

Also posted over at [Paramedicine 101](#). Go check out the rest of what is there.

<http://www.researchems.com/>

A recent study points out some of the problems with EMS (Emergency Medical Services) treatment in some places. Each medical director, or state medical director, is permitted to ignore the evidence that some treatments are harmful. They can use ignorance as an excuse for continuing harmful practices. Rather than ignorance, those familiar with the research will claim that somebody *might* benefit. Their battle cry is ***What if . . . ?***

If we take that approach, there is no limit to how much we can do to a patient, and I do mean *to* a patient, not *for* a patient. This is not patient care. This is *alternative* medicine. Since *alternative* medicine is not medicine, but an *alternative* to medicine, this EMS *treatment* qualifies as *alternative* medicine. When our patients need care, they do not need an *alternative* to medicine that works, they need medicine that works.

*Spine immobilization in penetrating trauma: more harm than good?*¹¹ shows that ***What if . . . ?*** medicine can double or triple the death rate of our patients.

What if . . . ? we act as if our patients matter enough to be treated as human beings.

What if . . . ? we try to help our patients survive.

The reason for the continued use of ***What if . . . ?*** practices seems to be more of a fear of lawyers, than any kind of understanding of medicine. The medical directors appear to presume that they will **never** get in trouble for doing too much, as long as we are not using pain medicine. They seem to think that anything they recommend is good, or at worst, not harmful. *We've got to do something!* That is the theme in EMS these days.

We need to continue to harm our patients right up until there is *inescapable* proof that we are causing harm.

What does the study say?

This study seeks to measure the effect of prehospital spine immobilization on mortality in a large national sample of penetrating trauma patients drawn from the NTDB (National Trauma Data Bank). We hypothesized that penetrating trauma patients who underwent prehospital spine immobilization would have higher mortality than penetrating trauma patients who did not undergo spine immobilization. In addition, we expected that a very small proportion of penetrating trauma patients potentially benefited from prehospital spine immobilization.^[2]

Patients were considered to have potentially benefited from prehospital spine immobilization if they had an incomplete spine injury and required an operative spine procedure (including vertebral spine repair, spine fusion, laminectomy, and/or halo placement).^[2]

This seems as if it should be the way to determine which patients *might* have been best treated with immobilization, but there remains a big problem. There is no research to show that without prehospital spinal immobilization, outcomes would be any worse, even for patients with unstable spinal fractures. We *presume* that this is an effective treatment, but we are only hoping that we are doing the right thing.^[3]

On subset analysis of specific patient populations, no group of penetrating trauma patients had any survival benefit with prehospital spine immobilization (Fig. 1) Even for patients with the least severe injuries (ISS <15), spine immobilization was independently associated with significantly decreased survival (OR of death 3.40, 95% CI 1.48–7.81). The OR of death was significantly elevated for GSW patients (OR 2.12; 95% CI 1.33–

3.37) and for hypotensive patients (OR of death 2.42, 95% CI 1.37–4.27).^[2]

The fatality rate appears to be multiplied, not just increased, by this *treatment*. Maybe it is time to stop killing so many of our patients. Fortunately, most places stopped this dangerous treatment long ago. This comes from Johns Hopkins. It appears to have been motivated by the continuing attempts by MIEMSS ([Maryland Institute for Emergency Medical Services Systems](#)) to stick to the *What if . . . ?* method of *treatment*, in spite of evidence of harm. MIEMSS protocols do not appear to differentiate between blunt and penetrating trauma, when determining if immobilization is *necessary*.^[4]

Of these 116 patients, 86 (74%) had complete spinal cord injury and would not have benefitted from spine immobilization. Only 30 (0.01%) of the 30,956 patients had incomplete spinal cord injury and underwent operative spine stabilization. The number needed to treat (NNT) with spine immobilization to potentially benefit one penetrating trauma patient was 1,032. The NNH (Number Needed to Harm) with spine immobilization to potentially contribute to one death was 66.^[2]

The NNT is not at all clear. They are using a *potential* benefit of spinal immobilization that has only been presumed. That benefit has not been demonstrated. Where is the research to show that prehospital spinal immobilization in any way improves outcomes for patients with unstable spinal injuries even due to blunt trauma?

In this case, the NNH is not the Number Needed to *Harm*. What is reported is the Number Needed to Kill, because they are only looking at fatal harm in calculating NNH. When looking at benefit, if they were to look for lives *saved* by spinal immobilization for penetrating injuries, they would still be looking. If they had a unicorn to guide them, they might find something.

According to one study of the harm due to spinal immobilization, the NNH is less than 2.

Conclusion

In this population of alert and cooperative patients with no obvious distracting injuries or clinical signs of intoxication, 52% had no complaints of neck pain or back pain yet were transported to the ED using FSI (Full Spinal Immobilization), which increased both their level of discomfort and their EMS charges.^[5]

The number needed to treat is 1,032 - assuming there is any benefit from prehospital spinal immobilization. Only 1 study has looked at this. It found no evidence of any benefit. Even those with unstable spinal fractures did worse with spinal immobilization. Unfortunately the study was too small to be statistically significant.^[6]

The number needed to harm is less than 2.

The number needed to kill is 66.

The extremely optimistic number needed to treat is 1,032.

Although the intention behind conservative prehospital spine immobilization protocols is to protect the minority of patients who suffer spine injuries, this study demonstrates that spine immobilization is associated with higher mortality in penetrating trauma patients and may harm more penetrating trauma patients than it helps. Prehospital spine immobilization was associated with higher odds of death in all penetrating trauma patients, and this association was qualitatively robust across all subsets of penetrating trauma patients.^[2]

The merits of IV fluid administration, endotracheal intubation, and now spine immobilization (in penetrating trauma patients) have been called into question, because their clinical benefit may not be worth the extra time on scene.^[2]

This is an excellent example of narrative fallacy.

We know that spinal immobilization leads to worse outcomes for patients with penetrating injuries. That is the part that is important to know. Then there is an attempt at an explanation - *because their clinical benefit may not be worth the extra time on scene*. This explanation is where we make a mistake. I have written quite a bit about narrative fallacy. The posts are linked below, in chronological order, just above the footnotes.

In the limitations, they do acknowledge this to some extent.

Our conservative estimate of the benefit is possibly exaggerated as not all patients with an incomplete spinal cord injury who underwent surgery truly benefitted from spinal immobilization.^[2]

Elsewhere in the limitations, they write this.

This retrospective study suffers some significant limitations, mainly because of the data available. The NTDB does not report prehospital scene or transport times or differentiate urban versus rural care. Thus, we could not demonstrate that the excess mortality in patients who underwent spine immobilization was associated with delays in transport to definitive care.^[2]

There is not really a good reason to presume that extra time on scene is the reason for the dramatic increase in death among those immobilized. While it is possible that time does contribute to the result, it is a mistake to claim that a study that does not have

the ability to examine prehospital times *at all* is capable of providing evidence that extra time on scene is the cause.

Another recent study showed that there is no reason to believe that prehospital times significantly affect outcomes even for the most unstable trauma patients.^[7]

Where research is not being used, we need to find ways to get the medical directors to understand research. Then we need to get them to apply the research.

Footnotes:

^ 1 Spine immobilization in penetrating trauma: more harm than good?

Haut ER, Kalish BT, Efron DT, Haider AH, Stevens KA, Kieninger AN, Cornwell EE 3rd, Chang DC.

J Trauma. 2010 Jan;68(1):115-20; discussion 120-1.

PMID: 20065766 [PubMed - in process]

^ 2 Spine immobilization in penetrating trauma: more harm than good?

Haut ER, Kalish BT, Efron DT, Haider AH, Stevens KA, Kieninger AN, Cornwell EE 3rd, Chang DC.

J Trauma. 2010 Jan;68(1):115-20; discussion 120-1.

PMID: 20065766 [PubMed - in process]

This is the same as footnote ^[1]

^ 3 Out-of-hospital spinal immobilization: its effect on neurologic injury.

Hauswald M, Ong G, Tandberg D, Omar Z.

Acad Emerg Med. 1998 Mar;5(3):214-9.

PMID: 9523928 [PubMed - indexed for MEDLINE]

I wrote about this study in [Spinal Immobilization Harm](#).

[^](#) ⁴ **MIEMSS Maryland Medical Protocols**

Effective July 1, 2008

348 pages of trying to predict everything that might go wrong.

[Free large PDF](#)

[^](#) ⁵ **Unnecessary out-of-hospital use of full spinal immobilization.**

McHugh TP, Taylor JP.

Acad Emerg Med. 1998 Mar;5(3):278-80. No abstract available.

[PMID: 9523943 \[PubMed - indexed for MEDLINE\]](#)

What do we do to protect our patients from injury when we immobilize them?

But spinal immobilization protects the patient from injury!

Maybe, but if spinal immobilization does offer *any* protection from *any* injury, it may only offer that protection when spinal immobilization is performed perfectly. We do not know what perfect spinal immobilization is, but it probably is not the method we currently use - strapping people to pieces of wood, or pieces of plastic.

Here is one example of spinal immobilization creating more of a risk of paralysis.

Imagine that we are dispatched to a motor vehicle collision. There is significant damage to the vehicles. Our patient is up and staggering around. We attempt to assess our patient and find that he is not cooperative. Mr. Charming is behaving in a way similar to other patients - patients who have stated that they might have consumed some alcohol, but only **2 drinks**. However, Mr. Charming is not as charming as these previous patients. He does not even answer most of our questions, never mind demonstrating

that his math skills become undefined beyond the number two.

Protocol states that Mr. Charming should be immobilized to *protect* his neck from possible movement during transport. We attempt to put a collar on Mr. Charming, but find that we have to wrestle with him to keep the collar on his neck. In a moment of inspiration, we call medical command for possible orders to either sedate Mr. Charming or to not immobilize Mr. Charming. Tonight, medical command is Dr. Charming (no relation). The doctor is about as charming as Mr. Charming, but no more reasonable.

Dr. Charming is worried about the possible harm that might come from *not immobilizing* Mr. Charming. It seems that this harm is legal harm that would affect Dr. Charming. The possibility that Mr. Charming's combativeness might convert a stable fracture to an unstable fracture, or an unstable fracture of the spine to a permanent injury of the spinal cord - these risks are insignificant compared to creating a legal alibi. Mr. Charming is applying significant forces to his cervical spine, by wrestling with us, by fighting with the collar, and once he is strapped to the board, those forces applied to the cervical spine are increased exponentially.

This understanding of mechanism, or kinesiology, is ignored by Dr. Charming. Mr. Charming will be laying on his back, his head taped to the board, wearing a cervical collar. He will be continually raising his head against the restraining tape. He will be applying the kind of forces to his neck that essentially clear his spine as far as unstable fractures are concerned, because if this does not result in paralysis, nothing will. Dr. Charming does not understand, but he has seen people play lawyers on TV and he is more worried about his theoretical legal problems.

Dr. Charming's concern about sedation is that sedation may mask the ability to thoroughly assess the patient. No, we're not considering sedating the doctor - that *would* affect the assessment. OK, we're not completely ruling out sedating the doctor, but don't tell anybody. *Shhh*. That will be our secret. Even though that ability to thoroughly assess Mr. Charming is little more than a hallucination, Dr. Charming believes it is significant. Dr. Charming

believes that, if we do not sedate Mr. Charming, he will be the ideal patient. Dr. Charming is worried that a sedative may convert Mr. Charming from a combative and uncooperative patient, to a sedated and uncooperative patient. Dr. Charming does not realize that this is one of the benefits of sedating Mr. Charming.

Dr. Charming is also concerned about Mr. Charming's blood pressure, which appears to be elevated, but it is difficult to obtain, due to the way his combativeness does not exactly assist with our assessment. Mr. Charming says he will allow a blood pressure, but only if we agree remove the collar and remove him from the long board. Dr. Charming considers the inability to be able to obtain a clear blood pressure as a sign that it must be on the low side, perhaps dangerously low, even though all indications are to the contrary. Dr. Charming is worried that giving a depressant, and sedatives are almost all depressants, will lower Mr. Charming's blood pressure to even more dangerous levels, although there really is no indication that there is a problem with the blood pressure.

Number three on Dr. Charming's hit parade is the possibility that the sedative may induce nausea and vomiting. These are significant risks in the immobilized patient. We can deal with vomiting in a couple of ways. We can give anti-emetic medication, but Dr. Charming is afraid that the sedating effect of the anti-emetic may similarly compromise assessment. Not to worry - we can still turn the long spine board on its side, while we shovel the vomit out of Mr. Charming's airway. Remember, this is EMS. Immobilization is much more important than airway. In EMS, we consider it more important to keep the immobilization *just so*, than to make airway management the priority.

Let's see, the research on breathing vomit does not exactly include randomized placebo controlled trials, but the purely observational nature of the research does seem to have produced a consensus. Breathing vomit does not lead to a long life. Even I do not criticize this conclusion.

On the other hand, the evidence that the immobilization device

actually protects the patient from further injury, even without the complication of a vomiting patient - **that evidence does not exist.** That *evidence* is really just expert opinion, just like the *Golden Hour*, prophylactic lidocaine, giving medication down the endotracheal tube, System Status Management, high flow oxygen is harmless and good for everything, MAST (Medical Anti-Shock Trousers) creates an *auto-transfusion* of blood from the legs to the upper body, if it wheezes it is asthma, if it crackles it is CHF and will have *pink frothy sputum*, and so on. All of those expert opinions have been shown to be wrong, so how much should we endanger our patients in defense of this *not yet discarded* expert opinion?

Is the concern about sedation leading to vomiting a legitimate concern?

Yes. And. No.

Huh?

Yes. One of the side effects of medication is vomiting. Even anti-nausea/anti-vomiting medication can cause vomiting. Combining the sedative with a condition that may lead to vomiting on its own (intoxication), may increase the chances of vomiting.

No. Mr. Charming probably has eaten chili, hot wings, pizza, and washed it down with some cheap imported beer (such as Budweiser), followed by some ~~jet fuel/miracle semi-digested food propellant~~ even cheaper home grown tequila. Therefore, Mr. Charming already has a total stomach evacuation scheduled. Maybe he will wait until he is safely being ignored in a hallway bed. Maybe he will not vomit at all, but not being prepared for vomiting is stupid, especially with such a charming patient.

While the one large study to compare a system with spinal immobilization and a system without spinal immobilization was not large enough to clearly demonstrate that spinal immobilization is harmful, that is the way the numbers were trending.^[1]

I am sure that none of us will *ever* deal with an intoxicated person, who has a mechanism where the protocol indicates full spinal immobilization be applied, it is good to think about what might happen in the rare event that we come across one of these trauma zebras.

First do no harm is a pithy phrase that is more of a medical punchline than a medical reality, but we should wonder if this spinal immobilization *treatment* is even as safe as *any* alternative. If we wish to claim that spinal immobilization is safe and/or effective, we need to provide some research to support it.

Without research, spinal immobilization is just another experimental treatment.

Should we be experimenting on our patients?

We do not have IRB (Institutional Review Board) approval

We do not have researchers.

We do not have control groups.

This is just a huge uncontrolled unauthorized experiment on the unsuspecting.

Can spinal immobilization be said to have satisfied any requirements to be treated as not experimental?

No.

But - It would be unethical to study this, because that would deprive some patients of this obviously beneficial treatment!

That is what doctors say about treatments based on expert opinion. They keep saying that - right up until the evidence of harm is unavoidable - or the doctors come up with a *new and improved* expert opinion treatment ~~perhaps as a way of deflecting the claims about the discarded treatment.~~

Is there any evidence that those with spinal fractures are not harmed by immobilization?

Is there any evidence that those with spinal fractures receive any benefit from spinal immobilization?

As far as I know, the answer to both questions is **No**.

Footnotes:

Every year we see hundreds of patients with suspected spinal injuries or who require precautionary spinal immobilization. A tiny weeny percentage of these are proven to have any actual lasting damage. Complacency however, is not an option.

I once triaged an 11 year old who presented with persistent neck pain 3 days after a fall in Judo class. He had an unstable C2 fracture.

Some mechanisms of injury that should be ringing your bells include:

- A pedestrian or cyclist hit with an impact speed greater than 30km/hr.
- Occupant of motor vehicle involved in a collision greater than 60km/hr.
- Fall more than 3 meters.
- Kicked by or thrown by a horse.
- Backed over by a car.
- Thrown over handlebars of a bike.
- Severe electric shock.
- Any significant trauma above the level of the clavicles.
- Unexplained hypotension following trauma.
- Obvious history of neck trauma .
- Midline tenderness or reluctance to move the neck.
- Neurological deficit.

Fit a rigid immobilizing collar.

Inform the patient of your concerns and that in all likelihood this will only be a precautionary intervention that will be removed as soon as a more thorough assessment can be made.

You will need an assistant to immobilize the c-spine whilst you fit the collar.

If the patient has walked in to the department you might find it easier to fit the

collar whilst they are sitting on the edge of a bed. After fitting, carefully assist them to the supine position. We use special slide sheets to minimize friction as we swivel them into position.

Remove any jewellery above the clavicles including necklaces, earrings, nose studs, tongue studs and anything else that will interfere with x-ray views.

The Fitting. There are quite a few rigid collars available with slightly different sizing techniques. Follow manufacturer's instructions to obtain a snug symmetrical and effective fit.

Tie me up. Tie me down.

We used to use medieval lashings of tapes and bindings to immobilize the rest of the body to the bed or spinal board. This only made the patient more anxious and uncomfortable leading to increased movement.

Usually a couple of sandbags on either side of the head accompanied by appropriate analgesia and thorough explanation will be sufficient. Remember, human beings are innately jiggly, fidgety, headwagging animals so gently emphasize, in the nicest possible way, the catastrophic sequelae of a spinal injury.

may be cleared without X-ray:
(all boxes must be ticked)

-
- Patient is alert and has normal conscious state.
 - No distracting injury, intoxication or sedation etc.
 - No neck pain or tenderness on direct palpation.
 - Normal neurological examination.

I'm going to be sick.

Once your patient is properly immobilized you must remain vigilant and attentive. Staring up at the ceiling and not knowing what is going on will promote isolation and anxiety.

Once again explanation of your management plan is important. If you are going to leave the bedside, ensure they have a call bell handy. Consider the use of an anti-emetic to manage nausea and vomiting. Make sure you have suction equipment at the bedside in case this does occur. You will also need to have a plan to initiate a rapid log roll of the patient onto their side if they are vomiting. You will need a minimum of 3 people to do this, one to maintain spinal alignment of the head and 3 to roll the body, so be prepared.

During transfer to x-ray etc. the patient must have a medical escort.

As I have mentioned appropriate and adequate pain relief is mandatory. Pressure area care should be attended every 2 hours whilst the patient is immobilized (especially in the elderly), and the collar should be substituted with a two-piece hard collar such as the *Philadelphia collar* if it is to be utilized for longer than 6 hours.

Reassess their neurological status after any interventions.

The drunk or aggressive patient.

I tell you, the things we do that interfere with the process of natural selection. No, seriously, the management of a drunk or aggressive patient with a suspected spinal injury is a complex problem. Attempting to maintain spinal immobilization in these cases will often only lead to increased movement of the neck. Sedation may be contraindicated if they have an accompanying head injury, but if at high risk of spinal injury; sedation, paralysis and intubation may need to be considered. Usually though, less intervention is best in achieving some balance of spinal stability in these people.

Who to X-ray.

- Any patient who has a suspected spinal injury with an altered conscious state.
- Adequate assessment is difficult due to distracting injury or intoxication/sedation.
- Neck tenderness and/or pain.
- Abnormal neurological signs

1. There are NO peer reviewed scientific studies that show that there is any benefit to Spinal Immobilization whatsoever. However, there are peer reviewed scientific studies which demonstrate that our spinal immobilization has had DETRIMENTAL effects to the patient. Are we doing any good for the patient? Or do we simply go through this ridiculous ritual simply because we are afraid of being sued?

- Journal of Emergency Medical Services "Insanity" by Brian Bledsoe 3/1/2007

- Academic Emergency Medicine "Out of Hospital Spinal Immobilization: Its Effect on Neurological Injury" by Hauswald M, Ong Tandberg 1998

- Annals of Emergency Medicine "Is routine spinal immobilization an effective intervention for trauma patients?" Baez AA, Schiebel N

-Injury "The effect of a rigid collar on intracranial pressure" Davies G, Deakin C, Wilson A 1996

-Prehospital Emergency Care "Respiratory effects of spinal immobilization" Totten VY, Sugarman DB 1999

[^ 6](#) **Out-of-hospital spinal immobilization: its effect on neurologic injury.**

Hauswald M, Ong G, Tandberg D, Omar Z.

Acad Emerg Med. 1998 Mar;5(3):214-9.

[PMID: 9523928 \[PubMed - indexed for MEDLINE\]](#)

This is the same study as footnote ^[3].

As such, we continue to propose the development of a methodologically sound, prospective randomized clinical trial that will attempt to answer the question of utility (or lack thereof) of standard out-of-hospital spine precautions and immobilization, as well as the development of out-of-hospital specific clearance protocols for low-risk patients. Until then we can only conclude that at the present time there exists no published or unpublished solid scientific evidence justifying the practice of spinal immobilization in the out-of-hospital setting and challenge the current ethical debate against the development of such studies.

*Amado Alejandro Báez, MD, MSc
Department of Emergency Medicine and
Division of Trauma
Burns and Surgical Critical Care
Department of Surgery*

218 Annals of Emergency Medicine Volume □□, □□. □ : August □□□□

[Volume 48, Issue 2](#), Pages 218-219
(August 2006)

◀ [previous](#) 34 of 45 [next](#) ▶

▶ [FULL TEXT](#)
[FULL-TEXT PDF \(63 KB\)](#)

[CITATION ALERT](#)
[CITED BY](#)
[RELATED ARTICLES](#)
[EXPORT CITATION](#)
[EMAIL TO A COLLEAGUE](#)
[RIGHTS/PERMISSIONS](#)
[NEED REPRINTS?](#)
[BOOKMARK ARTICLE](#)

Out-of-Hospital Spine Precautions: Ethics and the Available Evidence Response ro LTE #2006-169: In reply

[Amado Alejandro Báez, MD, MSc](#)

Refers to article:

The Evidence for Spinal Immobilization: An Estimate of the Magnitude of the Treatment Benefit

Scott M. Sundheim, Michael Cruz

Annals of Emergency Medicine

August 2006 (Vol. 48, Issue 2, Pages 217-218)

[Full Text](#) | [Full-Text PDF \(62 KB\)](#)

Article Outline

- [References](#)
- [Copyright](#)

We read with great attention the letter sent by Drs. Sundheim and Cruz and wanted to express our gratitude for their valuable observations; their literature review provides a comprehensive and sophisticated description of the potential benefits of spinal immobilization practices. In response we would first like to point out that the primary objective of our systematic review abstract was to offer a summary of data published in the Cochrane Collaboration by Kwan et al¹; as a secondary objective we wanted to illustrate the necessity for the development and universal implementation of a set of out-of-hospital spine clearance rules for low-risk patients.

We are in agreement with the information presented by our colleagues, and wanted to recognize and underline the value of “selective” out-of-hospital spine immobilization, as it is clear that unstable and occult spinal injuries carry significant and potentially preventable morbidity and mortality. However, we need to respond by reiterating that both extremes of the spinal immobilization spectrum are open to ethical discussions, as indiscriminate use of “strict” spine precautions holds vast potential for complications, including pain, tissue ischemia, direct harm to the spine and airway compromise.

A detailed analysis of articles referenced by Drs. Sundheim and Cruz are supportive of our arguments. Reid et al² describe that intoxication, multiple injuries and altered levels of consciousness were factors thought to be directly associated with an inability to identify spinal injuries. Davis et al³ comment that “Cervical spine precautions should be maintained, particularly in high-risk patients.” We believe that the development of any out-of-hospital clearance protocol necessarily needs to integrate these precautionary elements. However, in a later publication, Kaups and Davis⁴ present a case series of 215 penetrating head injuries and conclude that “no patients sustained indirect (blast or fall-related) spinal column injury,” and note that more intubation attempts occurred in those patients with cervical spine immobilization, potentially complicating airway management. This is in full agreement with our argument for the selective use of spine precautions and immobilization.

From an evidence-based and methodological perspective, case reports bear considerable intrinsic limitations; moreover, the translation and extrapolation of hospital-specific and emergency department data into the out-of-hospital environment may be inappropriate and an overall dangerous practice. As such, we continue to propose the development of a methodologically sound, prospective randomized clinical trial that will attempt to answer the question of utility (or lack thereof) of standard out-of-hospital spine precautions and immobilization, as well as the development of out-of-hospital-specific clearance protocols for low-risk patients. Until then we can only conclude that at the present time there exists no published or unpublished solid scientific evidence justifying the practice of spinal immobilization in the out-of-hospital setting and challenge the current ethical debate against the development of such studies.

References

 [return to article outline](#)

1. Kwan I , Bunn F , Roberts I WHO Pre-Hospital Trauma Care Steering Committee . Spinal immobilisation for trauma patients . (Cochrane Review) The Cochrane Library, Issue 1 . Chichester, UK: John Wiley & Sons, Ltd; 2005; .
2. Reid DC , Henderson R , Saboe L , et al. Etiology and clinical course of missed spine fractures . *J Trauma* . 1987;27:980–986 . [MEDLINE](#)
3. Davis JW , Phreaner DL , Hoyt DB , et al. The etiology of missed cervical spine injuries . *J Trauma* . 1993;34:342–346 . [MEDLINE](#)
4. 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 . [MEDLINE](#)