



# Spinal Cord Trauma

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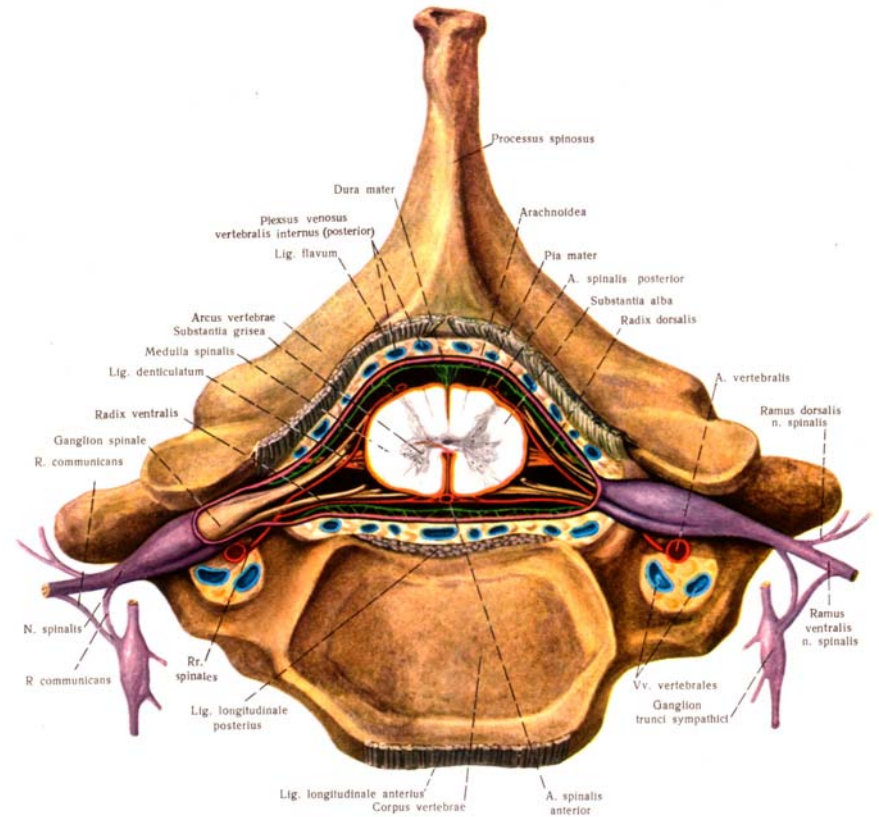
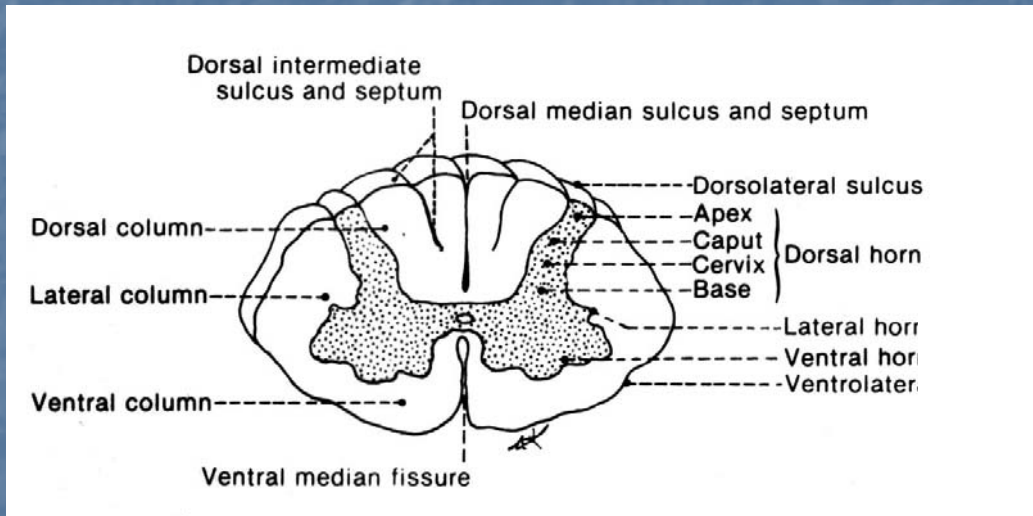
# Objectives

- To discuss basic mechanism, anatomy and physiology of spinal cord injury
- To review assessment and diagnostic steps
- To identify maneuvers to help improve outcomes
- To not fall asleep

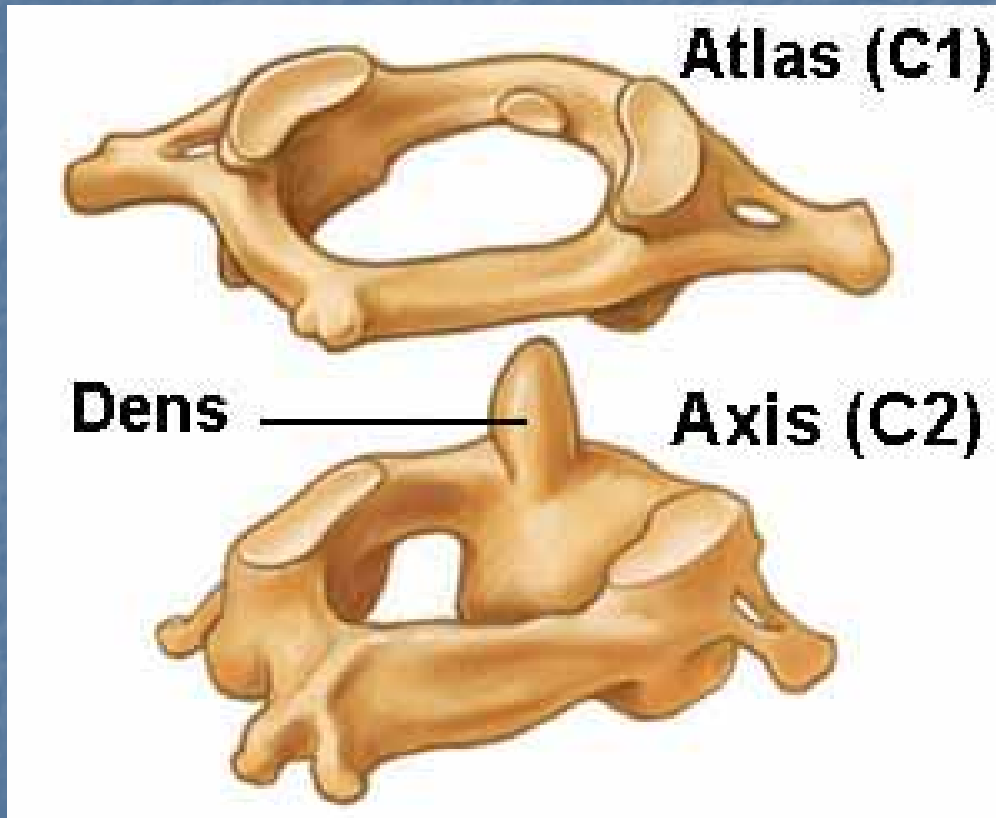


- 18 year old female dives into a shallow body of water
- Friends notice she hasn't surfaced after an appropriate interval
- Cousin swims to her and finds her unable to move, face down in shallow water

# Basic Anatomy



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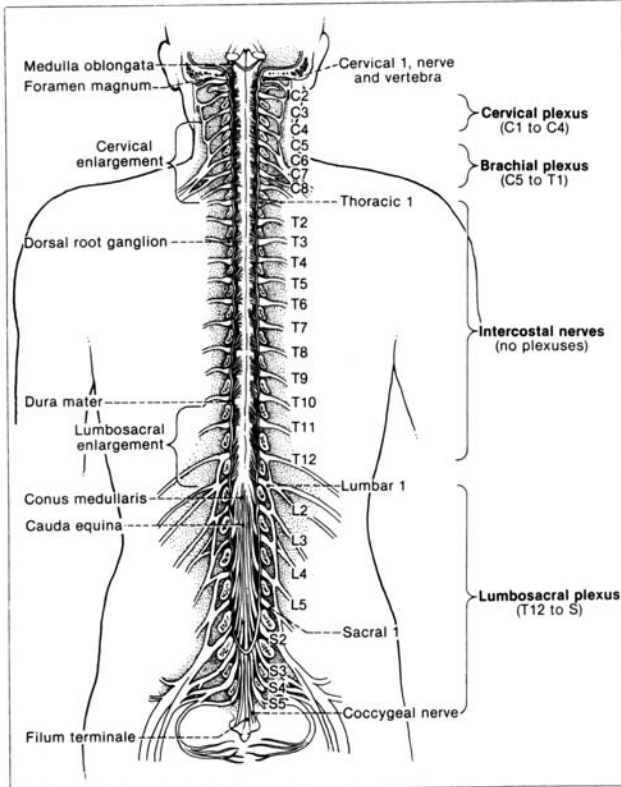


Figure 7-1. Dorsal view of the spinal cord and dorsal nerve roots in situ, after removal of the neural arches of the vertebrae.

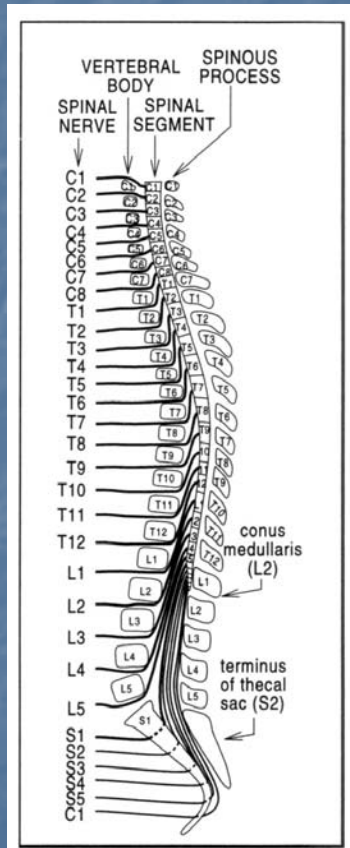
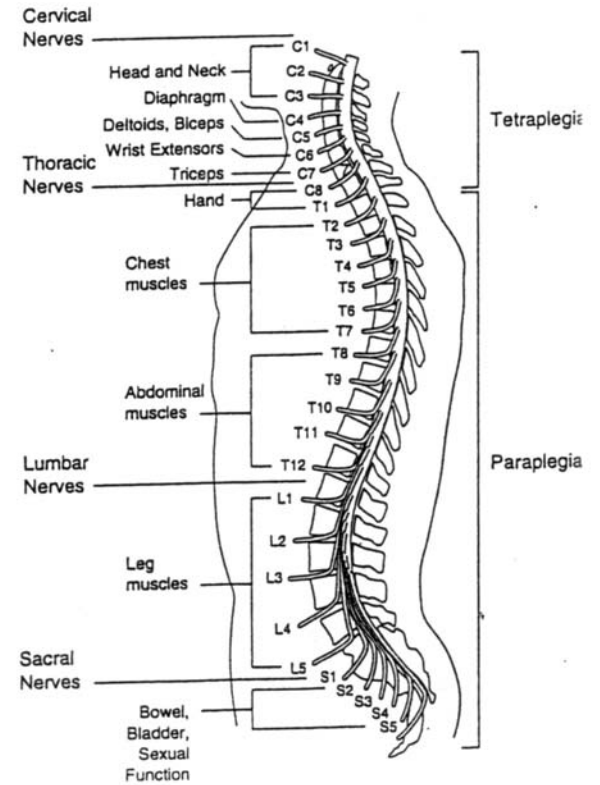
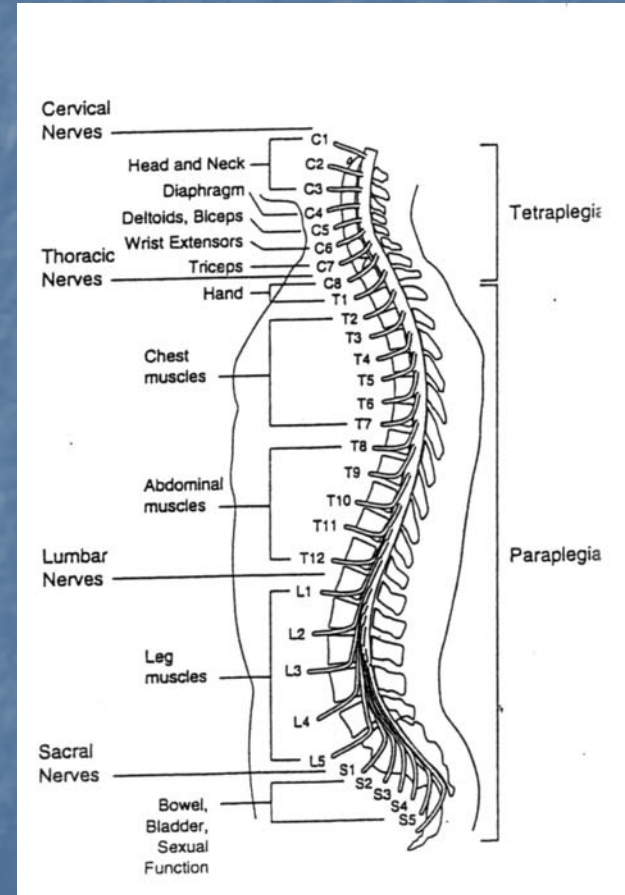


Figure 26-1 Relationship between spinal cord, nerve roots, and bony spine



# Terminology

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- Plegia = complete lesion
- Paresis = some muscle strength is preserved
- Tetraplegia (or quadriplegia)
  - Injury of the cervical spinal cord
  - Patient can usually still move his arms using the segments above the injury (e.g., in a C7 injury, the patient can still flex his forearms, using the C5 segment)
- Paraplegia
  - Injury of the thoracic or lumbo-sacral cord, or cauda equina
- Hemiplegia
  - Paralysis of one half of the body
  - Usually in brain injuries (e.g., stroke)

# Muscle or Sensory Loss?

**Table 26-7 ASIA motor scoring system  
(EXTREMITIES)**

RIGHT grade	Segment	Muscle	Action to test	LEFT grade
0-5	C5	deltoid or biceps	shoulder abduction or elbow flexion	0-5
0-5	C6	wrist extensors	cock up wrist	0-5
0-5	C7	triceps	elbow extension	0-5
0-5	C8	flexor digitorum prof	squeeze hand	0-5
0-5	T1	hand intrinsic	abduct little finger	0-5
0-5	L2	iliopsoas	flex hip	0-5
0-5	L3	quadriceps	straighten knee	0-5
0-5	L4	tibialis anterior	dorsiflex foot	0-5
0-5	L5	EHL	dorsiflex big toe	0-5
0-5	S1	gastrocnemius	plantarflex foot	0-5
50	← TOTAL POSSIBLE POINTS →			50

GRAND TOTAL: 100

Grade	Strength
0	no contraction
1	flicker or trace contraction
2	movement with gravity eliminated
3	movement against gravity
4	movement against resistance
5	normal strength

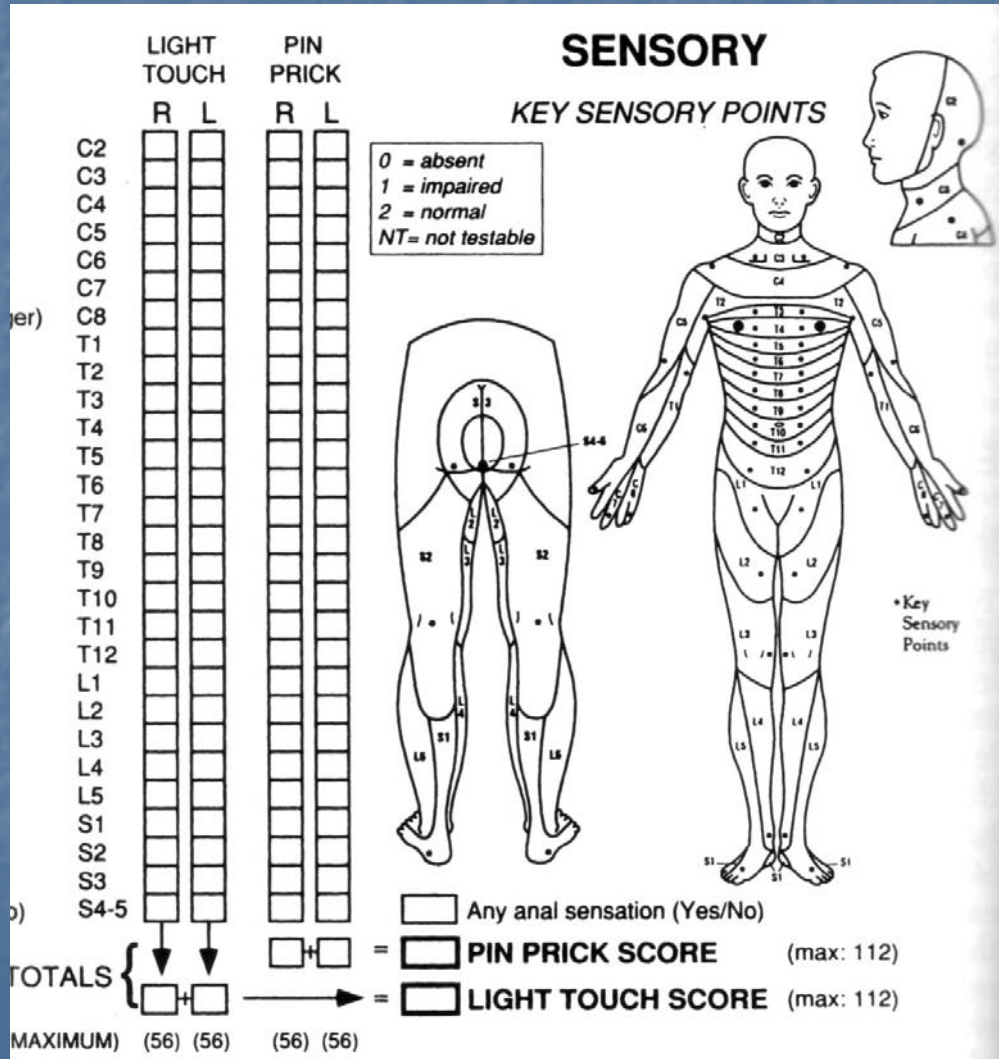
{ 4- slight resistance  
 4 moderate resistance  
 4+ strong resistance



# Muscle or Sensory Loss?

**Table 26-6 Key sensory landmarks**

Level	Dermatome
C4	shoulders
C6	thumb
C7	middle finger
C8	little finger
T4	nipples
T6	xiphoid
T10	umbilicus
L3	just above patella
L4	medial malleolus
L5	great toe
S1	lateral malleolus
S4-5	peri-anal



# Basic Anatomy

- Deep Tendon Reflexes
  - Arm
    - Bicipital: C5
    - Styloradial: C6
    - Tricipital: C7
  - Leg
    - Patellar: L3, some L4
    - Achilles: S1

# What is and how do you determine the level of injury?

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- Motor level = the last level with at least 3/5 (against gravity) function
  - NB: this is the most important for clinical purposes
- Sensory level = the last level with preserved sensation
- Radiographic level = the level of fracture on plain XRays / CT scan / MRI

# Mechanism

- Penetrating Injury vs Blunt Injury
- Acceleration/Deceleration Patterns
- Always suspect in patients:
  - Neurologic deficit
  - Unconscious/Altered Mental Status
  - Mechanism
  - Spine Tenderness
  - When in doubt....assume they have one!



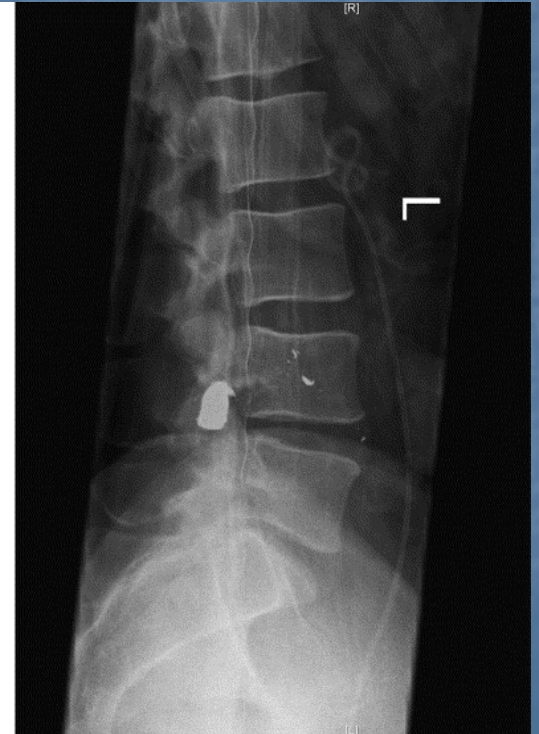
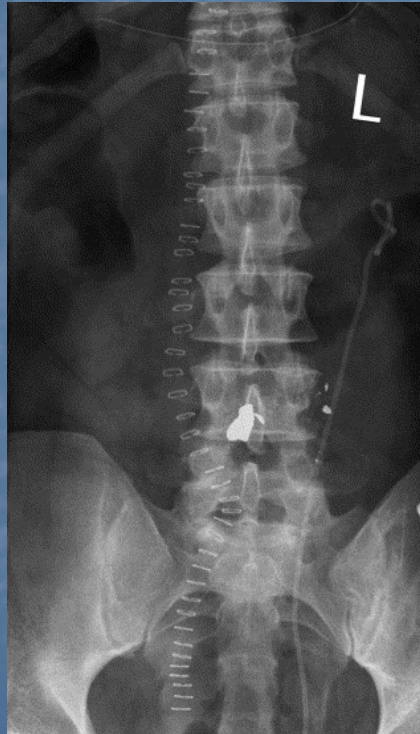
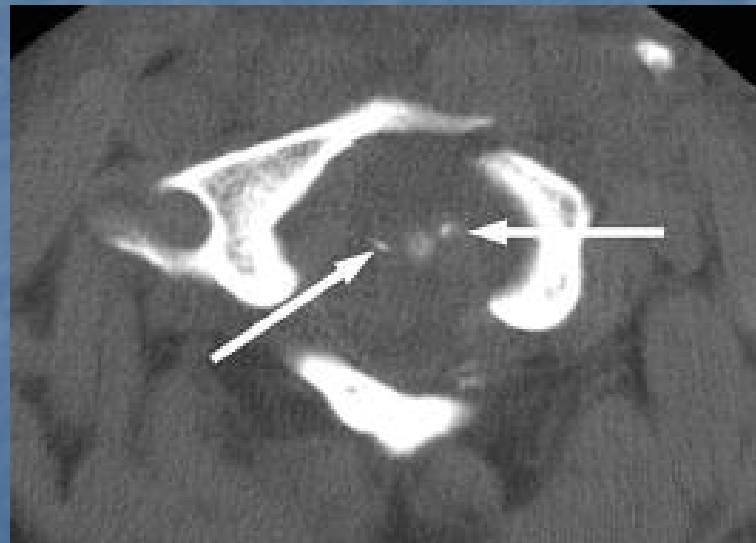




Figure 1



Figure 2



# Case Presentation

- 25 y/o white male
- Fell off the roof (20 feet)
- Had to be intubated at the scene by EMS
- Consciousness regained shortly thereafter
- Could not move arms or legs
- Could close and open eyes to command
- Not able to breathe by himself—totally dependent on mechanical ventilation



# High cervical injuries (C3 and above)

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- Motor and sensory deficits involve the entire arms and legs
- Dependent on mechanical ventilation for breathing
  - (diaphragm is innervated by C3-C5 levels)
- Early tracheostomy, rehabilitation
- Most mortality after the first 48 hours due to pneumonia or pressure ulcers/other infections



# Case Presentation

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- 19 y/o white male
- Diving accident (shallow water)
- No loss of consciousness
- Could not understand why he could not move his legs, forearms and hands (he could shrug shoulders and elevate arms)
- BP 75/40, HR 54 bpm
- Had difficulties breathing and required intubation a few hours after the accident

# Midcervical injuries (C3-C5)

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- Varying degrees of diaphragm dysfunction
- Usually need ventilatory assistance in the acute phase
- Shock

# What is the difference between spinal shock and neurogenic shock?

- Spinal shock is mainly a loss of reflexes (flaccid paralysis)
  - Usually not associated with cardiovascular symptoms
- Neurogenic shock is mainly hypotension and bradycardia due to loss of sympathetic tone
  - Decreased SVR
  - Ensure adequate fluid resuscitation prior to vasopressor use

# Low cervical injuries (C6-T1)

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- Usually able to breathe, although occasionally cord swelling can lead to temporary C3-C5 involvement (need mechanical ventilation)
- The level can be determined by physical exam
- Steroids are *occasionally* used at this level and *dependent on neurosurgeon and critical care team*
  - Have been associated with higher septic complications
  - Can spare one or two cervical levels in some cases
  - **NOT** recommended by ATLS

# So what do you expect with a cervical lesion?

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- Quadriplegia or quadriparesis
- Bowel/bladder retention (spastic)
- Various degrees of breathing difficulties
- Neurogenic and/or spinal shock
- Treatment Necessities
  - Bowel/Bladder training
  - Early Rehabilitation
  - Prevent contractures and muscle spasticity
  - Pulmonary toilet

# Case scenario

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- 22 y/o Hispanic female
- Motor vehicle accident (hit a pole at 60mph)
- + for ETOH and THC
- Short term loss of consciousness (10')
- Not able to move or feel her legs
- DTRs 2+ in BUE, 0 in BLE
- No bladder / bowel control or sensation
- Sensory level at the umbilicus



# Thoracic injuries (T2-L1)

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- Paraparesis or paraplegia
- UMN (upper motor neuron) signs

# Case scenario

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- 22 y/o African-American female
- Motor vehicle accident
- Not able to move or feel her legs below the knee
- Could flex thighs against gravity
- DTRs 2+ in BUE, 0 in BLE
- No bladder / bowel control or sensation
- Sensory level above the knee on L, below the knee on R

# Cauda equina injuries (L2 or below)

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- Paraparesis or paraplegia
- LMN (lower motor neuron) signs
- Thigh flexion is almost always preserved to some degree



# What is the central cord syndrome?

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- Cervical spinal cord involvement with arms more affected than legs
- May occur with trauma, tumors, infections, etc
- Traumatic lesions tend to improve in 1-2 weeks
- Surgical decompression may be indicated if there is spinal stenosis

# Initial Management

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- Immobilization
  - Rigid collar
  - Sandbags and straps
  - Spine board
  - Log-roll to turn
- Prevent hypotension
  - Pressors: Dopamine, not Neosynephrine
  - Fluids to replace losses; do not overhydrate
- Maintain oxygenation
  - O<sub>2</sub> per nasal canula
  - If intubation is needed, do NOT move the neck

# Surgical Decompression and/or Fusion

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## ■ Indications

- Decompression of the neural elements (spinal cord/nerves)
- Stabilization of the bony elements (spine)

## ■ Timing

### ■ Emergent

- Incomplete lesions with progressive neurologic deficit

### ■ Elective

- Complete lesions (3-7 days post injury)
- Central cord syndrome (2-3 weeks post injury)

# Soft and hard collars

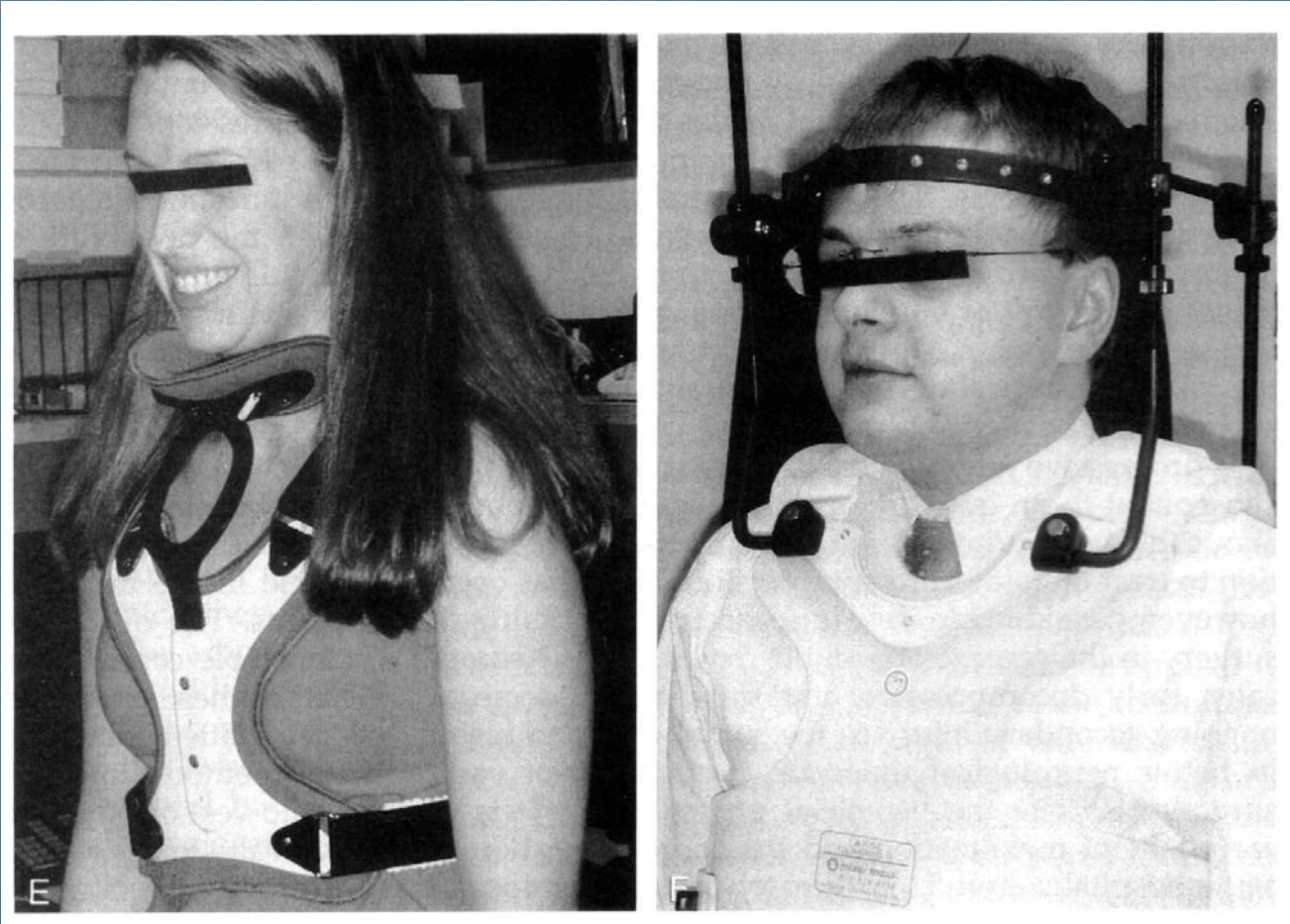
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# Minerva vest and halo-vest

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# Long term care

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- Rehab for maximizing motor function
- Bladder/bowel training
- Psychological and social support
- Ethical considerations

# Original Case



# Questions?

