

Cervical Spine Fractures in Elderly Patients with Hip Fracture After Low-Level Fall: An Opportunity to Refine Prehospital Spinal Immobilization Guidelines?

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Abbreviations:

C-spine: cervical spine
DI: distracting injury
ICD: International Classification of Diseases
LOC: loss of consciousness
MOI: mechanism of injury

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Abstract

Background: Conventional prehospital spine-assessment approaches based on low index of suspicion and mechanism of injury (MOI) result in the liberal application of spinal immobilization in trauma patients. A painful distracting injury (DI), such as a suspected hip fracture, historically has been a sufficient condition for immobilization, even in an elderly patient who suffers a simple fall from standing and exhibits no other risk factors for spinal injury. Because the elderly are at increased risk of hip fracture from low-level falls, and are also particularly susceptible to the discomfort and morbidity associated with immobilization, the prevalence of cervical spine (c-spine) fracture in this patient population was examined.

Methods: Hospital billing records were used to identify all cases of traumatic femur fracture in Minnesota (USA) in 2010-2011. Concurrent diagnosis and external cause codes were used to estimate the prevalence of c-spine fracture by age and MOI.

Results: Among 1,394 patients with femur fracture, 23 (1.7%) had a c-spine fracture. When the MOI was a fall from standing or sitting height and the patient age was ≥ 65 , the prevalence dropped to 0.4% (2/565). The prevalence was similar when the definition of hip fracture additionally included pelvis fractures (0.5%; 11/2,441). Eight of the 11 patients with c-spine fracture had diagnosis codes indicative of criteria other than the DI that likely would have resulted in immobilization (eg, head injury and compromised mental status).

Conclusions: C-spine fracture is extremely rare in elderly patients who sustain hip fracture as a result of a low-level fall, and appears to be accompanied frequently by other known predictors of spinal injury besides DI. More research is needed to determine whether conservative use of spinal immobilization may be warranted in elderly patients with hip fracture after low-level falls when the only criteria for immobilization is the distracting hip injury.

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Introduction

Prehospital spinal immobilization has been used liberally in trauma patients for decades under the rationale that it mitigates exacerbation of occult or unstable spinal injuries. However, the procedure can cause significant discomfort and result in complications,¹ so there has been movement towards the development of more selective prehospital guidelines that will reduce unnecessary use of rigid immobilization while preserving optimal trauma care. Previous radiographically-based research designed to guide the appropriate use of spinal imaging in trauma patients in the emergency department has led to the discovery of five clinical findings that are most often associated with spinal injury in trauma patients: altered mental status, focal neurological deficit, acute intoxication, cervical or spinal pain/tenderness, and a painful distracting injury (DI).²⁻⁵ Under the assumption that these five criteria might similarly be applied in the prehospital setting, they have formed the basis for selective prehospital immobilization protocols that have been developed and tested with promising results.⁶⁻⁸

The concept of a DI being a sufficient condition for prehospital immobilization is based upon the supposition that trauma patients with significant pain elsewhere on the body cannot reliably report spinal pain or tenderness and thus cannot be clinically cleared of possible spinal injury. But exactly what constitutes a painful DI is largely left to clinician interpretation, and its status as a sufficient condition for immobilization has been challenged.⁹ Elderly patients with hip fracture after low-level falls are almost universally subjected to rigid prehospital immobilization because a hip fracture qualifies as a DI in the minds of most prehospital clinicians. Given that the elderly are particularly susceptible to the discomfort and morbidity associated with immobilization, and the high frequency with which they experience long-bone extremity fractures as a result of low-energy trauma, the prevalence of cervical spine (c-spine) fracture in this specific patient population in the state of Minnesota was explored.

Methods

A cross-sectional study was conducted using hospital billing data collected by the Minnesota Hospital Association. All billing records involving International Classification of Diseases (ICD), Tenth Revision¹⁰ codes for injury and other select conditions are regularly submitted to the Injury and Violence Prevention Unit at the Minnesota Department of Health, and these data were queried to identify patients with traumatic hip fracture in Minnesota in 2010–2011. Records were flagged if any of the first 25 ICD diagnosis codes for the hospitalization indicated a fracture of the femur (ie, any 820.xx or 821.xx), and these were considered definitive hip fracture events. However, because pelvis fracture may be indistinguishable from femur fracture in terms of initial clinical presentation, a broader definition of suspected hip fracture that included both femur fractures and pelvis fractures (ie, any 808.xx) also was examined. Multiple records reflecting the same patient event (eg, due to transfer between acute care facilities) were eliminated by retaining only the record representing the definitive (final) acute care hospitalization. If a patient had more than one distinct hip fracture event during the study timeframe, the events were considered individually. The final dataset obtained by the investigators was de-identified, and included only patient age, length of stay, up to 25 ICD diagnosis codes, up to three external cause codes, and discharge disposition. No information about prehospital care was available in the source data.

C-spine fracture was defined as any fracture of the C1 through C7 vertebrae, with or without mention of spinal cord injury. No attempt was made to obtain radiographic images and confirm c-spine, femur, or pelvis fractures. For purposes of this analysis, mechanism of injury (MOI) was dichotomized into low-level falls and other MOI. Low-level fall was defined as an accidental fall from slipping, tripping, or stumbling, an accidental fall from a chair, wheelchair, or commode, or other/unspecified fall due to slipping or tripping (ICD codes: E884.2, E884.3, E884.6, E885.9, E888.8, and E888.9). Elderly was defined as age ≥65 years. The prevalence of c-spine fracture overall and in age- and MOI-specific subgroups was computed using the Stata12 statistical software package (StataCorp. College Station, Texas USA).

Results

A total of 1,394 femur fractures were identified for the 2-year study period, with 565 cases (41%) occurring in elderly patients who sustained the fracture as a result of a low-level fall (Figure 1). Low-level falls accounted for 64% of femur fractures in elderly

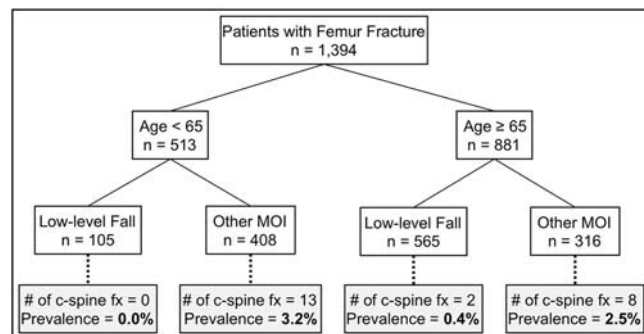


Figure 1. Prevalence of Cervical Spine Fracture (c-spine fx) in Patients With Traumatic Femur Fracture, By Age Group and Mechanism of Injury (MOI)

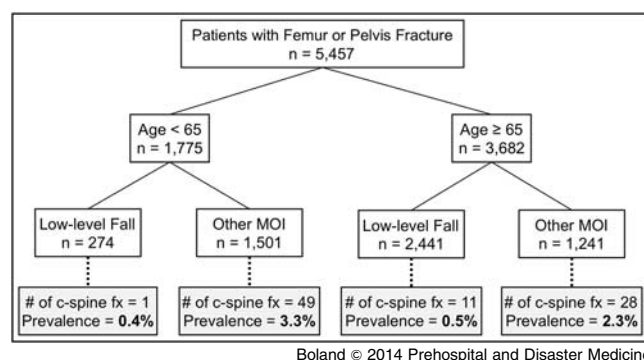


Figure 2. Prevalence of Cervical Spine Fracture (c-spine fx) in Patients With Traumatic Femur or Pelvis Fracture, by Age Group and Mechanism of Injury (MOI)

patients, but only 20% of femur fractures in patients less than 65 years of age. The overall prevalence of c-spine fracture among patients with traumatic femur fracture was 1.6% (23/1,394) and was crudely associated with MOI type. When femur fracture was caused by a MOI other than a low-level fall, the risk of having a concurrent diagnosis of c-spine fracture was 9.7 times higher than when the femur fracture was the result of a low-level fall (95% CI, 2.3–41.3, *P* < .0001). Among 565 elderly patients with femur fracture from a low-level fall, c-spine fracture was coded in only two patients, yielding a prevalence of 0.4% in this subgroup (Figure 1). When the definition of hip fracture was broadened to include pelvic fractures, estimates of c-spine prevalence by age and MOI were similar (Figure 2).

Among elderly patients with a documented femur or pelvis fracture after low-level fall (*n* = 2,441), c-spine fracture was coded in only 11 patients (0.5%; Figure 2). The ICD diagnosis codes of these 11 patients were reviewed to explore whether other factors known to be predictive of spinal injury in elderly trauma patients, such as head injuries, altered mental status, acute intoxication, cervical/spinal tenderness, and focal neurological deficits,^{3,11} may have been present and detectable to prehospital providers. However, while head injuries, altered mental status, and acute intoxication are likely to be noted by hospital providers and coded, the presence of cervical/spinal pain and focal neurological deficits in the prehospital setting are not likely to be detectable from hospital ICD codes. Eight of the 11 patients with c-spine fracture (72%) had concurrent diagnosis codes

Patient #	Age	Fractures	Findings associated with increased risk of spinal injury in blunt trauma patients ^a
1	89	Pelvis, C1	Cerebral laceration/contusion with LOC; Fracture of facial bones
2	73	Pelvis, C7	Concussion
3	69	Pelvis, C1	None
4	83	Pelvis, C2, C7	Open wound of head
5	95	Femur, C5	None
6	92	Pelvis, C5	Open wound of head
7	88	Pelvis, C2	Contusion of face/scalp; Contusion of eyelids
8	89	Pelvis, C2	None
9	85	Pelvis, C1	Dementia
10	78	Pelvis, C1	Acute intoxication
11	84	Femur, C2	Open wound of head

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Table 1. Pertinent Clinical Findings in Elderly Patients with Femur or Pelvis Fracture and Cervical Spine Fracture After a Low-Level Fall

Abbreviation: LOC, loss of consciousness.

^aICD codes found in the hospitalization billing record that reflect head injury or compromised mental status.

indicative of head injury, altered mentation, or acute intoxication (Table 1). Among the two patients with femur fracture who sustained c-spine fracture, one had suffered an open head wound.

Discussion

To improve efficiency and reduce unnecessary exposure to radiation, emergency physicians use validated clinical decision rules to selectively apply c-spine radiography in alert and stable blunt trauma patients.^{2,12} Given that these rules have proven safe and effective, and that emerging theories suggest post-injury motion may play less of a role in preventing catastrophic disability in patients with suspected spinal injury than previously believed,¹³ there is an opportunity to similarly refine the liberal prehospital spinal immobilization protocols still in use by most Emergency Medical Service agencies. Preliminary studies that extend the clinical decision rules used by emergency physicians to the prehospital setting have demonstrated that with more selective criteria in place, paramedics can safely withhold rigid spinal immobilization in 40%–60% of blunt trauma patients.^{7,8,14} To inform further refinement of prehospital immobilization criteria, the prevalence of c-spine fracture in a commonly-encountered population of trauma patients who have both a very low risk of c-spine fracture (ie, because of low-energy trauma), and a high likelihood of benefitting from the avoidance of unnecessary immobilization (ie, the elderly) was examined. The findings suggest radiographically detectable c-spine fractures are documented in only 0.5% of elderly patients who suffer a hip fracture as a result of a low-level fall.

Based on the DI principle, prehospital providers usually will institute spinal precautions in trauma patients with suspected hip fracture. But an oft-cited criticism is that the term “distracting injury” is too nonspecific, and the mere presence of a painful, non-cervical injury has come under some scrutiny as an independent predictor of c-spine fracture and a sufficient cause

for immobilization. One retrospective study in elderly blunt trauma patients found that only DIs at or above the clavicle were associated with increased risk of c-spine fracture,¹⁵ and in a separate study, lower-body DIs were actually observed to have a protective effect against c-spine injury in trauma patients.¹⁶ Recently, Rose et al⁹ challenged the DI criterion altogether, noting that among 464 awake and alert trauma patients with DI who initially were cleared of c-spine injury by clinical examination and underwent computerized tomography, only one (0.2%) was diagnosed with a c-spine injury. Both Ong¹⁵ and Rose⁹ argue that the relevance of a DI is debatable if the neurological status of the patient is sound. In an evaluation of a selective prehospital spinal immobilization protocol that did not incorporate DI, investigators concluded that adding the DI criterion to the protocol would not have improved sensitivity.⁶ Nearly three-quarters of the patients with detected c-spine fracture in the current report had evidence of head trauma, altered mental status, or acute intoxication, and while head injury is not included among the established criteria for clinical clearance of the c-spine in trauma patients, an independent positive association between superficial head trauma and c-spine fractures has previously been described in elderly blunt trauma patients.¹¹ The implications of these findings in terms of the population studied here is that prehospital spinal immobilization might be used more conservatively in elderly hip fracture patients when the mechanism is a low-level fall and the only conventional criteria met for immobilization is the distracting hip injury.

The significance of patient age is what differentiates the two widely-used clinical decision rules for c-spine radiography,^{2,12} ie, the Canadian C-Spine Rule mandates c-spine imaging in all blunt trauma patients over 65, while the NEXUS rule does not. So if and how elderly patients might be targeted for selective prehospital immobilization requires careful consideration. On one hand, the elderly are more prone to the discomfort and

complications associated with spinal immobilization, such as pressure sores and airway impairment,¹ and there are age-related circumstances (eg, marked kyphosis) that can make the procedure particularly difficult. On the other hand, elderly patients also have a higher risk of fracture from low-energy trauma than younger patients,¹¹ and the risk of radiographically occult fractures in this population is higher due to chronic bony irregularities. So although the prevalence of c-spine fracture may be extremely low in elderly patients with hip fracture after low-level fall, the risk-benefit balance of withholding spinal precautions in those of advanced age requires further study.

Limitations

There are limitations of this work that should be noted. This was a cross-sectional analysis of only two years of data, and hip fractures were identified retrospectively from billing records and not from a prospective surveillance tool. No medical record review was conducted to confirm diagnostic codes of any of the fracture types examined, and there was no ability to distinguish the severity of the c-spine fractures that were detected (ie, stable versus unstable) since procedural codes that might have indicated operative stabilization were not available. Perhaps the most important limitation of this study was the absence of prehospital

care information. It is unknown which patients in the cohort may have received protective prehospital spinal immobilization, and there is no information about the clinical criteria other than DI that are commonly used in the prehospital decision to immobilize. The observation that eight of 11 patients with c-spine fracture probably met other criteria for immobilization was only meant to demonstrate symptoms that may have been detectable to prehospital providers, but doesn't infer they were recognized.

Conclusion

These data provide initial evidence that elderly patients who sustain a hip fracture during a low-level fall are at very low risk for c-spine injury, and that more often than not, the elderly patient who suffers a c-spine fracture in conjunction with this type of event presents with clinical findings beyond DI that would not satisfy the other conventional criteria for clinical spine clearance. As selective prehospital spinal immobilizations guidelines evolve, closer examination of this patient population seems warranted. Particularly insightful would be studies of elderly low-level fall trauma patients that allow for the evaluation of important prehospital care details such as the use of spinal immobilization, the presence of reported cervical pain, and findings from cognitive assessments performed by prehospital providers.

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