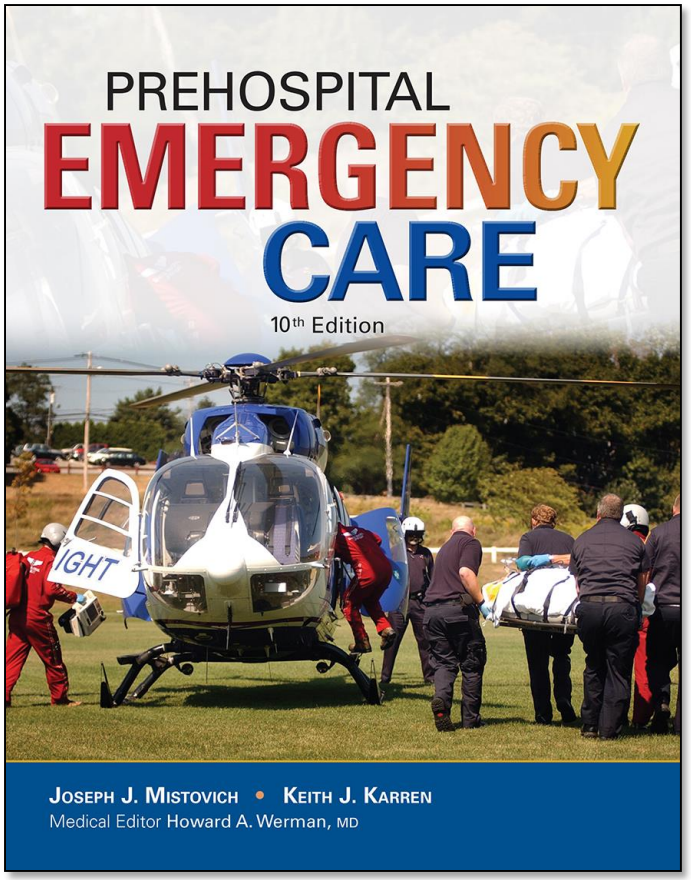
PREHOSPITAL EMERGENCY CARE

TENTH EDITION



CHAPTER 32

Spinal Column and Spinal Cord Trauma

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Learning Readiness

- EMS Education Standards, text p. 881

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Learning Readiness Objectives

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Learning Readiness Key Terms

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Setting the Stage

- Overview of Lesson Topics
  - Anatomy and Physiology of Spine Injury
  - Emergency Care for Suspected Spine Injury
  - Guidelines for Immobilization
  - Special Considerations

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Case Study Introduction

EMTs Sarah Smithson and Angela Ruiz arrive on the scene of a person who made a hard landing while skydiving. Sarah approaches the patient, instructing her not to move, and immediately provides in-line stabilization of the head and neck.

The patient, a 25-year-old female, landed on both feet and is complaining in pain in both ankles and her lower back.

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Case Study

- How could this mechanism of injury lead to injury of the spine?
- What signs and symptoms of spinal injury should the EMTs assess for?

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Introduction

- Vehicle collisions, falls, and recreational activities pose a risk of spine injury.
- Spine injuries include injuries to the spinal column and injuries to the nervous system.
- Patients with spinal injury must be handled in such a way as to avoid movement of the spine.

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Anatomy and Physiology of Spine Injury

- The nervous system
  - Two major functions
    - Communication
    - Control
  - Enables awareness of and reaction to the environment
  - Coordinates body responses to changes in the environment

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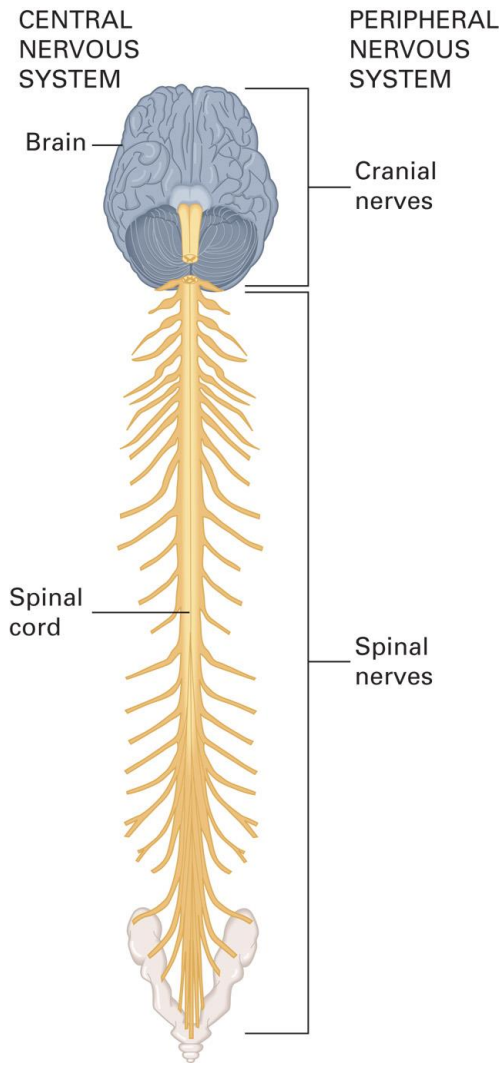
Components of the central and peripheral nervous systems.



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Anatomy and Physiology of Spine Injury

- Functional divisions of the nervous system
  - Voluntary
  - Autonomic
    - Sympathetic
    - Parasympathetic

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Anatomy and Physiology of Spine Injury

- Skeletal system protection of the CNS
  - Skull
  - Spinal column
    - 33 vertebrae
    - Vertebrae bound together by ligaments
    - Vertebrae are separated by disks.

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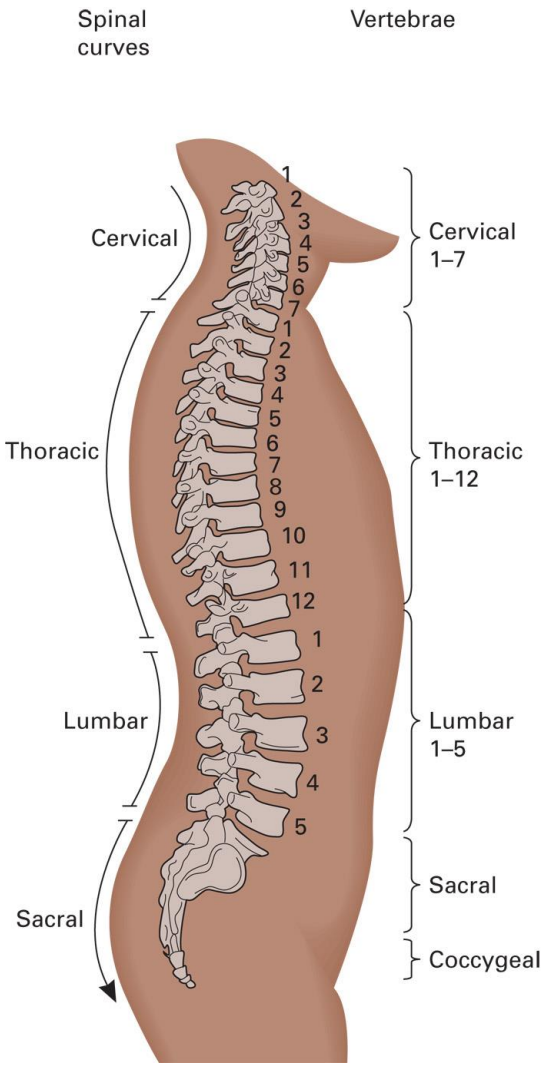
The spinal (vertebral) column.



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Anatomy and Physiology of Spine Injury

- A series of openings in the vertebrae create the spinal canal.
- The spinal cord passes through the spinal canal.
- The spinal cord consists of nerve tracts; all nerves to the trunk and extremities originate in the spinal cord.

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Anatomy and Physiology of Spine Injury

- Spinal cord tracts
  - Motor tracts carry impulses to the same side of the body.
  - Pain tracts carry impulses from the opposite side of the body.
  - Light touch tracts carry impulses from the same side of the body.

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Anatomy and Physiology of Spine Injury

- Causes of spine injury
  - Vehicle collisions – 48%
  - Falls – 21%
  - Gunshot wounds
  - Recreational activities

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Anatomy and Physiology of Spine Injury

- Only 14% to 15% of patients with spinal column injury present with neurological deficit.
- Improper handling of a patient with a spinal column injury may result in neurological injury.
- A patient may have spinal cord injury without spinal column injury.

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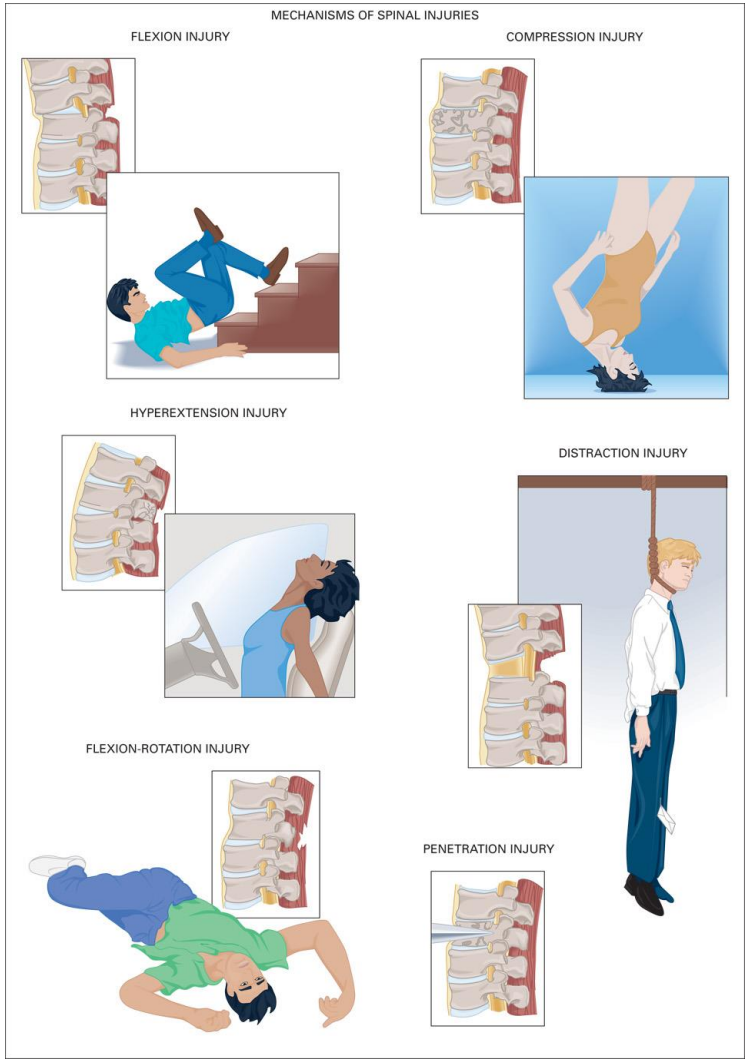
Mechanisms of spine injury.



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Anatomy and Physiology of Spine Injury

- Spinal column injury: injury to the vertebrae
  - Fractures and dislocations
  - Results in pain or tenderness
- Spinal cord injury
  - Disruption in movement or sensation

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Anatomy and Physiology of Spine Injury

- Complete spinal cord injury
  - Transection of the cord; loss of motor, sensory, and autonomic function below the site of injury
  - Spinal shock also can result in initial presentation with complete loss of function.

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Anatomy and Physiology of Spine Injury

- Neurogenic hypotension
  - Loss of sympathetic control of arterioles results in vasodilation.
  - Loss of sympathetic communication with the adrenal glands prevents release of epinephrine and norepinephrine.
  - The skin is warm and dry, and the pulse rate is normal.

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Anatomy and Physiology of Spine Injury

- Incomplete spinal cord injury
  - Injury does not involve all three tracts.
  - Some, but not all, signs of spinal injury are present.
  - The pattern of lost functions is reflected in different syndromes.

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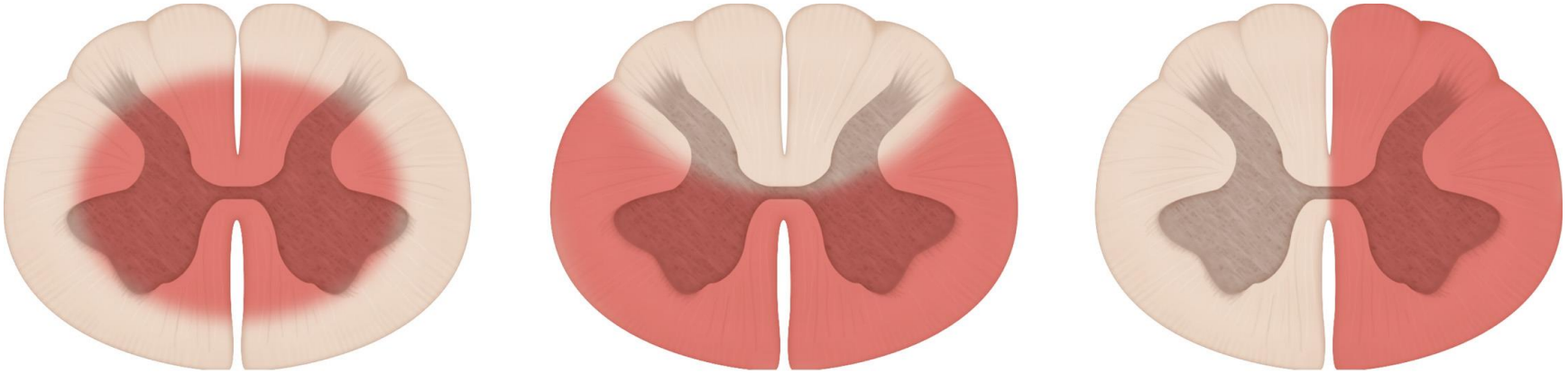
Cross sections of the spinal cord showing the H-shaped gray matter surrounded by white matter. Illustrated here are the three most common types of incomplete spinal cord injury. (The areas of injury are highlighted in red.) Each results in a distinctive syndrome, or pattern of sensory and motor deficits. (a) Central cord syndrome results from injury to the central cord. (b) Anterior cord syndrome results from injury to the anterior cord. (c) Brown-Séquard syndrome results from injury to the right or left half of the cord.



(a) Central cord syndrome

(b) Anterior cord syndrome

(c) Brown-Séquard syndrome

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Anatomy and Physiology of Spine Injury

- Central cord syndrome
  - The medial portion of the motor and pain tracts control the upper extremities.
  - The lateral portions of the tracts control the lower extremities.
  - In central cord syndrome, the medial portion of the spinal cord is injured.

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Anatomy and Physiology of Spine Injury

- Central cord syndrome
  - Patients present with weakness or paralysis and loss of pain sensation in the upper extremities.
  - Function of lower extremities remains intact.

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Anatomy and Physiology of Spine Injury

- Anterior cord syndrome
  - Loss of function in motor and pain tracts, but not in light touch tracts.
  - The patient experiences paralysis and inability to feel pain below the level of injury, but can detect light touch.

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Anatomy and Physiology of Spine Injury

- Brown-Séquard syndrome
  - The injury affects only one side of the cord.
  - Loss of motor and light touch sensation on the affected side
  - Loss of pain sensation on the side opposite the injury

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Click on the findings that would be most consistent with central cord syndrome.

A. Loss of movement and light touch sensation below the site of injury on one side, and loss of pain sensation on the opposite side

B. Loss of all motor and sensory function on both sides below the site of injury

C. Weakness and loss of pain sensation of the upper extremities, with no weakness of the lower extremities

D. Loss of motor function and sensation of pain on both sides below the site of injury, but retention of light touch sensation

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Emergency Care for Suspected Spine Injury

- Scene size up: mechanisms of injury
  - Motorcycle crashes
  - Motor vehicle crashes
  - Pedestrian-vehicle collisions
  - Falls

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Emergency Care for Suspected Spine Injury

- Scene size up: mechanisms of injury
  - Blunt trauma
  - Penetrating trauma to the head, neck, torso
  - Sporting injuries
  - Hangings

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Emergency Care for Suspected Spine Injury

- Scene size up: mechanisms of injury
  - Diving, water-related injuries
  - Gunshot wounds to the head, neck, chest, abdomen, pelvis
  - Unresponsive trauma patient
  - Electrical injuries

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Front-end damage and a driver's side windshield fracture indicate that the driver was probably thrown head first into the windshield.

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Emergency Care for Suspected Spine Injury

- With mechanism of injury consistent with potential for spine injury:
  - Immediately provide in-line manual stabilization of the spine.
  - Use a jaw-thrust maneuver to open the airway.

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Emergency Care for Suspected Spine Injury

- Primary assessment
  - Perform manual stabilization of the spine based on mechanism of injury.
  - Maintain manual stabilization until a thorough assessment, based on your protocols, does not reveal indications for immobilization, OR complete spinal immobilization has been accomplished.

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Emergency Care for Suspected Spine Injury

- Primary assessment
  - Immobilize patients with positive mechanism of injury who:
    - Have an altered mental status
    - Have painful distracting injuries
    - Cannot effectively communicate with you

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Emergency Care for Suspected Spine Injury

- Primary assessment
  - Open the airway, if needed, with a jaw-thrust maneuver.
  - Cervical cord injury can impair ventilation.
  - Skin condition can appear normal, despite hypotension.

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Emergency Care for Suspected Spine Injury

- Primary assessment
  - High-priority patients
    - Unresponsive
    - Responsive but unable to obey commands
    - Abnormal respiratory pattern
    - Obvious signs of spine injury

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Emergency Care for Suspected Spine Injury

- Secondary assessment
  - Maintain in-line spinal stabilization.
  - Conduct a physical exam.
  - After assessing the neck, apply a cervical collar.
  - Assess pulses and motor and sensory function.

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Assess flexion.

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Assess extension.

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Assess finger abduction.

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Assess finger adduction.

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Assess the wrist and hand.

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Assess plantar flexion.

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Assess dorsiflexion.

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Assess pain response in the hand.

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Assess pain response in the foot.

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Assess light touch response in the hand.

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Assess light touch response in the foot.

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Assess flexion of the great toe on the same foot.

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Emergency Care for Suspected Spine Injury

- Secondary assessment
  - Baseline vital signs
  - History

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Emergency Care for Suspected Spine Injury

- Ask the following:
  - Does your neck or back hurt?
  - Where does it hurt?
  - Can you move your hands and feet?
  - Do you have any pain or muscle spasms along your back or to the back of your neck?

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Emergency Care for Suspected Spine Injury

- Ask the following:
  - Do you have any numbness or tingling sensations in either of your arms or legs?
  - Was the onset of pain associated with a fall or other injury?

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Emergency Care for Suspected Spine Injury

- Ask the following:
  - Did you move or did someone move you before our arrival?
  - Were you up walking around before our arrival?

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Emergency Care for Suspected Spine Injury

- Signs and symptoms
  - Tenderness along the spine
  - Pain associated with movement
  - Pain independent of palpation or movement
  - Deformity of the spine on palpation
  - Soft tissue injuries

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Emergency Care for Suspected Spine Injury

- Signs and symptoms
  - Numbness, tingling, weakness; loss of sensation or motor function
  - Loss of bladder or bowel control
  - Priapism
  - Impaired breathing

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Emergency Care for Suspected Spine Injury

- Assessment findings that are indications for spinal immobilization
  - GCS <15
  - Suspected traumatic brain injury
  - Altered mental status
  - Signs of acute stress reaction
  - Pain or tenderness of spinal column

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Emergency Care for Suspected Spine Injury

- Assessment findings that are indications for spinal immobilization
  - Paralysis, weakness, numbness, tingling, or prickling sensation
  - Priapism
  - Deformity of the vertebral column

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Emergency Care for Suspected Spine Injury

- Assessment findings that are indications for spinal immobilization
  - Significant MOI and any of these findings:
    - Under the influence of drugs or alcohol
    - Cannot communicate effectively
    - Has a painful, distracting injury

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Emergency Care for Suspected Spine Injury

- Complications of spine injury
  - Inadequate breathing effort
    - Paralysis of the respiratory muscles can lead to respiratory failure.
    - Respirations may be shallow with little movement or the chest or abdomen.
    - Provide positive pressure ventilation.

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Emergency Care for Suspected Spine Injury

- Complications of spine injury
  - Paralysis
    - Paraplegia
    - Quadriplegia (tetraplegia)
    - Hemiplegia

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Emergency Care for Suspected Spine Injury

- Complications of spine injury
  - Inadequate circulation
    - Vasodilation leads to hypotension and poor tissue perfusion.
    - The skin may be warm and dry, and the heart rate is normal to slightly decreased.
    - Always look for other reasons for hypotension.

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Emergency Care for Suspected Spine Injury

- Emergency medical care
  - Use Standard Precautions.
  - Establish in-line spinal stabilization.

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Keep the head in a neutral position and the nose in line with the patient's navel.

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Emergency Care for Suspected Spine Injury

- Emergency medical care
  - Airway and breathing
    - Use a jaw-thrust maneuver, if necessary.
    - Provide positive pressure ventilation for inadequate breathing; maintain an SpO_2 greater than or equal to 94%.

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Emergency Care for Suspected Spine Injury

- Emergency medical care
  - Assess the pulse, motor function, and sensation in all extremities.
  - Assess the neck before applying a cervical collar.
  - Apply a cervical collar.

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Emergency Care for Suspected Spine Injury

- Emergency medical care
  - Immobilize the patient on a long backboard.
  - After immobilization, reassess pulse, motor, and sensory function.
  - Transport.

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Emergency Care for Suspected Spine Injury

- Reassess
  - Airway and breathing
  - Vital signs
  - Complaints
  - Interventions

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Case Study

The patient is alert and oriented, with a patent airway and adequate breathing. She has a strong radial pulse of 88 per minute.

She has movement and sensation to pain and light touch in her upper extremities. She has sensation to pain and light touch in her lower extremities, but bilateral ankle injuries make assessment of motor function difficult.

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Case Study

- What equipment will Sarah and Angela need to properly immobilize the patient?
- Describe the procedures Sarah and Angela should use to immobilize the patient.

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Guidelines for Immobilization

- Sizing a cervical immobilization collar

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To size a cervical spine immobilization collar, first draw an imaginary line across the top of the shoulders and the bottom of the chin. Use your fingers to measure the distance from the shoulder to the chin.

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Check the collar you select. The distance between the sizing post (black fastener) and lower edge of the rigid plastic should match that of the number of stacked fingers previously measured against the patient's neck.

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Assemble and preform the collar.

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Guidelines for Immobilization

- Applying a cervical collar to a seated patient

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After selecting the proper size, slide the cervical spine immobilization collar up the chest wall. The chin must cover the central fastener in the chin piece.

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Bring the collar around the neck and secure the Velcro. Recheck the position of the patient's head and collar for proper alignment. Make sure the patient's chin covers the central fastener of the chin piece.

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If the chin is not covering the fastener of the chin piece, readjust the collar by tightening the Velcro until a proper sizing is obtained. If further tightening will cause hyperextension of the patient's head, then select the next smaller size.

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Guidelines for Immobilization

- Applying a cervical collar to a supine patient

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Slide the back portion of the cervical spine immobilization collar behind the patient's neck. Fold the loop Velcro inward on the foam padding.

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Position the collar so that the chin fits properly. Secure the collar by attaching the Velcro.

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Hold the collar in place by grasping the trachea hole. Attach the loop Velcro so it mates with (and is parallel to) the hook Velcro.

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Guidelines for Immobilization

- Placing a supine patient on a long backboard

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Maintain in-line spinal stabilization while preparing for the log roll.

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Roll the patient onto the side at command of the EMT maintaining stabilization. Inspect the back.

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Move the spine board into place.

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Lower the patient onto the spine board at command of the EMT maintaining in-line stabilization. Center the patient on the board.

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Guidelines for Immobilization

- Immobilization to a long backboard

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Apply straps to secure the patient to the backboard. Place one strap at the level of the chest, one at the hip, one above the knee, and another below the knee. Pad between the legs.

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A "spider" strap method with Velcro straps.

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Guidelines for Immobilization

- Short spinal immobilization devices

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The Ferno Kendrick Extrication Device (K.E.D.).

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After a cervical spine immobilization collar has been applied, slip the K.E.D. behind the patient and center it.

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Properly align the device. Then wrap the vest around the patient's torso.

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When the device is tucked well up into the armpits, secure the chest straps.

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Secure the leg straps.

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Secure the patient's head with the Velcro head straps.

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Tie the hands together.

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Pivot the patient onto the backboard while maintaining in-line stabilization.

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Guidelines for Immobilization

- Rapid extrication

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Bring the patient's head into a neutral in-line position. This is best achieved from behind or to the side of the patient. Perform a primary assessment and a rapid physical exam. Then apply a cervical spine immobilization collar.

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Support the patient's thorax. Rotate the patient until her back is facing the open car door. Bring the patient's legs and feet up onto the car seat.

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Bring the board in line with the patient and against the buttocks. Stabilize the cot under the board. Begin to lower the patient onto the board.

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Lower the patient onto the board. Depending on the structure of the car, it may be necessary to change positions to maintain in-line stabilization while lowering the patient onto the board.

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If the structural features of the vehicle, time, resources, and the patient's condition permit, it may be worthwhile to remove the roof before performing a rapid extrication.

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Depending on variables such as the vehicle's structure and the patient's condition, a rapid extrication may be performed more easily and safely if the roof has been removed.

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Guidelines for Immobilization

- Helmet removal

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One rescuer applies stabilization by placing hands on each side of the helmet with fingers on the patient's mandible to prevent movement.

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A second rescuer places one hand on the mandible at the angle of the jaw.

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With the other hand, the second rescuer holds the occipital region. This maneuver transfers the stabilization responsibility to the second rescuer.

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The rescuer at the top begins to remove the helmet, pulling the sides apart to clear the ears and allowing the second rescuer to readjust his hand position around the mandible and under the occipital region.

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Throughout the removal process, the second rescuer maintains in-line stabilization from below to prevent head tilt.

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After the helmet has been removed, the rescuer at the top replaces his hands on either side of the patient's head with palms over the ears, taking over stabilization.

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Guidelines for Immobilization

- Child immobilization

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EMT #1 stabilizes the car seat in an upright position and applies manual stabilization to the child's head and neck. EMT #2 prepares equipment, then loosens or cuts the seat straps and raises the front guard.

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A cervical collar is applied to the child as EMT #1 maintains manual stabilization of the head and neck.

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As EMT #1 maintains manual stabilization, EMT #2 places the child safety seat on the center of a backboard and slowly tilts it into supine position. The EMTs are careful not to let the child slide out of the safety seat. For a child with a large head, place a towel under the area where the shoulders will eventually be placed on the board to prevent the child's head from tilting forward.

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EMT #1 maintains manual stabilization and calls for a coordinated long axis move onto the backboard.

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EMT #1 maintains manual stabilization as the move onto the board is completed with the child's shoulders over the folded towel.

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EMT #1 maintains manual stabilization as EMT #2 places rolled towels or blankets on both sides of the child.

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EMT #1 maintains manual stabilization as EMT #2 straps or tapes the child to the board at the level of the upper chest, pelvis, and lower legs. DO NOT STRAP ACROSS THE ABDOMEN.

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EMT #1 maintains manual stabilization as EMT #2 places rolled towels on both sides of the head, then tapes the head securely in place across the forehead and cervical collar. DO NOT TAPE ACROSS THE CHIN TO AVOID PRESSURE ON THE NECK.

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Case Study Conclusion

Angela applies a cervical collar after assessing the neck, as Sarah continues manual stabilization of the spine.

Since the patient is stable, the EMTs quickly immobilize both ankles, to prevent further pain and damage upon moving her.

Sarah and Angela completely immobilize the patient to a long backboard and begin transport.

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Case Study Conclusion

At the hospital, the patient is found to have compression fractures of L3 and L4. She requires surgery for both the ankle fractures and spinal injury.

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Lesson Summary

- Spine injuries can lead to permanent disability.
- Proper management to avoid movement of the spine is imperative.
- Spinal cord injuries can be partial or complete.

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Lesson Summary

- Spinal cord injuries can cause loss of motor and sensory function.
- Complications of spinal cord injury include respiratory failure and neurogenic shock.

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