The Painful Truth about Spinal Immobilization
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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?

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

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


REFERENCES
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. 105-107.
Spinal Immobilization

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

Immobilization Concepts

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

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.

Canadian study of 6 volunteers that simulated ambulance transport of immobilized patients. All wore c-collar.

Compared:
- Towels
- Wedges
- Headbed
“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.”


“Cervical immobilization is a myth. Even the halo frame permits 4% motion.”

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).


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.


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Table 2: Comparison of Incidence Rate of Pain Between Backboard and Mattress

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Mattress</th>
<th>Backboard</th>
<th>Headache</th>
<th>Back Pain</th>
<th>Neck/Upper Back</th>
<th>Sciatica</th>
<th>Nausea</th>
<th>Pain Score</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Occipital pain</td>
<td>16</td>
<td>72</td>
<td>72</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
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<tr>
<td>Sacral pain</td>
<td>9</td>
<td>43</td>
<td>51</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
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<tr>
<td>Lumbosacral pain</td>
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<td>33</td>
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<tr>
<td>Mandibular pain</td>
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<td>33</td>
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<td>Scapular pain</td>
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<td>14</td>
<td>2</td>
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<td>Head pain</td>
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<td>10</td>
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<td>Buttock pain</td>
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<td>5</td>
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<td>1</td>
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<td>1</td>
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<tr>
<td>Chondrocostal pain</td>
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<td>5</td>
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<td>1</td>
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<tr>
<td>Shoulder pain</td>
<td>1</td>
<td>5</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<td>Plantar</td>
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<td>Nausea</td>
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<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>


Pain

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


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.


Airway Interference

High pressure to the neck and chest caused by the long spinal board or the ZED board can interfere with airway patency.

Table 3: Long spinal board

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Prestrapping (L/min)</th>
<th>Poststrapping (L/min)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRC</td>
<td>5.52 ± 0.19</td>
<td>4.08 ± 0.67</td>
<td>.001</td>
</tr>
<tr>
<td>FVC</td>
<td>4.26 ± 0.64</td>
<td>3.98 ± 0.67</td>
<td>.001</td>
</tr>
<tr>
<td>FEF 25-75%</td>
<td>4.11 ± 1.23</td>
<td>3.88 ± 1.00</td>
<td>.022</td>
</tr>
<tr>
<td>FVC/FRC</td>
<td>0.79 ± 0.035</td>
<td>0.79 ± 0.035</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Values are mean ± SD

Table 4: ZED rescue device

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Prestrapping (L/min)</th>
<th>Poststrapping (L/min)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRC</td>
<td>5.61 ± 0.16</td>
<td>4.05 ± 0.73</td>
<td>0.01</td>
</tr>
<tr>
<td>FVC</td>
<td>4.34 ± 0.67</td>
<td>3.86 ± 0.59</td>
<td>0.001</td>
</tr>
<tr>
<td>FEF 25-75%</td>
<td>4.05 ± 1.26</td>
<td>3.50 ± 0.46</td>
<td>0.003</td>
</tr>
<tr>
<td>FVC/FRC</td>
<td>0.77 ± 0.025</td>
<td>0.65 ± 0.024</td>
<td>0.07</td>
</tr>
</tbody>
</table>

Values are mean ± SD

FRC: forced vital capacity; FVC: forced expiratory volume in one second; FEF 25-75%: forced expiratory flow at 25-75% of FVC; FEV1: forced expiratory volume in one second; PEF: peak expiratory flow; TLC: total lung capacity.
Cervical collars and spinal immobilization have been found to reduce mouth opening by 20-25%.

Increased ICP

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


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

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


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.

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).

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

- 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.


Spinal Injury Mortality/Year

- 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.

MOI and Spinal Injury

- 57,523 trauma patients:
  - LAC/USC
  - WHC

- Evaluated by:
  - Blunt assault
  - Stab wounds
  - Gunshot wounds


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 (26/156 [15.5%])
  - BA (6/19 [31.6%])
  - SW (3/11 [27.3%])

- No patient with penetrating SCI regained significant neurologic recovery.

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

- 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).

Penetrating Trauma

- Fresno study.
  - 215 patients with GSW to head:
    - DOA and c-spine injuries excluded.
    - Cervical spine clearance was determined in 202 (93%).

- 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.

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 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.


Imaging

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 greatly unremarkable. No bullet fragments identified.

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.

There is no evidence!
Position Paper

Still a document in evolution.

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.
• There is no major mechanism for severe injury (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.
• Have no evidence of intoxication or altered mental status.
• Have no evidence of a distracting injury such as fractures, major burns, crush injuries, severe or distracting pain.
• Have no midline back or neck pain or tenderness upon palpation.

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

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?

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).


One should never allow knowledge or reason to substitute for dogma.