Compulsory Use of the Backboard is Associated with Increased Frequency of Thoracolumbar Imaging


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**Compulsory Use of the Backboard is Associated with Increased Frequency of Thoracolumbar Imaging**

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**ABSTRACT**

*Background:* Backboards have been shown to cause pain in uninjured patients. This may alter physical exam findings, leading emergency department (ED) providers to suspect a spinal injury when none exists resulting in additional imaging of the thoracolumbar spine. New York had previously employed a “Spinal Immobilization” protocol that included compulsory backboard application for all patients with suspected spinal injuries. In 2015, New York instituted a new “Spinal Motion Restriction” protocol that made backboard use optional for these patients. The objective of this study was to determine if this protocol change was associated with decreased backboard utilization and ED thoracolumbar spine imaging. *Methods:* This was a retrospective before-and-after chart review of subjects transported by a single emergency medical services (EMS) agency to one of four EDs for emergency calls dispatched as motor vehicle collisions (MVC). EMS and ED data were included for all calls within a 6-month interval before and after the protocol change. The protocol change was implemented in the second half of 2015. Subject demographics, backboard use, and spine imaging were reviewed for the intervals January–June 2015 and January–June 2016. *Results:* There were 818 subjects in the before period and 796 subjects in the after period. Subjects were similar in terms of gender, age and type of MVC in both periods. A backboard was utilized for 440 (54%) subjects in the before period and 796 subjects in the after period. There were 818 subjects in the before period, and 235 (30%) subjects in the after period (p < 0.001). ED thoracic spine imaging was performed on 285 (35%) subjects in the before period, and 235 (30%) subjects in the after period (p = 0.02). ED lumbar spine imaging was performed for 335 (41%) subjects in the before period, and 281 (35%) subjects in the after period (p = 0.02). *Conclusion:* A shift from a spinal immobilization protocol to a spinal motion restriction protocol was associated with a decrease in backboard utilization by EMS providers and a decrease in thoracolumbar spine imaging by ED providers. *Key words:* backboards; thoracolumbar imaging; emergency department; emergency medical services

**INTRODUCTION**

Historically, most emergency medical services (EMS) protocols called for EMS providers to perform “spinal immobilization” for patients with any mechanism, history, or exam findings potentially concerning for spinal injury (1). True immobilization of the spine is impossible using any current methods, as some movement is always possible (2–9). Prehospital spinal immobilization entails placing a cervical collar around the patient’s neck and securing their head and torso with straps to a long spine board. In recent years, there has been a move away from indiscriminant spinal immobilization as research has better described the potential morbidity associated with placing patients on a rigid backboard (10–17). Complications from spinal immobilization include pain, soft tissue injury, and prolonged scene time (11–15, 17–21).

Like most states, New York had traditionally employed a Spinal Immobilization protocol that included compulsory backboard application for all patients with suspected spinal injuries. In late 2015, based on the harms associated with backboard use and the low percentage of patients who actually had an unstable spine injury (22), New York State introduced a new “Spinal Motion Restriction” protocol. The new protocol states that when a spinal injury is suspected “a long spine board is one of multiple modalities that can be used to minimize spinal movement” (23). Under the new protocol, providers are now empowered to choose the method that they feel is best for moving the patient given the circumstances. In the case of patients involved in motor vehicle collisions (MVC) with a suspected spinal injury, providers now most often place a cervical collar and assist the patient in a stand and pivot maneuver from the car directly onto the ambulance stretcher.

There are no randomized control trials examining patient-oriented outcomes with regard to
immobilization. Professional guidelines do exist and recommendations vary (24–29). Multiple studies of the effects of backboards on non-injured adult patients describe pain and soft tissue injury (11–14, 21). The effects on already-injured trauma patients are less known, but can be inferred to be worse. The effect of backboard use on the type and frequency of subsequent spinal imaging is unclear.

The primary objective of this study was to determine if this change in protocol was associated with decreased backboard utilization and ED thoracolumbar imaging.

**METHODS**

This was a multi-hospital retrospective before-and-after chart review of subjects transported by a single EMS agency for emergency calls that were dispatched as motor vehicle collisions (MVC). The study was approved by the University at Buffalo’s Institutional Review Board.

The protocol change was implemented in the second half of 2015. For purposes of the study, the before protocol change period was January–June 2015, and the after protocol change period was January–June 2016. Data from July–December 2015 was not reviewed to eliminate bias from the roll out period and to minimize possible seasonal variations.

EMS was provided by a single large, commercial, multi-tier transport agency responding to over 140,000 requests for service each year in a mixed urban, suburban and rural area with career and volunteer fire departments providing first response support. The majority of calls are interrogated using Medical Priority Dispatch (MPDS) protocols at municipal public safety answering points. The EMS agency utilized Zoll ePCR documentation during the entire study period. All four participating hospitals were in the Western NY area, one of which was an ACS-veriﬁed Level 1 trauma center.

To identify relevant cases for review, the EMS agency performed an electronic query for all calls dispatched as MVC that resulted in a transport of a patient to one of four participating trauma centers. The study was performed an electronic query for all calls dispatched as MVC that resulted in a transport of a patient to one of four participating trauma centers. The study was performed an electronic query for all calls dispatched as MVC that resulted in a transport of a patient to one of four participating trauma centers.

Emergency department records were reviewed and data regarding the following tests were extracted: thoracic spine CT, lumbar spine CT, thoracic spine x-ray, and lumbar spine x-ray.

Frequency of cervical collar and backboard use by EMS and thoracolumbar spine imaging subsequently ordered at the hospital was determined per patient and compared between the periods. The association between backboard use and thoracolumbar spine imaging was determined using Chi-Square tests. Finally, the estimated average radiation dose for thoracolumbar spine imaging between the periods was compared using Student’s t-tests. For this comparison, the radiation exposure was assumed to be 1.0 mSv for thoracic spine x-rays, 1.5 mSv for lumbar spine x-rays, 10 mSv for thoracic spine CTs and 5.6 mSv for lumbar spine CTs (30, 31).

**RESULTS**

The ePCR electronic search yielded 900 records in the before period and 872 records in the after period. There were 818 (91%) subjects in the before period and 796 (91%) subjects in the after period that met the inclusion criteria and were successfully linked to their hospital data. In both periods, subjects were similar in terms of gender, age and type of MVC but not trauma center utilization or cervical collar application. A comparison of subjects in the before and after periods is demonstrated in Table 1.

A backboard was utilized for 440 (54%) subjects in the before period and 92 (12%) subjects in the after period (p < 0.001) indicating the expected significant change in EMS care based on the protocol change.

A comparison of thoracolumbar spine imaging in the before and after periods is demonstrated in Table 2. ED thoracic spine imaging was performed on 285 (35%) subjects in the before period, and 235 (30%) subjects in the after period (p = 0.02). ED lumbar spine imaging was performed for 335 (41%) subjects in the before period, and 281 (35%) subjects in the after period (p = 0.02).

<table>
<thead>
<tr>
<th>Table 1. Subject demographics</th>
<th>Before Spinal Immobilization</th>
<th>After Spinal Immobilization</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Subjects</td>
<td>818</td>
<td>796</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>52.9%</td>
<td>50.5%</td>
<td>0.330</td>
</tr>
<tr>
<td>Avg. Age</td>
<td>38.9 years</td>
<td>39.4 years</td>
<td>0.510</td>
</tr>
<tr>
<td>MVC in Car/ Mechanism</td>
<td>83.9%</td>
<td>82.5%</td>
<td>0.800</td>
</tr>
<tr>
<td>Trauma Center</td>
<td>77.5%</td>
<td>83.2%</td>
<td>0.004</td>
</tr>
<tr>
<td>Cervical Collar</td>
<td>66.8%</td>
<td>59.3%</td>
<td>0.002</td>
</tr>
</tbody>
</table>
Backboard utilization was associated with increased odds of thoracolumbar spine imaging in the before period (OR 4.41, 95%CI 3.27–5.93) and in the after period (OR 5.15, 95% CI 3.17–8.36).

Although the total number of patients receiving imaging of the thoracic or lumbar spine decreased in the after period, the total number of patients transported to the trauma center increased (p = 0.004). Among patients who had imaging of the spine performed, a larger proportion received CT scans in the after period compared to the before period (p = 0.004). The overall average radiation dose was similar between periods (p = 0.81).

### DISCUSSION

Evolving scientific literature regarding the implications of backboard use includes both concerns for missed spinal injuries and iatrogenic harm (10, 12–14, 17, 20, 22, 32–38). Following a statewide protocol change, EMS providers were allowed rather than compelled to utilize the backboard. As expected, this study documents a decline in backboard usage after the protocol change.

Accompanying the decrease in backboard use, we observed a decrease in ED thoracolumbar spine imaging. This association is likely multifactorial. It is possible that following an exposure to a traumatic mechanism, placing a patient on a long spine board could lead to an increase in patient discomfort, increasing the emergency department physician’s suspicion of spinal injury and the chance of thoracolumbar spine imaging being ordered. Beyond altering physical exam findings, it is also possible that the presence of the backboard may have had other subtle influences on the ED provider’s decision or the patient’s expectation that imaging would be performed.

Unlike the cervical spine, which has two well-validated decision rules for clinical clearance (39, 40), similar rules have not been derived for the thoracolumbar spine. Clinical examination of the thoracolumbar spine to determine whether imaging is indicated has been shown to be insensitive according to one study and quite sensitive in other studies, making this area of research unclear (35, 41, 42). As a result, the ED provider’s decision to image the thoracolumbar spine is based primarily on gestalt and may be more subject to external influences.

Backboard use may have iatrogenic effects such as increased pain, skin breakdown, and respiratory compromise (10–17, 20, 21, 36). To that list, this study now adds increased frequency of spine imaging. These effects are especially concerning in light of our groups’ previous finding that the rate of unstable injury requiring surgery among immobilized patients was 0.5% (22).

Although there was a decreased frequency of spine imaging, this effect was offset by the increased utilization of CT imaging, and thus, the total radiation dose per patient from spine imaging was unchanged between periods. An inherent weakness of any before and after study is changes in practice that occur over time. The trend toward increased CT usage in general, and more specifically the “pan-CT” in trauma (43, 44) may also explain this association though further studies are needed to define this relationship.

The after period also saw an increase in trauma center utilization. This may have been related indirectly to the change in protocol. After the study was completed, some EMS providers shared that the staff of the trauma center was initially more receptive to receiving patients who were not placed on a backboard. This may have established a subtle incentive for EMS providers to preferentially transport to this site. In both periods, the trauma center was associated with increased frequency of CT use. Patient acuity and institutional practice patterns likely contributed to this finding.

Our study findings can be interpreted in light of other studies such as one by Burton et al. performed in Maine in 2006 after a protocol change. Burton et al. looked at the incidence of spine fractures in patients transported by EMS under a new protocol. That study demonstrated that the decision not to immobilize did not result in significant spine injury (32).

We chose to focus on thoracolumbar imaging because the backboard is utilized primarily to immobilize the thoracolumbar spine and has the greatest potential to cause discomfort in that area. The results from this study suggest that the change in protocol resulted in fewer patients placed on a backboard, with all the inherent risks and complications. After the protocol change, fewer imaging studies of the thoracolumbar spine were ordered, perhaps as a result of decreased pain simply from being on a stretcher instead of a backboard. An effort is underway at national and international levels to decrease backboard use (1, 24, 25, 27,

### Table 2. Subject thoracolumbar spine imaging

<table>
<thead>
<tr>
<th></th>
<th>Before Spinal Immobilization</th>
<th>After Spinal Motion Restriction</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>T spine Imaging</td>
<td>35%</td>
<td>30%</td>
<td>0.020</td>
</tr>
<tr>
<td>L spine Imaging</td>
<td>41%</td>
<td>35%</td>
<td>0.020</td>
</tr>
<tr>
<td>T or L Spine Imaging</td>
<td>46.1%</td>
<td>38.7%</td>
<td>0.003</td>
</tr>
<tr>
<td>% receiving T/L CT among imaged patients</td>
<td>48.0%</td>
<td>59.1%</td>
<td>0.004</td>
</tr>
<tr>
<td>Total Radiation Dose Per Patient Imaged</td>
<td>8.0 mSv</td>
<td>9.8 mSv</td>
<td>0.001</td>
</tr>
<tr>
<td>Total Radiation Does Per Patient</td>
<td>3.7 mSv</td>
<td>3.8 mSv</td>
<td>0.810</td>
</tr>
</tbody>
</table>
29, 32, 36, 45, 46). If safe transportation of patients without the backboard is possible and does not adversely affect outcomes, this can only benefit our patients.

Our study has several limitations, some of which have already been addressed. In some cases, spinal imaging can be reconstructed from thoracoabdominal CTs that may have been performed for evaluation of other potential injuries. In this case, there would be no marginal increase in radiation dose while allowing for further evaluation of potential spinal injuries. Our study is unable to examine provider rationale for obtaining imaging and does not specifically include radiation exposure due to thoracoabdominal CT scans.

**CONCLUSION**

A shift from a spinal immobilization protocol to a spinal motion restriction protocol was associated with decreased backboard utilization by EMS providers and decreased frequency of thoracolumbar spine imaging. Increased frequency of thoracolumbar imaging may be a negative consequence of protocols that dictate the compulsory use of the backboard.

**References**

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