47 (100%)

Spinal Immobilization

TABLE 2 Characteristics of the Patients from the United States and Malaysia

	Immobilized	Unimmobilized	p-value
Number of patients	334	120	
Average age	34 yr	35 yr	0.31
Gender—male	256 (77%)*	106 (88%)	0.009
Level of injury			0.52
Cervical	113 (34%)	40 (33%)	
Thoracic	107 (32%)	33 (28%)	
Lumbosacral	113 (34%)	47 (39%)	
Mechanism			0.0001
Fall	66 (20%)	63 (53%)	
Vehicle crash	248 (74%)	45 (38%)	
Low-mass impact	9 (3%)	8 (7%)	
Other	11 (3%)	4 (3%)	
Significant disability	70 (21%)	13 (11%)	0.02

*Percentages are relative to each hospital's total.

Spinal Immobilization

TABLE 4 Logistic Regression Analysis

	Odds Ratio	95% Confidence Interval	p-value
Spinal immobilization	2.03	1.03–3.99	0.04
Gender—male	1.69	0.86–3.32	1.13
Age (by decade)	0.96	0.81–1.14	0.65
Level of injury			
Cervical	3.82	1.98–7.37	0.0001
Thoracic	1.99	0.98–4.00	0.06
Lumbosacral	0.34	0.19–0.62	0.0005
Mechanism			
Fall	0.60	0.14–2.54	0.49
Vehicle crash	0.91	0.23–3.56	0.90
Low-mass impact	0.38	0.03–4.77	0.45
Other	1.32	0.34–5.08	0.69

Spinal Immobilization

- The OR for disability was higher for patients in the United States (all with spinal immobilization) after adjustment for the effect of all other independent variables (2.03; 95% CI 1.03-3.99; p = 0.04).
- The estimated probability of finding data as extreme as this if immobilization has an overall beneficial effect is only 2%. Thus, there is a 98% probability that immobilization is harmful or of no value.
- We repeated this analysis using only the subset of patients with isolated cervical level deficits. We again failed to show a protective effect of spinal immobilization (OR 1.52; 95% CI 0.64-3.62; p = 0.34).

Hauswald M, Ong G, Tandberg D, Omar Z. Out-of-hospital spinal immobilization: its effect on neurologic injury. *Acad Emerg Med.* 1998;5:214-219

Spinal Immobilization

- 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.

The Cochrane Library
Evidence for healthcare decision-making

Spinal Immobilization

- Spinal cord damage from injury causes long-term disability and can dramatically affect quality of life. The current practice of immobilising trauma patients before hospitalisation to prevent more damage may not always be necessary, as the likelihood of further damage is small.
- Means of immobilisation …can cause tissue pressure and discomfort, difficulty in swallowing and serious breathing problems.

Spinal Immobilization

- The review authors could not find any randomised controlled trials of spinal immobilisation strategies in trauma patients.
- From studies of healthy volunteers it has been suggested that patients who are conscious, might reposition themselves to relieve the discomfort caused by immobilisation, which could theoretically worsen any existing spinal injuries.

Kwan I, Bunn F, Roberts I. Spinal immobilization for trauma patients. *Cochrane Database Syst Rev.* 2001;(2):CDC002803

Truths

Backboards Have Risks

Pain

	Number	Percentage
Subjects*	**21**	
Symptoms	**61**	
Patients with:		
1 symptom	4	19
2 symptoms	5	24
3 symptoms	3	14
4 symptoms	7	33
5 symptoms	2	10

*-Healthy volunteers with no pre-existing back pain or problems.

Immediate Symptoms

Symptom	Number	Percentage
Immediate Symptoms	**21**	**100**
Number of Symptoms	**49**	
Occipital pain	16	72
Sacral pain	9	43
Lumbosacral pain	7	33
Mandible pain	7	33
Scapular pain	3	14
Heel pain	2	10
Buttock pain	1	5
Chondrocostal pain	1	5
Shoulder pain	1	5
Panic	1	5
Nausea	1	5

Delayed Symptoms

Symptom	Number	Percentage
Delayed Symptoms	**6**	
Number of Delayed Symptoms	**12**	
Headache	6	29
Low back pain	2	10
Stiffness (neck/upper back)	1	5
Sciatica	1	5
Nausea	1	5
Exhaustion	1	5

Chan D, Goldberg R, Tascone A, Harmon S, Chan L. The effect of spinal immobilization on healthy volunteers. *Ann Emerg Med.* 1994;23:48-51

Pain

Table 2. Comparison of Incidence Rate of Pain Between Backboard and Mattress by Sequence of Exposure

Symptom	Exposure	Rate (#Yes/No) Backboard	Mattress	Adjusted relative risk*	95% C.I.	P-Value
Occipital pain	First	88.89% (16/18)	15.79% (3/19)	5.63	1.97–16.11	<0.0001
	Second	47.37% (9/19)	0.00% (0/16)	Undefined		<0.0015
				7.88	2.81–25.42	<0.0001
Cervical pain	First	5.88% (1/17)	26.32% (5/19)	0.22	0.33–1.73	0.1821
	Second	0.00% (0/19)	0.00% (0/16)	Undefined		Undefined
				0.22	0.03–1.73	0.2389
Scapular pain	First	5.88% (1/17)	5.26% (1/19)	1.12	0.08–16.52	1.0000
	Second	5.26% (1/19)	0.00% (0.16)	Undefined		1.0000
				2.09	0.18–23.85	0.9882
Lumbosacral pain	First	58.82% (10/17)	5.26% (1/19)	11.18	1.59–78.46	0.0018
	Second	15.79% (3/19)	12.50% (2/16)	1.26	0.28–6.65	1.0000
				4.27	1.36–13.41	0.0086
Any symptom	First	100.00% (18/18)	36.85% (7/12)	2.71	1.51–4.89	0.0002
	Second	52.6% (10/19)	12.50% (2/16)	4.21	1.08–16.48	0.0328
				3.08	1.74–5.44	<0.0001

* The adjusted relative risk is the relative risk between backboard and mattress adjusted for the order of exposure. EPI-INFO software program was used in these calculations.

Chan D, Goldberg RM, Mason J, Chan L. Backboard versus mattress splint immobilization: a comparison of symptoms generated. *J Emerg Med.* 1996;14:293-298.

Pain

39 Healthy Volunteers

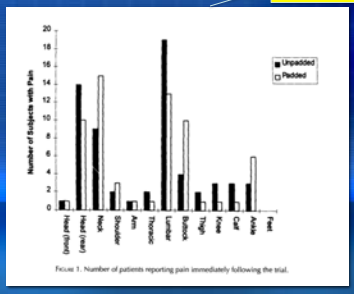


FIGURE 1. Number of patients reporting pain immediately following the trial.

Pain

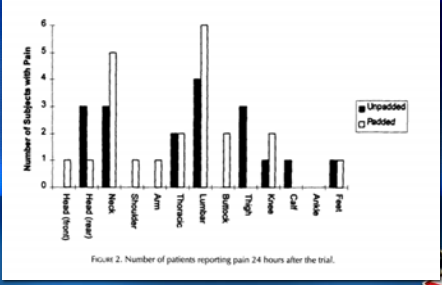


FIGURE 2. Number of patients reporting pain 24 hours after the trial.

Pain

- Healthy volunteers frequently experienced pain following spinal immobilization. The use of occipital padding does not appear to alleviate this pain.

Lerner EB, Billittier AJ, Moscati RM. The effects of neutral positioning with and without padding on spinal immobilization of healthy subjects. *Prehospital Emergency Care.* 1998;2:112-116.

Respiratory Impairment

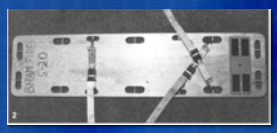


TABLE 2. *Long spinal board*

Parameter	Prestrapping (L/min)	Poststrapping (L/min)	P
FVC	5.52 ± 0.79	4.98 ± 0.67	.0001
FEV_1	4.29 ± 0.64	3.99 ± 0.57	.0079
FEF 25%-75%	4.11 ± 1.12	3.68 ± 1.02	.0252
FEV_1:FVC	0.791 ± 0.05	0.793 ± 0.05	.8541

Values are mean ± SD.

Respiratory Impairment

TABLE 1. *ZEE extrication device*

Parameter	Prestrapping (L/min)	Poststrapping (L/min)	P
FVC	5.41 ± 0.81	4.78 ± 0.73	.0040
FEV_1	4.43 ± 0.67	3.95 ± 0.59	.0022
FEF 25%-75%	4.56 ± 1.28	3.90 ± 0.96	.0080
FEV_1:FVC	0.816 ± 0.05	0.820 ± 0.04	.6107

Values are mean ± SD.
FVC, forced vital capacity; FEV_1, forced expiratory volume in one second; FEF 25%-75%, forced midexpiratory flow; FEV_1:FVC, ratio of FEV_1 to FVC.

Respiratory Impairment

- Our study demonstrated that the long spinal board and the ZED board used for spinal immobilization have restrictive effects on pulmonary function in the healthy, nonsmoking man.

Bauer D, Kowalski R. Effect of spinal immobilization devices on pulmonary function in the healthy, nonsmoking man. *Ann Emerg Med.* 1988;17:915-918.

Airway Interference

Fig 1 Types of semi-rigid collar used (left to right): Stiffneck (Laerdal Medical Corp.); Miami J (Jerome Medical); Philadelphia (Philadelphia Cervical Collar Company).

Airway Interference

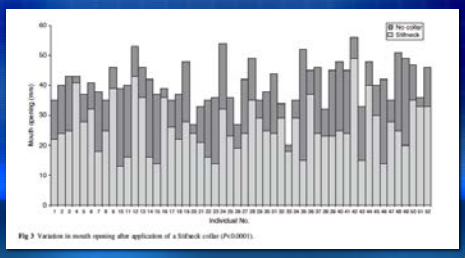


Fig 3 Variation in mouth opening after application of a Stiffneck collar (P<0.0001).

Airway Interference

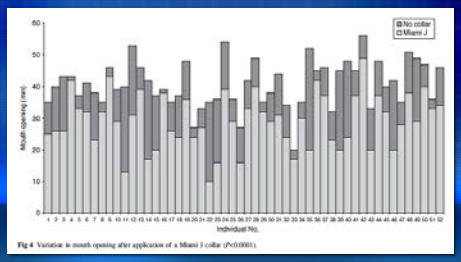


Fig 4 Variation in mouth opening after application of a Miami J collar (P<0.0001).

Airway Interference

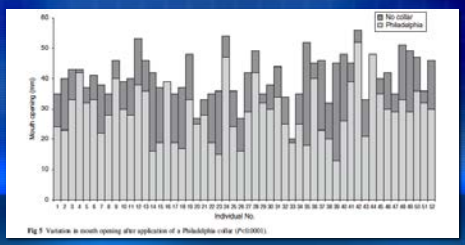


Fig 5 Variation in mouth opening after application of a Philadelphia collar (P<0.0001).

Airway Interference

- Cervical collars and spinal immobilization have been found to reduce mouth opening by 20-25%.

Goutcher CM, Lochhead V. Reduction in mouth opening with semi-rigid cervical collars. *Br J Anaesth*. 2005;95:344-348.

Aspiration

Aspiration

Increased ICP

Increased ICP

Table I. Intracranial pressure changes (mmHg) following application of Stifneck collar

Patient	1st	2nd	3rd	Change
A	22	29	21	7.5
B	19	20	20	0.5
C	14	21	15	6.5
D	11	11	12	−0.5
E	11	10	9	0
F	16	24	17	7.5
G	1	2	1	1
H	21	22	24	−0.5
I	10	12	10	2
J	12	22	18	7
K	6	14	9	6.5
L	15	23	21	5
M	13	14	13	1
N	7	11	7	4
O	16	22	19	4.5
P	13	14	13	1
Q	23	30	22	7.5
R	15	26	13	11
S	7	23	10	14.5
Mean	13.3	18.4	14.4	4.5

1st = reading before collar application; 2nd = Reading with collar *in situ* for 20 min; 3rd = Reading with collar off for 20 min. Change = 2nd reading – mean of readings without collar.

- **Significant rise ($p < 0.001$) in ICP:**
  - **Mean rise in ICP of 4.5 mmHg (σ 4.1).**
  - **Insignificant changes in MAP suggested that this effect is due to distortion of venous drainage.**

Increased ICP

- "In the prehospital environment, similar concerns exist. Patients at risk of raised ICP require alternative means of cervical spine immobilization."

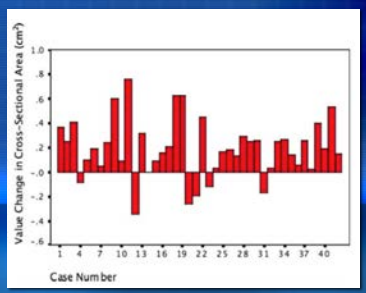
Davies G, Deakin C, Wilson A. The effect of a rigid collar on intracranial pressure. *Injury.* 1996;27:647-649..

Increased ICP

- **Sydney, NSW prospective study:**
  - **10 head-injured patients with GCS ≤ 9 (post-resuscitation).**
  - **ICP measurements before and after cervical collar application.**
  - **9 or 10 patients had statistically significant increase in ICP ($p < 0.05$).**

Mobbs RJ, Stoodley MA, Fuller J. Effect of cervical hard collar on intracranial pressure after head injury. *ANZ J Surg.* 2002;72:389-391.

Increased ICP



Increased ICP

- In healthy volunteers, internal jugular vein cross-sectional area increases after application of a rigid cervical collar.
- This may provide a possible explanation for the increase in intracranial pressure seen with rigid cervical collar use in victims of head trauma.

Stone MB, Tubridy CM, Curran R. The effect of rigid cervical collars on internal jugular vein dimensions. *Acad Emerg Med.* 2010;17:100-102.

Truths

Spinal Injuries are Uncommon

Incidence

- SCI is a relatively rare condition.
- Annual incidence of spinal cord injury:
  - ~ 40 cases/million population in the US (~12,000 new cases annually).

FOUNDATION FOR SPINAL CORD INJURY PREVENTION, CARE & CURE

Cervical Fracture Incidence

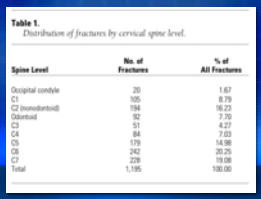


Table 1.
Distribution of fractures by cervical spine level.

Spine Level	No. of Fractures	% of All Fractures
Occipital condyle	20	1.67
C1	105	8.79
C2 (monodontoid)	194	16.23
Odontoid	92	7.70
C3	51	4.27
C4	84	7.03
C5	179	14.98
C6	242	20.25
C7	228	19.08
Total	1,195	100.00

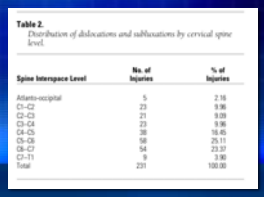


Table 2.
Distribution of dislocations and subluxations by cervical spine level.

Spine Interspace Level	No. of Injuries	% of Injuries
Atlanto-occipital	5	2.16
C1–C2	23	9.96
C2–C3	21	9.09
C3–C4	23	9.96
C4–C5	38	16.45
C5–C6	58	25.11
C6–C7	54	23.37
C7–T1	9	3.90
Total	231	100.00

BLUNT TRAUMA

Cervical Fracture Incidence

- NEXUS derivative study.
- 34,069 patients with blunt trauma:
  - 818 (2.4%) individuals had:
    - 1,496 distinct cervical spine injuries to 1,285 different cervical spine structures.
  - C2 vertebra was the most common level of injury (286 [24.0%] fractures).
  - 1/3 of all injuries (29.3%) were considered clinically insignificant.

Cervical Fracture Incidence

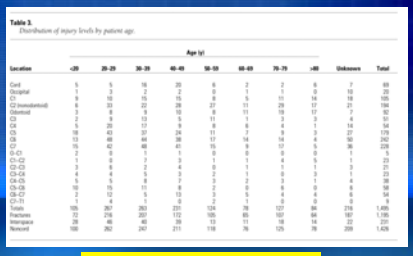


Table 3.
Distribution of injury levels by patient age.

Location	Age (y)									
	<20	20–29	30–39	40–49	50–59	60–69	70–79	≥80	Unknown	Total
Cord	5	5	16	20	6	2	2	6	7	69
Occipital	1	3	2	2	0	1	1	0	10	20
C1	5	10	15	15	9	5	10	14	18	105
C2 (monodontoid)	6	33	22	28	37	11	29	17	21	194
Odontoid	3	8	9	10	6	11	16	17	7	92
C3	2	9	13	5	11	1	3	3	4	51
C4	5	20	17	9	8	6	4	1	14	84
C5	18	43	37	24	11	7	9	3	27	179
C6	13	48	44	36	17	14	14	4	50	242
C7	15	42	48	41	15	9	17	5	36	228
C-C1	2	0	1	1	0	0	0	0	1	5
C1–C2	1	0	2	3	1	1	4	5	1	23
C2–C3	3	6	2	4	0	1	1	3	1	21
C3–C4	4	4	5	3	2	1	0	3	1	23
C4–C5	5	5	8	7	3	2	3	1	4	38
C5–C6	10	15	11	8	2	0	0	0	0	56
C6–C7	2	2	5	10	3	0	4	6	6	54
C7–T1	1	4	1	0	2	1	0	0	0	9
Totals	105	267	263	231	124	78	127	84	216	1,495
Fractures	72	216	207	172	105	65	107	64	187	1,195
Interspace	28	46	40	39	17	11	18	14	22	231
Noncord	100	262	247	211	119	76	125	78	209	1,426

BLUNT TRAUMA

Cervical Fracture Incidence

- Cervical spine injuries occur in a small minority of patients with blunt trauma who undergo imaging:
  - Most common site: atlantoaxial region and C6 and C7 (over 1/3 of injuries).
  - A substantial minority of radiographically defined cervical spine injuries are of little clinical importance.

Goldberg W, Mueller C, Panacek E, et al. Distribution and patterns of blunt traumatic cervical spine injury. *Ann Emerg Med*. 2001;38:17-21.

Spinal Injury Mortality/Year

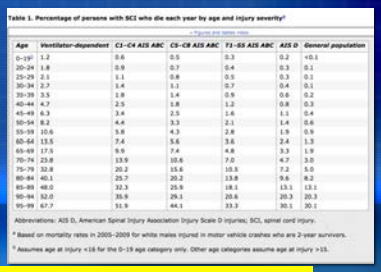


Table 1. Percentage of persons with SCI who die each year by age and injury severity[a]

Age	Ventilator-dependent	C1–C4 AIS ABC	C5–C8 AIS ABC	T1–S5 AIS ABC	AIS D	General population
0–19[b]	1.2	0.6	0.5	0.3	0.2	<0.1
20–24	1.8	0.9	0.7	0.4	0.3	0.1
25–29	2.1	1.1	0.8	0.5	0.3	0.1
30–34	2.7	1.4	1.1	0.7	0.4	0.1
35–39	3.5	1.8	1.4	0.9	0.6	0.2
40–44	4.7	2.5	1.8	1.2	0.8	0.3
45–49	6.3	3.4	2.5	1.6	1.1	0.4
50–54	8.2	4.4	3.3	2.1	1.4	0.6
55–59	10.6	5.8	4.3	2.8	1.9	0.9
60–64	13.5	7.4	5.6	3.6	2.4	1.3
65–69	17.5	9.9	7.4	4.8	3.3	1.9
70–74	23.8	13.9	10.6	7.0	4.7	3.0
75–79	32.8	20.2	15.6	10.5	7.2	5.0
80–84	40.1	25.7	20.2	13.8	9.6	8.2
85–89	48.0	32.3	25.9	18.1	13.1	13.1
90–94	52.0	35.9	29.1	20.6	20.3	20.3
95–99	67.7	51.9	44.1	33.3	30.1	30.1

Abbreviations: AIS D, American Spinal Injury Association Injury Scale D injuries; SCI, spinal cord injury.

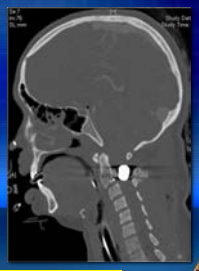
[a] Based on mortality rates in 2005–2009 for white males injured in motor vehicle crashes who are 2-year survivors.

[b] Assumes age at injury <16 for the 0–19 age category only. Other age categories assume age at injury >15.

DeVivo MJ. Epidemiology of traumatic spinal cord injury: trends and future implications. *Spinal Cord*. 2012;50:365-372.

MOI and Spinal Injury

- 57,523 trauma patients:
  - LAC/USC
  - WHC
- Evaluated by:
  - Blunt asaault
  - Stab wounds
  - Gunshot wounds



Rhee P, Kuncir EJ, Johnson L, et al. Cervical spine injury is highly dependent on the mechanism of injury following blunt and penetrating assault. *J Trauma*. 2006;61:1166-1170.

MOI and Spinal Injury

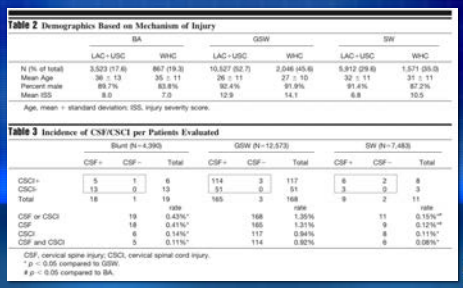


Table 2 Demographics Based on Mechanism of Injury

	BA		GSW		SW	
	LAC+USC	WHC	LAC+USC	WHC	LAC+USC	WHC
N (% of total)	3,523 (17.6)	867 (19.3)	10,527 (52.7)	2,046 (45.6)	5,912 (29.6)	1,571 (35.0)
Mean Age	36 ± 13	35 ± 11	26 ± 11	27 ± 10	32 ± 11	31 ± 11
Percent male	89.7%	83.8%	92.4%	91.9%	91.4%	87.2%
Mean ISS	8.0	7.0	12.9	14.1	8.8	10.5

Age, mean ± standard deviation; ISS, injury severity score.

Table 3 Incidence of CSF/CSCI per Patients Evaluated

	Blunt (N = 4,390)			GSW (N = 12,573)			SW (N = 7,483)		
	CSF+	CSF−	Total	CSF+	CSF−	Total	CSF+	CSF−	Total
CSCI+	5	1	6	114	3	117	6	2	8
CSCI-	13	0	13	51	0	51	3	0	3
Total	18	1	19	165	3	168	9	2	11
			rate			rate			rate
CSF or CSCI			19	0.43%*		168	1.35%		11	0.15%*#
CSF			18	0.41%*		165	1.31%		9	0.12%*#
CSCI			6	0.14%*		117	0.94%		8	0.11%*
CSF and CSCI			5	0.11%*		114	0.92%		8	0.08%*

CSF, cervical spine injury; CSCI, cervical spinal cord injury.
* $p < 0.05$ compared to GSW.
# $p < 0.05$ compared to BA.

MOI and Spinal Injury

- Rates for CSF:
  - GSW (1.35%)
  - BA (0.41%)
  - SW (0.12%).
- Rates of CSCI:
  - GSW (0.94%)
  - BA (0.14%)
  - SW (0.11%)
- Surgical stabilization:
  - GSW (26/158 [15.5%])
  - BA (6/19 [31.6%])
  - SW (3/11 [27.8%])
- No patient with penetrating SCI regained significant neurologic recovery.

MOI and Spinal Injury

- Rates overall low.
- Consider mechanism of injury.
- Neurologic deficits from penetrating assault were established and final at the time of presentation.
- Concern for protecting the neck should not hinder the evaluation process or life saving procedures.

Penetrating Trauma

- 45,284 penetrating trauma patients:
  - Median age: 29 years
  - Male: 87.8%
  - Race:
    - Black: 41.8%
    - White: 34.6%
    - Hispanic: 19.3%
- Injuries:
  - Neck and torso: 32.0%
  - ISS>15: 22.0%
  - Prehospital spinal immobilization: 4.3%
  - Mortality: 8.1%

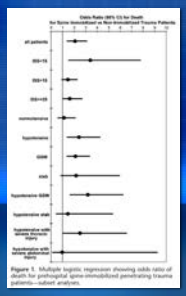
Penetrating Trauma

TABLE 3. Multiple Logistic Regression Showing Odds Ratio of Death for Penetrating Trauma Patients With Pre-Hospital Spine Immobilization

	OR of Death	95% CI	*p*
Prehospital procedures			
Spine immobilization	2.06	1.35–3.13	0.001
Intubation	1.31	0.97–1.77	0.079
IV fluids	1.95	1.55–2.47	<0.001
MAST	0.64	0.52–0.80	<0.001
Chest decompression	0.63	0.52–0.77	<0.001
Splint	3.83	0.30–48.96	0.301

Haut ER, Kalish BT, Efron DT, et al. Spine immobilization in penetrating trauma: more harm than good? *J Trauma*. 2010;68:115-20; discussion 120-1.

Penetrating Trauma



- Prehospital spine immobilization is associated with higher mortality in penetrating trauma and should not be routinely used in every patient with penetrating trauma.

Penetrating Trauma

- NOLA retrospective chart review:
  - 847 charts
  - 188 studied patients
    - 35 (22.9%) died
      - 27 immobilized
      - 8 not immobilized
      - GSW (94%)
      - Stab wound (6%)
- C-spine immobilisation in this study was associated with an increased risk of death (p = 0.016, odds ratio 2.77, 95% CI 1.18- 6.49).

Vanderlan WB, Tew BE, McSwain NE. Increased risk of death with cervical spine immobilisation in penetrating cervical trauma. *Injury*. 2009;40:880-883.

Penetrating Trauma

- Fresno study.
- 215 patients with GSW to head:
  - DOA and c-spine injuries excluded.
- Cervical spine clearance was determined in 202 (93%).
- No patients had indirect c-spine injury.
- 3 patients had direct c-spine injury that was readily apparent.

Kaups KL, Davis JW. Patients with gunshot wounds to the head do not require cervical spine immobilization and evaluation. *J Trauma*. 1998;44:865-867.

Penetrating Trauma

- More intubation attempts occurred in patients with cervical collars:
  - 49 attempts in 34 patients with c-collars
  - 5 attempts in 4 patients without c-collars (*p*=0.008).
- Indirect spinal injury does not occur with GSWs to head.
- Airway management compromised by c-collars.

Penetrating Trauma

- 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 spinal mobilization in patients with isolated penetrating trauma to the cranium.

Penetrating Trauma

- 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.

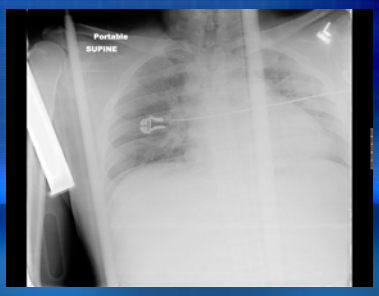
Penetrating Trauma

- Spinal mobilization may be performed after penetrating injury when a focal neurologic deficit is noted on the examination although there is little evidence of benefit even in these cases.

Stuke LE, Pons PT, Guy JS, Chapleau WP, Butler FK, McSwain NE. Prehospital spine immobilization for penetrating trauma--review and recommendations from the Prehospital Trauma Life Support Executive Committee. *J Trauma.* 2011;71:763-9; discussion 769-70.

Imaging

Imaging



Imaging

Supine Trauma Resus CXR
26 M s/p GSW to back/chest

FINDINGS:

Backboard artifacts noted. Low lung volume is seen. There is opacity in both lungs likely related to the low lung volume. The mediastinum cannot be evaluated. Cardiac silhouette is grossly unremarkable. No bullet fragments identified.

IMPRESSION:

Exam is compromised. Mediastinum cannot be evaluated. There is opacity in both lungs that may be secondary to low lung volume atelectasis, but cannot exclude pulmonary infiltrates or pulmonary contusion.

Imaging

TABLE 1. Characteristics of Children with and without Spinal Immobilization

Characteristic	Spine-Immobilized Prior to Evaluation (n = 173)	Not Spine-Immobilized but Met ACS Guidelines for Spinal Immobilization (n = 112)
Age—median (range), years*	11.3 (0.02–17.9)	7.6 (0.03–18.5)
Gender—male, % (95% CI)	49.1 (41.4–56.8)	58.9 (49.2–68.1)
Mechanism of injury, % (95% CI)		
Motor vehicle collision*	48.6 (40.9–56.3)	34.8 (26.1–44.4)
Fall*	20.8 (15.0–27.6)	42.0 (32.7–51.2)
Other	30.6 (23.9–38.0)	23.2 (15.8–32.1)
EMS arrival, % (95% CI)*	94.5 (90.0–97.5)	34.7 (24.0–46.5)
Glasgow Coma Scale score—median (range)	15 (12–15)	15 (13–15)
Pediatric Trauma Score—median (range)	11 (6–12)	11 (7–12)

*$p < 0.05$.
ACS = American College of Surgeons; CI = confidence interval; EMS = emergency medical services.

Imaging

TABLE 2. Effects of Spinal Immobilization in Children

	Spine-Immobilized Prior to Evaluation (n = 173)	Not Spine-Immobilized but Met ACS Guidelines for Spinal Immobilization (n = 112)	Odds Ratio/ Hazard Ratio (95% CI)
Pain score—median (range)	3 (0–4)	2 (0–4)	2.2 (1.4–3.4)*
Cervical spine imaging, % (95% CI)†	56.4 (49.0–64.2)	13.4 (7.6–21.1)	8.2 (4.5–15.4)†
ED length of stay—median (range), hours	2.8 (0.3–15.1)	2.8 (0.3–10.8)	0.96 (0.76–1.2)
ED disposition, % (95% CI)			
Home	58.4 (50.7–65.8)	85.7 (77.8–91.6)	*Reference*
Floor or transfer	31.8 (24.9–39.3)	11.6 (6.3–19.0)	4.0 (2.1–7.8)†
ICU or OR	9.8 (5.8–15.3)	2.7 (0.6–7.6)	5.3 (1.5–19.0)*

*$p < 0.05$.
†Adjusted for Glasgow Coma Scale (GCS) score.
‡$p < 0.0001$.
ACS = American College of Surgeons; CI = confidence interval; ED = emergency department; ICU = intensive care unit; OR = odds ratio.

Imaging

TABLE 3. Effects of Spinal Immobilization on Presenting Pain Score and Rate of Cervical Spine Imaging, Stratified by Emergency Department Disposition

	Spine-Immobilized Prior to Evaluation (n = 173)	Not Spine-Immobilized but Met ACS Guidelines for Spine Immobilization (n = 112)	Odds Ratio (95% CI)
Pain score—median (range)			
Home	3 (0–4)	2 (0–4)	1.5 (0.9–2.5)
Floor or transfer	4 (0–4)	2 (2–4)	3.6 (1.2–11.1)*
ICU or OR	4 (1–4)	2 (0–4)	2.7 (0.3–25.5)
Cervical spine imaging, % (95% CI)			
Home	50 (40.4–60.6)	8.3 (3.7–15.8)	11.2 (4.9–25.5)†
Floor or transfer	63.6 (50.0—76.2)	46.2 (19.2–74.9)	2.0 (0.6–6.9)
ICU or OR	70.6 (44.0—89.7)	33.3 (1–90.6)	4.8 (0.35–65.8)

*$p < 0.05$.
†$p < 0.0001$.
ACS = American College of Surgeons; CI = confidence interval; ICU = intensive care unit; OR = odds ratio.

Leonard JC, Mao J, Jaffe DM. Potential adverse effects of spinal immobilization in children. *Prehosp Emerg Care*. 2012;16:513-518.

Truths

No Evidence it Improves Outcomes

Truths

- There is no evidence!

Summary

Procedure	Usage
Proven benefit; no risks	Ethical NOT to use procedure
Proven benefits; possible risks	Weigh benefits against risks and apply if expected outcomes are worth the known risks.
Proven benefits; proven risks	Weigh benefits against risks and apply if expected outcomes are worth known risks.
No proven benefits; no proven risks	Why use procedure?
No proven benefits; possible risks	Unethical to use procedure.
No proven benefit; proven risks	Criminal to use procedure.

Position Paper

- Still a document in evolution.

ACS COMMITTEE ON TRAUMA

NAEMSP

SERTAC

Spinal Assessment and Selective Immobilization

Patients with blunt traumatic injuries with mechanism concerning for spinal injury should be assessed for spinal injury. Patients may have all spinal immobilization omitted if ALL of the following conditions apply:

- They are conscious, cooperative and able to communicate effectively with provider[1,2]
- There is no major mechanism for severe injury[1] (i.e. No prehospital trauma triage criteria to go to a high level trauma center.)
- Have no history of new or temporary neurologic deficit such as numbness or weakness in an extremity.[1,2]
- Have no evidence of intoxication or altered mental status[1,2,3,4]
- Have no evidence of a distracting injury,[1,2] such as
  - Fractures
  - Major burns
  - Crush injuries
  - Severe or distracting pain
- Have no midline back or neck pain or tenderness upon palpation[1,2,3]

If all the above criteria are met, have patient move their neck 45° to either side of midline and if still no pain[1], no immobilization is indicated.

Spinal immobilization consists of keeping the head, neck and spine inline. The neck can be immobilized with a well fitted cervical collar, head blocks, blanket rolls or other immobilization techniques. Patients who are already walking or standing should be laid directly on the ambulance stretcher and secured to the stretcher with seatbelts. Back boards and scoop stretchers are designed and should only be used to extricate patients.

[1] Hoffman JR et al. Validity of a set of clinical criteria to rule out injury to the cervical spine in patients with blunt trauma. *N Engl J Med* 2000; 343:94-99.
[2] Stiell IG et al. The Canadian C-spine rule for radiography in alert and stable trauma patients. *JAMA* 2001. 286:1841-1848.
[3] Barton JH et al. A Statewide, Prehospital Emergency Medical Service Selective Patient Spinal Immobilization. *J Trauma* 2006; 61: 161-167.
[4] Evaluation for evidence of intoxication: Ask "What medications did you take today? Have you had any alcohol? Have you had any recreational drugs?" Is there slurring of speech, dilated or constricted pupils, unsteady gait? Do they smell like alcohol or marijuana?

SERTAC Approved Guideline February 19, 2013

SERTAC

Once extricated, patients should be taken off the back board or scoop stretcher and be placed directly on the ambulance stretcher.

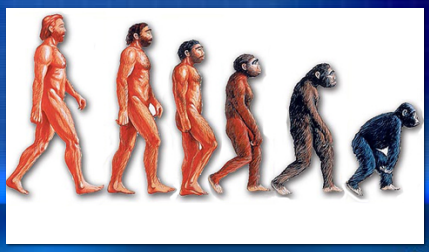
Decisional patient's have the right to refuse aspects of treatment including spinal immobilization. If a patient refuses immobilization after being informed of possible permanent paralysis, do not immobilize them and document the patient's refusal in your medical record.

Patients with penetrating traumatic injuries should only be immobilized if a focal neurologic deficit is noted on physical examination (although there is little evidence of benefit even in these cases)[5].

[5] Barkana Y., Stein M., Scope A., et al. Prehospital stabilization of the cervical spine for penetrating injuries of the neck – is it necessary? *Injury, Int. J. Care Injured* 2000; 31:305-309.
[6] Stoke, Lance E., Pons, Peter T., Guy, Jeffrey S., Chapleau, Will P., Butler, Frank K., McSwain, Norman E. Prehospital Spine Immobilization for Penetrating Trauma—Review and Recommendations From the Prehospital Trauma Life Support Executive Committee. *J Trauma* 2011; 71(3):763-770.

SERTAC Approved Guideline February 19, 2013

Politics and Medicine



Summary