

T5

CENTRAL NERVOUS SYSTEM INJURIES

Injuries to the central nervous system (CNS) require extremely careful treatment and management. Inadvertent movements of the patient could result in a lifetime of disability. EMS personnel must ensure they are current and competent in all aspects of immobilization.

GENERAL

- scene assessment for mechanism of injury, including
 - cause of accident
 - height of fall, if any
 - objects struck, if any
 - vehicle damage, both external and internal
 - speed involved
 - direction of impact(s)
 - rollover, if any
 - were other patients severely injured or killed in the same incident
 - weapons involved, if any
 - any other relevant information
- personal protective equipment should be utilized as appropriate
- if a CNS injury is suspected based on the mechanism of injury (e.g. blunt trauma, fall from a height), the patient should be immobilized even if they have no signs and symptoms of CNS injuries
- C-spine precautions are not indicated in penetrating head injuries (including gunshot wounds)
- body substance isolation techniques and equipment should be utilized as appropriate
- establish cervical spine control for head, neck, and spine
 - if the patient is conscious advise the patient to remain still
 - apply manual in-line stabilization of the head and neck, supporting the weight of the head
 - maintain the patient's head in a neutral position and maintain this position until the head and torso are immobilized
- do not attempt to move the patient's head to a neutral in-line position if
 - patient complains of increased pain when movement of the head is started
 - there is muscle spasm or resistance to the movement is felt
 - patient holds their head in an angulated (tilted) position and states they cannot move their head
 - head is rigidly held to one side
 - manoeuver cannot be safely achieved due to space or other scene conditions
 - if any or all of the above conditions exist, then the patient's head and neck should be immobilized in the position found

- primary survey
 - items in primary survey specific to CNS injuries
 - do not hyperextend or flex the neck
 - assess and manage ABCs
 - use jaw thrust without head tilt for opening the airway
 - maintenance of an open airway and ensuring adequate respirations has priority over all other treatments, including control of the cervical spine
 - ensure the adequacy of oxygenation and ventilation
 - provide high concentration oxygen
 - insert oropharyngeal or nasopharyngeal airway to maintain the airway if the patient is unconscious and there is no contraindications
 - assist ventilations if required
 - maintain cervical spine control during primary survey and treatment of life threatening injuries
 - control external bleeding to the head with sterile pressure dressings
 - never apply direct pressure to the skull if there is evidence of bone fragments or obvious fracture or deformity
 - use bulky dressings and apply pressure around the injured area
- consider load and go criteria

Consider Load and Go with Rapid Extrication for any Patient with

- head injury with unilaterally dilated pupil
 - difference in pupil diameters of more than 1 mm is abnormalor
- head injury with decreased or rapidly deteriorating level of consciousness
- load and go should be initiated immediately for a patient with either of the above findings (see Load and Go Guideline)
 - perform a rapid extrication if required
 - maintain cervical spine control
 - maintain high concentration oxygen delivery to the patient
 - assist ventilations if required
 - immobilize the patient
- if the patient does not meet the criteria for immediate load and go, further assessments and stabilization can be performed on scene
- obtain a pertinent history
 - injuries identified by patient
 - time of injury
 - mechanism of injury
 - was the patient moved in any way
 - loss of or altered level of consciousness, if any
 - presence or suspicion of drugs or alcohol
 - past medical history
 - medications
 - allergies
 - last meal
 - note differences between the scene assessment, witness statements, and the patient's recollection

- secondary survey, if the patient's status and injuries permit (see table in G4 for additional details)
 - log rolling the patient with suspected central nervous system injury should only be done if sufficient trained personnel are available
 - patient should be talked to and informed of what actions are being taken
 - person controlling the patient's head and neck should coordinate all of the turning actions
 - patient's head and neck must be maintained in a neutral position throughout this procedure
 - patient should be rolled towards the personnel moving the patient's body
 - visual and manual scan of the back, buttocks, and posterior legs may be done at this time and any dressings applied, as required
 - patient should be log rolled back onto the immobilization device in a controlled and coordinated manner
 - final positioning of the patient on the immobilization device should be coordinated by the EMS personnel maintaining the patient's head and neck
 - reassess and document the patient's neurologic status after all movements are completed
- apply an appropriately sized cervical collar
 - this should be done prior to log rolling the patient if assessments of the neck have been completed and collar application does not cause cervical spine compromise
- treat for shock if indicated (see Shock Guideline)
- if vital signs are normal and stable, search for and treat other injuries
- monitor closely for vomiting, regurgitation, or seizures
- immobilize the patient's head, neck and spine to a long spine board, scoop stretcher, or appropriate immobilization device, to ensure sufficient security and integrity of the cervical spine is maintained
- employ measures to prevent aspiration
 - ensure the patient is immobilized securely to facilitate turning the patient on their side in the event that the patient vomits or regurgitates
 - turn the patient only if vomiting or other aspiration threats are present
 - once the threat has diminished, return the patient to the supine position and realign as required
 - monitor the patient for recurrence of the threat
- primary survey and vital signs assessment should be repeated at regular intervals (5-15 mins.) or when there is a change in the patient's status
- initiate transport
 - on scene times should be kept to a minimum
 - handle the patient gently and carefully
- transport the patient to the nearest appropriate health care facility
 - notify the receiving facility of the patient's status
 - monitor and treat the patient en route
 - report all findings to the receiving facility staff, and document on the patient care report

SPECIAL CONSIDERATIONS**Immobilization**

- immobilization should be considered for patients who may have suffered a central nervous system injury or may have a potential cervical spine injury
- **patient with normal mental status**
 - consider immobilization for patients
 - complaining of pain or tenderness in the spine in association with trauma
 - with multiple systems trauma
 - complaining of numbness or weakness in an extremity secondary to trauma
- **patient with altered mental status**
 - this includes patients whose mental status is altered by the influence of drugs, alcohol, or disease process
 - consider immobilization for patients
 - complaining of spinal pain or tenderness
 - found in the setting of trauma, including diving accidents
 - with signs of facial, head, or neck trauma (e.g. lacerations, contusions, epistaxis, etc.)
 - who exhibits signs of or complains of numbness in the extremities
 - who are unconscious and may have been a victim of an accident, violence, or a fall
 - who have an unknown mechanism of injury
- application of a cervical collar and immobilization requires a controlled team approach
 - one person must coordinate the activities of the team to prevent further injury to the patient during the procedures and to monitor the patient's overall condition at all times

Application of a Cervical Collar

- one EMS personnel maintains manual cervical spinal control during application
- assess the neck and upper chest prior to application
- dress all injuries
- note jugular venous distension and whether a tracheal stoma is present
- a second member of the EMS team measures the patient for the appropriate size cervical collar
 - cervical collar may be modified, if necessary, to accommodate a stoma or tracheostomy
- without moving the patient's head and neck the second team member
 - position (apply) cervical collar as per manufacturer's recommendation
 - as application progresses the fit of the cervical collar is assessed
 - if the collar does not fit properly, a different size cervical collar should be utilized
 - once the front and rear of the cervical collar are in place, the Velcro closure(s) are carefully attached
- maintain manual cervical spinal control until the head and torso are properly immobilized
- cervical collar should be checked and readjusted as required

Securing a Patient to a Long Spine Board (See Immobilization – General Appendix 3)

- one EMS personnel maintains manual cervical spinal control during application
- cervical collar should be applied prior to securing the patient
- position the long spine board next to the patient
 - if the patient is unclothed or insufficiently clothed (e.g. pajamas, nightgown), then the board should be padded with a double layer of blanket or other suitable material. A patient should never be transported on a board with bare skin against an unpadded board
- patient is log rolled to the side opposite the long spine board
- tilt long spine board and slide as far as possible under the patient and position so the patient will fit properly onto the board

- assess the board positioning prior to moving the patient onto the board
 - ensure the patient is not pinched by the board
- log roll the patient back onto the long spine board in a controlled and coordinated manner, without compromising the integrity of the spine
- adjust the patient's position on the long spine board as required, without compromising the integrity of the spine
- secure the patient to the long spine board in the following order
 - upper torso
 - lower torso
 - pelvis
 - head
 - legs (place pad between legs and tie together prior to securing to the long spine board)
 - arms
- secure and immobilize patient's head to long spine board using a blanket roll, padding or head blocks and straps
- secure patient's legs by placing padding between legs and tie them together prior to securing to the long spine board
- recheck all points of attachment, belts, cravats, or tape to ensure patient is held securely on long board
 - adjust as required
- padding of the natural hollows is appropriate to enhance patient comfort

Securing a Patient to a Scoop Stretcher (See Immobilization – General Appendix 3)

- one EMS personnel maintains manual cervical spine control during application
- cervical collar should be applied prior to securing the patient
- scoop stretcher should be measured and then split and positioned next to the patient, one piece on each side of the patient
- slide one half of scoop stretcher under one side of the patient and position it so patient will fit properly onto the scoop stretcher
- slide the other half of the scoop stretcher under the other side of the patient
 - position it so the patient will fit properly onto the device
- attach the two halves of the scoop stretcher together, preferably head end first
- assess the scoop stretcher positioning
 - ensure the patient is not pinched by the device
- adjust the patient's position, as required
- secure the patient to the scoop stretcher in the following order
 - upper torso
 - lower torso
 - pelvis
 - head
 - legs
 - arms
- secure and immobilize patient's head to scoop stretcher using a blanket roll or padding
- secure patient's legs by placing padding between legs and tie them together prior to securing to the scoop stretcher
- recheck all points of attachment, belts, cravats, or tape to ensure patient is held securely on scoop stretcher
 - adjust as required
- recheck scoop stretcher's foot and head connections
- if there are concerns that the scoop stretcher will flex or bend, it is recommended the scoop stretcher-secured patient be subsequently secured onto a long backboard prior to transport
- padding of the natural hollows is appropriate to enhance patient comfort

Securing a Patient to either a Short Spine Board or Kendrick Extrication Device (KED)

- one EMS personnel places patient's head in neutral in-line position and maintains manual cervical spinal control during application
 - cervical collar should be applied prior to securing the patient
 - device should be appropriately prepared prior to application
 - slide the device into proper position
 - pad hollow behind the patient's back and neck if necessary to maintain the head in a neutral in-line position
 - secure the device to the patient in the following order
 - abdominal straps, as required
 - pelvic and leg straps, as required
 - head, as required
 - chest strap, as required
 - check all straps and readjust, as required
 - once the patient has been secured to the short spine board or KED, carefully place the patient onto a long spine board
 - loosen the pelvic/leg straps
 - secure the patient to the long spine board
 - if the patient's respiratory effort is compromised due to the short spine board or KED straps, loosen the chest straps
 - ensure that cervical spine alignment is not lost
 - **Short Spine Board**
 - position the securing straps on the short spine board before placing the short spine board behind the patient
 - one EMS personnel maintains cervical spine control
 - apply cervical collar
 - a second EMS personnel positions the short spine board behind the patient so that the head and thorax securing portions are aligned appropriately
 - do not move the patient's head when securing it to the device
 - EMS personnel maintaining manual cervical spinal control must adjust their positioning to allow the device to be positioned properly without moving the patient's head or neck
 - secure the chest straps
 - secure the leg straps
 - use of the leg straps is contraindicated when a femur fracture is suspected
 - secure the patient's head to the device
 - place additional padding behind the patient's head and neck, if required
 - ensure the head securing material does not compromise the patient's airway and allows access to the airway for suctioning
 - check all straps and readjust, as required
 - in a controlled and coordinated manner the patient who has been secured on a short spine board must be moved onto a long spine board
 - carefully lower the patient onto the long spine board
 - loosen the pelvic and leg straps
 - position the patient's legs
 - position the patient on the long spine board and secure the patient to the board
- do not use the short spine board to lift the patient

- lift the patient not the short spine board

- **Kendrick Extrication Device (KED)**
 - one EMS personnel maintains cervical spine control
 - apply cervical collar
 - ensure the side flaps are positioned high in both axillae firmly against the upper margin (shrug position)
 - do not move the patient's head when securing it to the device
 - EMS personnel maintaining manual cervical spinal control must adjust their positioning to allow the device to be positioned properly without moving the patient's head or neck
 - secure the abdominal straps
 - secure the leg straps
 - use of the leg straps is contraindicated when a femur fracture is suspected
 - secure the patient's head to the device
 - pad hollow behind the patient's head and neck, if required
 - do not move the patient's head when securing it to the device
 - ensure that the head securing material does not compromise the patient's airway and allows access to the airway for suctioning
 - secure the chest strap
 - check all straps and readjust, as required
 - in a controlled and coordinated manner the patient who has been secured into the KED should be moved onto a long spine board
 - carefully lower the patient onto the long spine board
 - loosen the pelvic and leg straps
 - position the patient's legs
 - position the patient on the long spine board and secure the patient to the board
- the KED's side handles may be used to lift the patient
- care must be taken not to tip the patient over while using the KED lifting handles

Rapid Extrication

- rapid extrication should only be used in a situation where the patient's life is in immediate danger
- examples of situations that may require rapid extrication include
 - immediate danger in the environment (e.g. fire, gas, danger of explosion, structure collapse)
 - a life threatening condition identified in the Primary Survey that requires immediate intervention which cannot be done where the patient is positioned (e.g. an obstructed airway, uncontrolled bleeding)
 - patient that is so unstable that transport must be initiated immediately (e.g. multiple life-threatening injuries, vital signs are absent)

→ Rapid Extrication Requires

- an adequate number of personnel be available to stabilize the patient during any movement
- close coordination of the actions of all EMS personnel involved in extricating the patient

→ To Perform a Rapid Extrication

- one EMS personnel must take the lead role and coordinate the activities of all others involved
- one EMS personnel brings the patient's head into a neutral in-line position and maintains cervical spine control
- a rapid primary survey is conducted
- apply a cervical collar to the patient

- place a long board next to the patient position so the patient can be moved directly onto the long board
 - additional personnel should support the long board and be prepared to assist with positioning the patient on the long board
 - ensure the long board will not slip or move when the patient is being moved
- while supporting the patient's head, cervical spine and thorax, rotate the patient until the patient's back is towards the long board
 - another EMS personnel should free the patient's legs
- bring the long board in line with the patient and against the buttocks
- in a carefully controlled manner lower the patient onto the long board
 - EMS personnel controlling the patient's legs should lift them and move them so they remain in line with the patient's body as the patient is moved
- while maintaining in-line cervical spine control, slide the patient onto the long board
- the patient should be moved immediately to a safe location while manual immobilization is maintained
 - if the ambulance is only a short distance, the patient should be moved directly to the ambulance
 - if the patient must be moved more than a short distance, they should be strapped to the board using rapid immobilization techniques
- once the patient has been moved to a safe location and medical interventions have been initiated, the patient should be properly immobilized to the long board
- documentation should include
 - reason(s) for initiating a rapid extrication
 - patient assessment prior to and after rapid extrication
- load and go should be immediately initiated, unless interventions are required to manage immediate threats to life

→ **Helmet Removal**

- the decision whether or not to remove a patient's helmet should be dictated by the patient's medical needs

Remove the Helmet if the

- patient is in cardiac arrest
- helmet does not fit securely and allows excessive movement of the head and additional padding does not correct the problem
- helmet interferes with proper spinal immobilization
- helmet interferes with or does not permit assessment or reassessment of the patient's airway and breathing
- helmet interferes with or does not permit the management of the airway and ventilation

Leave the Helmet in Place if

- spine can be immobilized properly with the helmet in place
- helmet does not interfere with assessment or reassessment of the airway and breathing
- there are no impending airway or breathing problems
- helmet fits well and there is little or no movement of the head in the helmet
- removal of the helmet could cause further injury to the patient

- prior to removing the helmet, assess for
 - ABCs
 - vital signs
 - fit of the helmet
 - likelihood of movement of the head and neck
 - access to the airway
 - expertise on site to assist with helmet removal (physician, athletic therapist, etc.)
 - amount of lifting and handling that will be required to remove the patient from the scene
- if the patient is wearing shoulder pads
 - leave both the helmet and shoulder pads in place
or
 - remove the helmet pad underneath the head appropriately
- one EMS personnel applies stabilization with his/her hands on each side of the helmet and secures the patient's mandible with his/her fingers
- the person providing initial stabilization must control and direct the helmet removal
- a second member of the EMS team loosens or cuts the chin strap
- the second team member places one hand on the patient's mandible in a cupping manner and places his or her other hand on the patient's occipital supporting the back of the patient's head
- the first team member transfers control of the patient's head and neck to the second member
- the first team member removes the helmet by
 - carefully pulling out on the sides of the helmet
 - sliding the helmet off of the patient's head
 - full face style helmets may require the helmet to be tilted to pass the patient's nose
- in-line stabilization must be maintained by the second member while the helmet is removed
- the first team member should resume maintenance of the stabilization of the head and neck
- care must be taken to avoid a sudden drop of the patient's head once the helmet has been removed, additional padding under the patient's head may be required to ensure neutral alignment
- cervical collar application and immobilization should then be carried out

NOTE

- violent, obnoxious, unsteady, or unusually behaving patients may have a central nervous system injury
 - these findings should not be ascribed to alcohol or drug intoxication
- repeat and record vital signs, pupil reactions, and neurological assessments (including GCS) at regular intervals (5-15 mins.) or when there is a change in the patient's status
- a patient who has been immobilized and who is obviously pregnant or has a large abdomen should be positioned with the long spine board or scoop stretcher tilted towards the left side, if possible
 - care must be taken that the patient is secured in this position prior to and during transport
- immobilization should be done to minimize any impairment of respiratory effort
 - recall that patients who have been immobilized have a tendency to hypoventilate
 - the adequacy of respiratory effort must be assessed and reassessed during transport
 - immobilized patients should be encouraged to take regular, deep breaths

- sensory loss and paralysis from spinal injuries may mask intra-abdominal and lower extremity injuries
 - lack of abdominal or limb symptoms in patients with suspected or known spinal injuries does not rule out an abdominal or limb injury
 - a thorough patient assessment is essential in patients with spinal injuries
- staff in the receiving health care facility may not be familiar with the immobilization devices used to secure and transport the patient
 - EMS staff assistance may be required to remove the equipment
- dressings and bandages should be applied to all open head wounds
 - objects penetrating the scalp or skull should be stabilized, and not removed
 - dressings should be held in place just securely enough to touch the injury site, assisting in control of hemorrhage without displacing foreign object(s) or skull fragment(s)
- if the cervical collar or head restraints must be removed to treat life threatening airway or breathing problems, another member of the EMS team must maintain manual immobilization of the head and neck during treatment
 - cervical collar and head restraints should be reapplied after any intervention or treatment
- central nervous system injury should not be ascribed as the cause of low or decreasing blood pressure
 - other contributing factors for the abnormal or falling blood pressure (hypovolemia, hemorrhage, cardiac dysfunction, sepsis) should be considered and corrective interventions initiated
- routine hyperventilation of patients with central nervous system injuries is not indicated

Table 1. Specific Points to Note on a Secondary Survey for Patients with CNS Injuries

Secondary Survey Should Include

- complete head-to-toe survey with a minimum of patient movement

- **specific to the head**
 - skull and scalp
 - lacerations, fractures, depressions
 - bruising (including Battle's sign and/or Raccoon eyes) [late sign]
 - deformity of alignment of head and neck with respect to thorax
 - movement of the head
 - eyes
 - size and symmetry
 - reaction to light
 - whether there is a normal gaze
 - extraocular movements
 - presence of blurred or double vision→ note: the abbreviation "PERL" is meaningless unless pupil size, symmetry, and type of reaction to light are also documented
 - ears and nose
 - discharge of fluid or blood
 - loss of hearing
 - mouth
 - presence of blood, fluid, loose teeth or other foreign objects
 - unusual odors (acetone, alcohol, vomitus)
 - face
 - symmetry
 - use of facial muscles

- **specific to the neck**
 - pain
 - swelling
 - deformity
 - lacerations, bruising, and soft tissue injuries
 - distended neck veins

- **specific to the extremities**
 - paralysis or weakness
 - altered sensation
 - record the level of and locations on the patient's body that paralysis, weakness, loss of sensation, and loss of movement
 - ensure upper and lower extremities are assessed
 - compare right versus left for possible differences

- **specific to the neurologic system**
 - assess Glasgow Coma Score
 - check for priapism (in males) and incontinence
 - perform repeated assessments to document any change in level of function

Table 2. Signs and Symptoms of Nervous System Injuries

Signs and Symptoms of a Head or Neck Injury

- loss or altered level of consciousness
- disorientation to person, place, time
- personality change, restlessness, agitation, violence
- persistent nausea or vomiting
- bradycardia
- abnormal or altered respiratory rate and pattern
- rise in body temperature
- hypertension
- skull fracture or depression
- evidence of basilar skull fracture (battle's sign, raccoon eyes, blood or clear fluid discharge from the ear or nose)
- unequal, asymmetric, or unilaterally dilated pupil(s)
- asymmetry of the face or facial movements
- impaired ability to produce coherent speech
- impaired ability to understand spoken word
- abnormal or impaired hearing
- neck tenderness, spasm, or displacement
- altered sensation in area(s) of the body
- loss of motor function in area(s) of the body
- gait disturbances
- bowel or bladder incontinence

Signs and Symptoms of a Spinal Injury

- similar to those for a head or neck injury
- any of the signs and symptoms for a head and neck injury could be present with a spinal injury
 - weakness or paralysis below the level of the injury
 - altered sensation in area(s) of the body
 - loss of function in lower or upper extremities
 - incontinence of bowel or bladder
 - loss of response to painful stimuli
 - pain, bruising, or deformity in the injured area
 - tenderness surrounding injured area
 - pain on movement
 - evidence of impaired breathing (use of accessory muscles or diaphragm)
 - priapism (in males) and incontinence

NOTES :