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Why EMS Should Limit the Use of Rigid Cervical Collars



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Over the last few years we've seen significant changes in the prehospital treatment of patients with potential spinal injuries. We've quickly gone from using rather extensive spinal mobilization techniques to doing virtually nothing.

Few of the recent advancements in EMS have been this significant. As a result, these changes have caused considerable angst among both prehospital providers and hospital-based personnel. However, it's been said that the first step toward change is awareness. The second step is acceptance. Winston Churchill once said, "To improve is to change; to be perfect is to change often." Change can be good.

Rarely does a day go by when we don't learn of an EMS system that has abandoned backboards and the older archaic practices of prehospital spinal immobilization. This trend began initially in North Carolina and later in California. Now, most of the progressive EMS

systems have discarded or changed their spinal immobilization practices. They've replaced these with various strategies that minimize backboard use.

The impetus for these changes was various scientific studies that showed spinal immobilization, as previously practiced, was ineffective.¹ Some studies also demonstrated that spinal immobilization practices were possibly causing harm.

This was the principal reason this issue came to the forefront. There were significant discussions among various interested factions regarding these changes. However, there was enough of a groundswell support to effect change.

Now, spinal precautions are much simpler and much more comfortable for the patient. There's little argument that the backboard as an immobilization device is ineffective.

But, one has to wonder about cervical collars (C-collars) as well. Many EMS systems have elected to use rigid collars without backboards. Is this the best practice? Is this practice effective?

Cervical Immobilization

Interestingly, one of the first protocols that significantly changed spinal immobilization practices came out of several EMS agencies in Northern California. In a rather sweeping protocol change, they elected to forgo rigid C-collars and use soft collars.

Those of us who've been in EMS for a long time remember using soft collars for potential spinal injuries before the rigid collars were available. But to understand why we initially switched to rigid C-collars, it's important to review some concepts that led to the older spinal immobilization practices. They were based on the following assumptions:

- >> Injured patients may have an unstable cervical spine (C-spine) injury.
- >> Additional movement of the C-spine might result in additional damage to the spinal cord beyond that caused by the initial trauma.
- >> The application of a rigid or semi-rigid C-collar may prevent potentially harmful movements of the C-spine.
- >> Spinal immobilization is a relatively harmless procedure and can therefore be applied to a large number of patients with a relatively low risk of injury. It's often used as a precaution.

Unstable C-Spine Injury?

Unstable C-spine injuries do occur, yet they're relatively rare. In the United States it's estimated that there are approximately 12,000 new cases of spinal injury annually. Most of these result from motor vehicle collisions.

Over the last several years the number of patients with quadriplegia (cervical injuries) has decreased.² In patients who are alert and stable, the incidence of clinically significant C-spine injuries is exceedingly low.³

The National Emergency X-Radiography Utilization Study (NEXUS) criteria and Canadian C-spine rules were developed to help physicians determine which patients with possible C

-spine injuries from blunt trauma require diagnostic imaging (e.g., CT, X-ray, MRI).^{4,5}

If the patient doesn't require imaging, then they don't require immobilization. This was the basis for the development of the selective spinal immobilization protocols used in EMS.⁶

The term for this was later changed to spinal motion restriction (SMR) as it was recognized that the spine couldn't be truly immobilized. These protocols were found to be accurate and effective.⁷

The initiation of a statewide selective spinal immobilization protocol in Maine reduced spinal immobilization in that state by over 50%. The protocol only missed one patient with an unstable spinal injury out of 32,000 prehospital trauma patient encounters.⁸

The use of SMR protocols has been widely used in EMS for years and has safely reduced the use of spinal immobilization. However, many providers have been reluctant to use it.⁹

Attention was then turned to patients with penetrating trauma. It was a common practice to immobilize patients with penetrating injuries. However, it was found that spinal injuries from penetrating trauma were quite rare.¹⁰

Furthermore, it was found that immobilization of patients with penetrating injuries actually worsened outcomes.^{11,12} When present, these injuries are readily apparent on physical examination and generally never get better.¹³

This resulted in the development of guidelines and protocols to limit spinal immobilization of patients with penetrating trauma by the American College of Surgeons (ACS) and Prehospital Trauma Life Support (PHTLS).¹⁴

Worsening the Damage?

It was always thought and taught that additional movement of the spine in a patient with a spinal injury would actually worsen the condition or result in a secondary injury. There are really no data to support this.¹⁵

There are a couple of reasons for this. First, the initial mechanism of injury causing the spinal injury is usually significant, and simple movements during patient care are unlikely to be as severe.

Also, the natural responses of the body to a serious injury actually provide somewhat of a de facto splint. With C-spine injuries, the muscles of the neck contract and that, along with pain, limits additional severe motion.

Preventing Harmful Movement?

First, as detailed above, there's no evidence that additional simple movements of the C-spine cause additional damage. Even if that's assumed to be true, to stop the C-spine from moving would require the neck be completely immobilized in all axes of movement. This is difficult because the range of motion of the C-spine is rather extensive. (See Figure 1 above.)

Placing the patient in a simple C-collar isn't going to stop all axes of movement. Also, one must remember that the neck is attached to the body. Even if the C-spine were firmly immobilized, movement of the body below the neck would also cause movement of the neck.

In other words, it's impossible to immobilize the C-spine without immobilizing the entire patient.¹⁶

There's absolutely no evidence the C-spine can be immobilized to any significant degree. Even the post-operative halo frames used by neurosurgeons still allow 4 degrees of motion when properly placed.¹⁷

A 1998 study found that the rigid collars commonly used in hospitals (e.g., Aspen collar) reduce spinal motion somewhat, but don't immobilize the spine. This led the authors to remark, "Cervical spinal immobilization is a myth."¹⁸ Common prehospital C-collars allow even more movement than the Aspen collar.^{19,20}

Harmless?

It's repeatedly been argued that spinal immobilization is a relatively harmless procedure and the perceived benefits certainly outweigh any perceived risks. It was often said, "When in doubt, immobilize the spine." Much of this came from the 1984 U.S. Department of Transportation Emergency Medical Technician—Ambulance: National Standard Curriculum.

For reasons that remain enigmatic to this day, the decision was made to "dumb down" the EMT curriculum so more people could obtain the training. It was much easier to teach EMTs to apply spinal immobilization rather than teach them to determine which patients might need spinal immobilization and which may not.

Soon, the indications for prehospital spinal immobilization became simply the presence of a patient. This paralysis of intellect resulted in the current immobilization craze of all patients suffering from seizures to simple falls to minimal-energy motor vehicle collisions (that soon become multiple casualty incidents because the five occupants of the vehicle have a little neck and back pain and therefore must be immobilized).

Initially, that argument to immobilize "just in case" may have had some merit. Now, significant studies have shown that C-spine immobilization, and specifically application of rigid C-collars, is a potentially dangerous practice.²¹ The reasons include:

C-collars interfere with airway management: There are a considerable number of studies that have shown C-spine immobilization practices can interfere with airway management. Even a properly applied rigid C-collar restricts mouth opening by 25% or more.²²

Interestingly, there has never been a documented case where endotracheal intubation caused or worsened a C-spine injury.²³ Yet, how many trauma patients have died because of inability to obtain an airway because of concerns about the C-spine?

C-collars increase intracranial pressure: It's been clearly demonstrated that even proper application of a rigid C-collar can increase intracranial pressure. This is particularly problematic because many patients with spinal injuries also have head injuries where an increase in intracranial pressure can be devastating.

The principle behind this is simple. C-collars are often tight enough on the neck to restrict venous drainage of the head through the jugular veins. They're not tight enough to restrict arterial inflow through the carotid and the vertebral arteries.

Thus, arterial blood flowing into the cranial vault continues unimpeded while venous outflow is restricted. Since the cranial vault is a closed space, this causes increased intracranial pressure. The amount of the increase varies but the phenomenon has been well documented.²⁴⁻²⁶

C-collars increase spinal motion in high C-spine injuries: Injuries of the high C-spine are among the most catastrophic spinal injuries that occur and involve the first (C1) through the fourth (C4) cervical vertebra as well as the joint between the skull and the first cervical vertebra (atlantooccipital joint). Application of a rigid C-collar causes the separation of C1 from C2, thus stretching the high spinal cord.

This was first reported in a patient undergoing diagnostic imaging and was later studied using unembalmed cadavers where rigid C-collar application resulted in a $7.3 \text{ mm} \pm 4.0 \text{ mm}$ of separation between C1 and C2.²⁷ In high C-spine injuries, rigid collars can actually worsen the patient's condition.

C-collars cause pressure sores: Although not commonly seen in the prehospital setting, rigid C-collars cause increased tissue pressure and subsequent pressure sores. This can cause pain for the patient and increases the chances of secondary infection.^{28,29}

C-collars are uncomfortable: It's no secret that rigid C-collars are uncomfortable. Because of this, a major goal in the ED and trauma center is to get the patient off of a backboard and out of a C-collar as fast as possible.

C-collars can cause increased diagnostic imaging: EMS and hospital-based care are becoming more integrated. It's essential prehospital personnel consider what occurs after the patient has been delivered to the hospital. This is especially true for patients with potential spinal injuries.

The application of a rigid C-collar causes discomfort. Being placed on a hard backboard also causes discomfort. Even over a short period of time, patients in spinal immobilization will develop pain and tenderness in their C-spine.^{30,31}

When the patient is subsequently examined in the ED or trauma center, the treating physician will look for midline tenderness, among other things, to determine whether diagnostic imaging is necessary.

Both the NEXUS criteria and Canadian C-spine rules are partially based upon the presence or absence of midline C-spine tenderness.

Oftentimes, patients who didn't have midline point tenderness when placed in a C-collar

and/or on a backboard are found to have tenderness after being on the backboard for a short time.³²

The presence of tenderness can mandate diagnostic imaging. In a study of pediatric patients, it was found that children who were immobilized in the prehospital setting were more likely to be imaged, more likely to be admitted to the hospital, more likely to be admitted to the ICU, and were found to have more pain than their counterparts who weren't immobilized.³³

C-collars can foster a false sense of security: Once a patient has been placed in spinal mobilization, healthcare personnel often assume they're safe and can be easily moved. This was based on the idea that their spine was securely immobilized. Now, we know this isn't the case.

2015 & Beyond

Changes in prehospital spinal immobilization protocols are rapidly occurring across the country. Because these were such stark changes when compared to prior practices, many EMS systems have decided to make these changes in measured steps. Some simply tried to reduce the use of backboards. Others eliminated sandbags, head supports and tape.

Some elected only to use rigid C-collars and place the patient onto a soft bed as soon as possible. Some have now replaced the rigid C-collars with a soft foam C-collar as the only device for spinal immobilization. It's now known that current devices don't allow for true immobilization of the spine.

It's also known that rigid C-collars cause the numerous problems as detailed in this article. The soft C-collar doesn't immobilize the C-spine, but it serves as a reminder to the patient to limit movement of their neck.

This is just as effective as the limitations in movement afforded by rigid cervical collars—but is much more comfortable for the patient. This was the concept when soft C-collars were used in EMS 30 to 40 years ago and also makes sense today.

Although not an EMS study, a 2010 research paper compared rigid C-collars to soft foam C-collars during flexion, extension, lateral bending and rotation of the head and neck. Although the subjects exhibited a more limited range of motion of the C-spine when immobilized in a rigid collar than when placed in a soft collar, the motion recorded during the various functional tasks wasn't significantly different regardless of which cervical device was applied.³⁴

Conclusion

It's taken over 20 years to develop the necessary body of scientific evidence to change our practices of spinal immobilization. Fears of worsening a spinal injury, fears of missing a spinal injury and fears of litigation have long driven this process instead of scientific evidence.

In the course of this we've made our patients uncomfortable, sometimes hurt them, and made their healthcare more complicated and more expensive. This is one of the best

customer satisfaction practices that EMS can adopt.

It's important to point out that we shouldn't abandon our various tools for moving patients. There's a limited role for backboards in extrication. Scoop-type stretchers and basket stretchers are excellent devices for moving patients, especially over uneven or rough terrain.

The vacuum mattress is also an excellent device for moving patients and actually provides probably the best stabilization of the spine of any device out there.

We don't want to throw the baby out with the bathwater; we just want to provide the best possible evidence-based care for our patients. Overall, our patient care will improve and our patients will remain more comfortable.

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