

Removal of the Long Spine Board From Clinical Practice: A Historical Perspective

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Since the early 1970s, initial management of patients with suspected spinal injuries has involved the use of a cervical collar and long spine board for full immobilization, which was thought to prevent additional injury to the cervical spine. Despite a growing body of literature demonstrating the detrimental effects and questionable efficacy of spinal immobilization, the practice continued until 2013, when the National Association of EMS Physicians issued a position statement

calling for a reduction in the use of spinal immobilization and a shift to spinal-motion restriction. This article examines the literature that prompted the change in spinal-injury management and the virtual elimination of the long spine board as a tool for transport.

Key Words: cervical collar, spinal immobilization, spinal motion restriction, prehospital spinal care, spinal injuries

History of Spinal Immobilization

The American Academy of Orthopaedic Surgeons published one of the first textbooks¹ for emergency medical technicians (EMTs) in 1971 and proposed the use of a cervical collar and long spine board (LSB) for the management of patients with suspected spinal injuries in the prehospital arena based on the mechanism of injury, not a physical examination. This meant that if a patient was involved in a motor vehicle crash (MVC), fell from a standing position, or fell off the roof of a house, he or she was immobilized, regardless of the physical complaints. This practice was based on consensus; no evidence either supported or refuted the practice. Educational programs for EMTs were in their infancy, and evidence-based practice as we know it today did not exist. The only published articles regarding prehospital management of spinal injuries at this point were by Kossuth^{2,3} and Farrington.⁴ A US Air Force physician who commanded the Medical Service School at Gunter Air Force Base (Alabama), Kossuth became interested in spinal immobilization (SI) when managing airmen involved in MVCs on the base. He conducted multiple trials on safely extricating patients from vehicles. One of his first LSBs had a winch to assist in pulling a victim from the wreckage.

Farrington published the proceedings⁴ of a forum he led at a national meeting that proposed the use of LSBs and encouraged physicians to become actively involved in forming local ambulance services. One physician from Pennsylvania strongly advocated for the use of the LSB because of his experiences responding to 2 MVCs in his community.

Riggins and Kraus⁵ suggested that SI with the LSB was preferred because EMTs could not recognize possible spinal injuries and overuse of the LSB was preferable to missing and possibly exacerbating a spinal injury. This solidified the concept that SI should be based on the mechanism of injury and not the physical examination. I found no other articles to support the use of the LSB.

Evidence Against SI

Since the 1980s, multiple authors have questioned the use of the LSB for SI and described detrimental effects on patients. These effects fall into 4 categories: increased pain, respiratory compromise, tissue breakdown, and ineffective immobilization.

Lerner et al⁶ found that patients immobilized for 1 hour had pain 24 hours later. Chan et al⁷ demonstrated that healthy volunteers with no history of back pain reported back pain 24 hours after immobilization on an LSB for a short period of time. Hauswald et al⁸ compared the pain produced in healthy volunteers when immobilized for 10 minutes on a padded LSB versus an unpadded LSB. Participants equated the unpadded LSB with “lying on a concrete slab.” Cross and Baskerville⁹ found that participants placed on the LSB had higher pain scores than those placed on a vacuum mattress. Leonard et al¹⁰ looked at immobilized pediatric trauma patients: the LSB was associated with higher pain scores, more radiographic testing, and higher hospital admission rates.

Schafermeyer et al¹¹ demonstrated respiratory compromise in immobilized pediatric patients. Bauer and Kowalski¹² noted that the chest straps used in SI resulted in decreased pulmonary function, whereas Totten and Sugarman¹³ had similar findings in patients aged 7 to 85 years, with the greatest compromise at the age extremes. Yates et al¹⁴ observed respiratory compromise when using a Reeves stretcher (HDT Global, Solon, OH) instead of an LSB.

Cordell et al¹⁵ reported tissue breakdown with prolonged immobilization on an LSB, and Berg et al¹⁶ observed sacral tissue hypoxia in healthy volunteers after only 30 minutes of immobilization. Sheerin and de Frein¹⁷ described higher sacral and occipital tissue pressures with an unpadded LSB than a padded LSB or vacuum mattress.

Podalsky et al¹⁸ and Silbergleit et al¹⁹ found that the LSB did not effectively immobilize a patient and that significant vertical and horizontal forces occurred during transport. Peery et al²⁰ examined 50 trauma patients immobilized by

paramedics and showed that 88% had either loose or detached straps, which allowed significant motion. Mazolewski and Manix²¹ demonstrated that immobilized patients could create significant spontaneous motion.

These studies indicate that SI was detrimental to patients in these 4 categories. Additionally, increased numbers of radiographic studies and hospital admissions suggest it was also costing society more health care dollars.^{10,22}

Transitioning Away From SI

The 2013 National Association of EMS Physicians (NAEMSP) position paper²³ called for decreased use of the LSB and recommended less intrusive measures to manage patients with suspected spinal injuries. The paper listed 5 groups of patients in whom SI with an LSB may be indicated: blunt trauma and altered level of consciousness; spinal pain or tenderness; neurologic compromise, such as numbness or weakness; anatomic deformity of the spine; and high-energy mechanism with intoxication, inability to communicate, or distracting injury. The subsequent 2014 NAEMSP resource document²⁴ explained the rationale for the changes in prehospital spinal-injury care. Spinal precautions could be accomplished with the use of a rigid cervical collar, careful movement to the standard ambulance gurney, and firmly strapping the patient to the gurney. The LSB should be considered an extrication device and removed as soon as possible.

The American College of Emergency Physicians (ACEP) issued a similar statement²⁵ suggesting spinal-motion restriction (SMR) as a means of managing patients with possible spinal injuries and concluded that true SI was impossible. Although SMR and SI have often been considered the same technique, SMR does not involve the use of an LSB. The ACEP advised that the best approach was to maintain anatomic position and minimize motion, which might or might not involve any specific adjuncts such as a collar. Local emergency medical services (EMS) medical directors should determine the exact technique based on the best literature available.

As a result of these position papers, EMS agencies have moved away from the practice of SI on an LSB based on the mechanism of injury and now use some type of SMR based on physical examination. A rigid cervical collar is applied if indicated, and the patient is carefully placed on the ambulance gurney. Ambulatory patients can be assisted to the gurney under their own power.

Efficacy of SMR

The amount of acceptable motion in a patient with a spinal cord injury is unknown. Hauswald²⁶ suggested that a small amount of motion is unlikely to result in additional cord damage and any subsequent injury could be related to ischemia and swelling. A common concern is that SMR is inadequate to prevent movement in patients with spinal injuries and will lead to harm. Whether this is true is unclear at this time and will be difficult to ascertain because of the infrequency of spinal injuries. Eyre²⁷ reported that every year, more than 13 million people in the United States seek care in emergency departments for cervical spine injuries, but only 0.3% have actually sustained a significant neurologic injury. The cost of radiographic tests for these patients is estimated at more than \$180 million.

Domeier et al²⁸ reported incidences of 1% for cervical spine injuries in trauma patients (237/22 333), and only 0.3% for spinal cord injury (68/22 333). Such low incidences of significant injury indicate that a very large patient population would be necessary to identify injuries missed by SMR.

Domeier et al²⁹ found that EMS personnel could use a form of SMR called *selective spinal immobilization* and reduce the use of the LSB by 37%. This technique involves using the physical examination instead of the mechanism of injury to decide which form of immobilization should be applied. Dunn et al³⁰ demonstrated that EMTs could apply selective spinal immobilization just as effectively as paramedics.

Spinal-motion-restriction protocols have reduced the number of patients immobilized on LSBs. Morrissey et al³¹ reported a 58% drop in the number of patients placed on LSBs after implementation of an SMR protocol in a large California county (population = 1.5 million) EMS agency. They also noted 2 missed spinal injuries, neither of which resulted in neurologic compromise. Another study³² showed a similar drop (59%) with no missed injuries in patients immobilized by 3 Pittsburgh-area (population = 143 000) EMS agencies. After introduction of the SMR protocol in July 2015, these services applied the LSB only as an extrication device for patients with multisystem trauma related to severe MVCs, which accounted for the drastic reduction in use. The critically injured patients were not removed from the LSB until arrival at the trauma center in order to decrease unnecessary motion and save time. (Transport time to the trauma center was less than 10 minutes.) Unpublished data from 1 service demonstrated that the use of the LSB fell from 275 patients in a 6-month period to 7 patients in a similar 6-month period 2 years after changing to the SMR protocol.

Implications for Athletic Trainers

Similar to EMS, athletic trainers (ATs) have viewed the LSB as a staple of spine-injury management for decades. Because EMS will likely be involved with the transport of any critically injured athlete to the hospital, it is essential for the 2 professions to work together. All ATs must recognize why EMS moved away from using the LSB and must work with local agencies to determine the best means of securing and transporting a spine-injured athlete. The number of times ATs call EMS for transport of an injured athlete is unknown, but it is probably a rare event. Data from the Pittsburgh study³² showed that only 5 athletes (1 gymnast, 3 hockey players, and 1 football player) of 543 patients were immobilized for suspected spinal injury. Total call volume for the services studied was approximately 18 000. Emergency medical services personnel are not accustomed to responding to athletic venues and working with ATs on an everyday basis.

Certainly the management of athletes with suspected spinal injuries might present a unique set of circumstances, such as a gymnastics pit, swimming pool, or equipment-laden athlete. Both EMS physician group statements^{23,24} listed criteria such as neurologic deficit or spine pain for which an LSB could be used, but the LSB is considered an extrication device only and the athlete or patient should be removed from the board as soon as feasible. Moving these

athletes from the playing surface to the ambulance gurney may be difficult, and use of the LSB during transport should be discouraged based on the evidence. Although the LSB may be useful for moving the athlete from the field to the ambulance gurney, it cannot be emphasized too strongly that the LSB should be removed as soon as possible. Krell et al³³ demonstrated that the Ferno scoop stretcher (Wilmington, OH) caused less movement than the LSB and could be considered for patient movement. A scoop stretcher is standard equipment on most ambulances, and ATs should consider adding one to the emergency equipment available at each athletic venue.

Future Research

The cited literature here is a representative sampling of the volumes written on SI and the negative side effects of the LSB but is by no means exhaustive. The cervical collar as described in the EMS position statements is intended for the conscious patient and reinforces the concept of self-splinting for pain. The unconscious patient presents a challenge, especially if the cause cannot be differentiated between traumatic and medical conditions. In these instances, full immobilization with a cervical collar and LSB may be indicated, but consideration for removal from the LSB as soon as feasible is warranted.

Although the cervical collar has also come under fire as ineffective,³⁴ it will continue as standard practice for the foreseeable future. The equipment-laden athlete presents unique challenges that must be addressed. Athletic trainers understand equipment, and more importantly, optimal methods for equipment removal in the care of an injured athlete. Interprofessional collaboration is needed to develop best-practice guidelines for the management of potentially spine-injured athletes that are consistent with current practices in prehospital emergency care.

CONCLUSIONS

Spinal immobilization with the LSB is ineffective, has detrimental side effects, and came into initial use by consensus. The NAEMSP and ACEP have both recommended limiting the use of the LSB and moving from SI to SMR with a rigid cervical collar. The NAEMSP position paper¹ and supporting resource document²⁴ stated that a patient with neurologic deficit and spinal pain or tenderness may be placed on an LSB, but the LSB should be considered an extrication device only, and the patient must be removed from the LSB as soon as possible. The NAEMSP does not differentiate athletes from the general population. It is important for ATs to recognize that local EMS agencies may rarely use LSBs routinely, and alternate methods to manage the spine-injured athlete must be developed in conjunction with EMS and outlined in the venue emergency action plan and the pregame medical time-out. Unique settings and situations such as the gymnastics pit, swimming pool, and equipment-laden athletes deserve special attention in the emergency action plan. Dress rehearsals with EMS for managing athletes in these situations are crucial for success, especially considering the rarity of EMS being needed at athletic events and practices.

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