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Evaluation and Management of Spinal Column Fractures in Adults

Blaine A. Winters, DNP, ACNP-BC, and Craig Nuttall, MS, FNP-C

ABSTRACT

Nurse practitioners working in many settings are faced with the challenge of diagnosing and managing patients with potential or actual spinal column fractures. In this article we provide nurse practitioners with the knowledge necessary to evaluate for and diagnose spinal column fractures in adults. We also provide guidelines for the appropriate management of injuries and identify when referral is recommended.

Keywords: evaluation, injury, management, spinal, trauma, vertebral

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INTRODUCTION

Spinal column fractures (SCFs) range from minor injuries that cause pain but do not lead to permanent damage or disability to those that cause long-term disability and, in some cases, death. Nurse practitioners (NPs) working in many settings may be faced with the challenge of making the appropriate diagnosis of a SCF, determining the severity of the injury, and then providing appropriate treatment or referral. The purpose of this article is to provide NPs with the knowledge necessary to evaluate and diagnose fractures of the cervical, thoracic, and lumbar spine in adults; prescribe appropriate management; and determine when it is necessary to refer for emergency and or specialized treatment.

ANATOMY

Spinal Column

The spinal column consists of 33 vertebrae. It is divided into 5 functional areas, including the cervical (7 vertebrae), thoracic (12 vertebrae), and lumbar (5 vertebrae) spine. The vertebral column also includes 5 fused sacral and 4 fused coccygeal vertebrae.¹ The spinal column provides structure as well as protection for the spinal cord and accompanying spinal nerves. In this article we focus on the cervical, thoracic, and lumbar spines.

Cervical Vertebrae

The cervical spine consists of 7 vertebrae. The first cervical vertebra (C1) does not contain a vertebral

body or a spinous process. It is simply composed of a body ring at the base of the skull. It is connected by ligaments to the second cervical vertebrae (C2) via the odontoid process on C2.²

The third through seventh cervical vertebrae (C3–C7) each consist of the vertebral body, 2 transverse processes, a spinous process, 2 pedicles, 2 facets, and 2 lamina.² The spinal cord is housed within the vertebral arch and is protected by the vertebral body, pedicle, lamina, and spinous process.² Any fracture noted in the cervical spine requires immobilization and immediate referral to a spine specialist.

The individual cervical vertebrae are connected via anterior, middle, and posterior ligaments.² Damage to the ligaments may also place the spinal cord in danger of injury due to possible vertebral dislocation.

Thoracic and Lumbar Vertebrae

Both the thoracic and lumbar vertebrae are composed of a vertebral body, 2 pedicles, 2 transverse processes, 2 facets, 2 lamina, and a spinous process. The thoracic spine consists of 12 vertebrae. The first 9 are connected to the sternum and ribs. This provides increased stability in this section of the vertebral column.² Fractures within this area of the transverse process or spinous process are considered stable and do not require referral. All other fractures of the vertebral column require immobilization and immediate referral.² Fractures from T10 to L1 are particularly susceptible to injury due to spinal mobility in this area.

The lumbar spine consists of 5 vertebrae. This area is not as susceptible to injury due to the surrounding musculature and size of the vertebral bodies.² When a fracture does occur in the lumbar or sacral spine it is usually the result of high energy and can lead to vertebral instability.²

MECHANISMS AND CLASSIFICATIONS OF SPINAL COLUMN INJURIES

Demographics

It is estimated that approximately 8,000 spinal cord injuries occur each year in the United States.³ These are usually the result of an injury to the spinal column in the form of fractures or dislocations. Those most susceptible include men between the ages of 16 and 30 years. The most frequent causes include motor vehicle accidents (44%), acts of violence (24%), falls (22%), sports (8%), and other (2%). After the age of 45 years, the leading cause of injury becomes falls.³

Common forces leading to spinal column injuries include hyperextension, hyperflexion, axial compression, and flexion-rotation injuries.⁴ The classification and location of the fracture helps determine the severity of the injury and the likelihood of an associated spinal cord injury.⁴

Fractures Not Associated With Spinal Cord Injury

Vertebral fractures may be classified as a simple fracture, compressed or wedge fracture, comminuted or burst fracture, and dislocations.⁴ Simple fractures of the thoracic and lumbar spinal column, such as those affecting the transverse or spinous processes, do not place the spinal cord in danger of injury and many require only pain management. As noted previously, both spinous and transverse process fractures of the cervical spine place the patient at risk for spinal cord injury and require immediate referral.²

Fractures Associated With Spinal Cord Injury

Compression fractures, also called wedge fractures, occur when the vertebral body is compressed anteriorly. Comminuted or burst fractures occur when the vertebral body is shattered into several fragments. Dislocations occur when the vertebral body is forced out of alignment. These place the spinal cord at significant risk for injury.⁴

NEUROLOGIC EXAM

Before examination of the spinal column, a neurologic exam should be performed with the patient lying supine with the cervical spine immobilized. This exam should be used to determine the patient's mental status, motor function, sensation, and pain.⁵ Herein we present the basics of a neurologic exam for the evaluation of a possible SCF or spinal cord injury.⁵ For more information regarding completion of an in-depth neurologic exam, the reader is referred to the website of the American Spinal Injury Association.⁵

Mental Status

The exam begins by determining whether the patient is alert and oriented to person, place, time and able to follow commands.⁵ If the patient is unable to do so for any reason, including but not limited to head injury, alcohol or drug intoxication, or distracting injury, then physical exam alone should not be used to determine if injury has occurred. In situations of alcohol or drug intoxication, a secondary exam should be performed at a later time once the patient is able to participate in the exam process.

Motor Function

The NP should now determine the patient's muscle strength and ability to perform full range of motion of the extremities against resistance. For example, the NP could ask the patient to shrug their shoulders against resistance, check bilateral hand-grip strength, raise each leg off the bed, as well as plantarflex and dorsiflex their feet against resistance.⁵ Deficits should be recorded using the grading criteria in Table 1.⁵

Table 1. Scoring of Motor Function⁵

Score	Physical Exam Finding
0	Total paralysis
1	Palpable or visible contraction
2	Active movement, gravity eliminated
3	Active movement, against gravity
4	Active movement, against some resistance
5	Active movement, against full resistance

Sensation/Pain

To evaluate sensation ask the patient if they are experiencing any perceived numbness or weakness. If there are concerns, then the affected area should be determined and noted (Table 2). The patient should be asked whether they are experiencing any vertebral column pain and make note of the anatomic area.⁵

Spinal Immobilization

If any problems are noted during the initial neurologic exam, the patient should remain in spinal immobilization and the spine service contacted immediately.⁶ When in a clinic or rural setting, the patient should be transferred emergently to a facility where neurosurgical or orthopedic spine services are available.

RADIOGRAPHY

Until recently, plain films of the spinal column were used as the initial tool for evaluation of suspected SCFs. This is no longer the case now that high-quality computed tomography (CT) scans of the spine are readily available. CT scans have been shown to be highly sensitive and specific for the detection of spinal column injuries.^{6,7} Plain films should only be used when no CT scan is readily available and there is low suspicion for significant spinal column injury.

Magnetic resonance imaging should be considered in any patient with injury noted on CT scan with findings suggestive of neurologic injury.⁶ The images may be used to further evaluate spinal cord injury, ligamentous injury, hematomas, disk involvement, and facet joint injuries.⁶ A neurosurgeon or orthopedic spine specialist should always be consulted in these situations.⁶

CERVICAL SPINE EVALUATION

Cervical spine fractures may lead to death or permanent disability. Spinal immobilization should be

performed in any person with a suspected SCF. Those at risk for significant cervical spine injury include victims of a motor vehicle collision, sports-related injuries, assault, or falls from height. Any patient with known or suspected traumatic head injuries should also be evaluated for cervical spinal column injury.⁸

The Canadian C-spine rule (CCSR) and the National Emergency X-Radiography Utilization Study both provide criteria for use when evaluating possible cervical spinal column injury. Of these 2 criteria, the CCSR has been shown to be more sensitive and specific in determining the need for radiographic studies for the evaluation of possible SCFs.⁸ Because of the CCSR's superiority, evaluation of the cervical spine in this report is based on CCSR criteria (Figure).

Risk Factors Mandating Radiography

Radiographic evaluation is recommended for those ≥ 65 years, those whose mechanism of injury is great enough to lead to spinal fractures, and those who report paresthesiae in their extremities.⁸ Mechanisms of injury that place a person at high risk for C-spine fractures include falls of > 3 feet, an axial load to the head such as in a high-speed motor vehicle crash with or without ejection, injuries sustained in recreational vehicle accidents, and bicycling or diving accidents.⁸

In older adults, falls are a leading cause of SCFs and should be taken seriously. As the cervical spine degenerates with age, it becomes stiffer, which places the older adult at a higher risk for fractures of the cervical spine.⁹ NPs should have a low threshold for ordering a CT scan in older adults.

If a patient has a Glasgow Coma Score of < 15 or is obtunded, a CT scan should be obtained.⁷ If no injury is noted on CT scan, the patient may be taken off cervical spine immobilization precautions.

PALPATION OF THE CERVICAL SPINE

Once the need for immediate radiography has been ruled out, the cervical spine should be palpated with the patient lying supine and the neck immobilized. If the patient exhibits any midline pain upon palpation, the neck should remain immobilized and a CT scan ordered.⁸ If no pain is noted upon palpation, then the NP can proceed to the next step.

Table 2. Scoring of Sensory Function⁵

Score	Criteria
0	Absent sensation
1	Altered sensation
2	Normal sensation

Figure. The Canadian C-spine rule.^{8,14}

Able to Rotate Neck Actively

The next step in evaluating for cervical column injury is to ask the patient to actively rotate their neck 45° from left to right. If able to do so and no pain is noted, there is a low likelihood that an injury is present. If pain is present, then a CT scan should be ordered.⁸

Normal Radiography and Tenderness

If the neurologic exam and CT scan are both normal yet the patient has cervical spine tenderness, the injury may be treated as a cervical strain. There is no clear evidence regarding the most effective treatment for a cervical strain.¹⁰ In a 2011 *Cochrane Review*, no clear evidence was presented that recommended either active or passive treatments for this injury. It was stated, however, that physical therapy was more effective for the treatment of an acute cervical strain than rest and a cervical collar.¹⁰

From personal experience we have noted that patients placed in a cervical collar for cervical strain reported increased discomfort relating to the collar and also exhibited cervical muscle weakness if the collar was worn continually for several weeks. We recommend the use of a cervical collar for comfort only, along with physical therapy referral as soon as

possible. Further studies regarding the treatment of cervical strain are necessary to determine the best treatment modalities.

Abnormal Radiography

If at any time there are signs or symptoms of neurologic injury or abnormal findings on CT scan, the patient should be placed in a rigid cervical collar. An emergent orthopedic or neurosurgical consult should be obtained.⁶ If the NP is practicing in a rural community where this is not possible, the patient should be transferred to a facility where these services are available, or obtain a telemedicine consult (see Figure).

THORACIC AND LUMBAR SPINE EVALUATION

The thoracic and lumbar spines are protected and held in place by the large muscles of the back. This makes them less likely than the cervical spine to be injured. The thoracic and lumbar spines should also be evaluated clinically and, if pain is present, then imaging should be ordered.

Neurologic and Physical Exam

As with the cervical spine, a neurologic examination should be done looking for pain, numbness, or

weakness. If any of these are present, a CT scan should be ordered.⁶

To examine the thoracic and lumbar spine, the patient should be log-rolled onto their side with the head and neck supported. With the patient lying on their side, both the thoracic and lumbar spine should be observed for step-offs or for swelling. If neither are present, the top of the thoracic spine to the bottom of the lumbar spine should be palpated, noting areas of midline pain, step-offs, or boggiess. If the exam is normal and the patient does not exhibit any neurologic findings, no further imaging is required. If the patient does have pain, step-offs, or boggiess, they should be rolled over onto their back and a CT scan ordered.

Normal Radiography and Tenderness

Tenderness in the face of a normal CT scan of the thoracic or lumbar spines is likely muscular in nature. No further evaluation is necessary and the patient may be treated conservatively with rest, nonsteroidal anti-inflammatory drugs, cold and heat, or physical therapy.

Abnormal Radiography

Depending on CT findings, the patient may be treated conservatively or may require orthopedic or neurosurgical evaluation. Spinous process or transverse process fractures of the thoracic or lumbar spines may be treated conservatively.^{11,12} Conservative treatment may include pain management, ice, physical therapy, corsets for comfort, and rest.¹³ One recent study showed that an in-situ block of steroids and pain medications were effective for the treatment of pain in patients with lumbar spine transverse process fractures. In-situ blocks have been effective for other injuries, but there are still few data on the treatment of spinal fractures.¹³

Spinous process or transverse process fractures may also be indications of other associated injuries of the chest, abdomen, pelvis, or vertebrae. Thus, patients presenting after a high-energy injury with known spinous process or transverse process fractures should be thoroughly evaluated for other more serious injuries.^{11,12} If other injuries are noted, appropriated consultation should be requested immediately. Any

fractures of the thoracic or lumbar spine other than those of the spinous or lumbar process will require immobilization and immediate consultation.

CONCLUSION

NPs in many settings may be faced with the challenge of diagnosing and treating SCFs. The basic skills presented herein gives NPs the knowledge necessary to evaluate and treat SCFs and to determine when referral is necessary. **JNP**

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