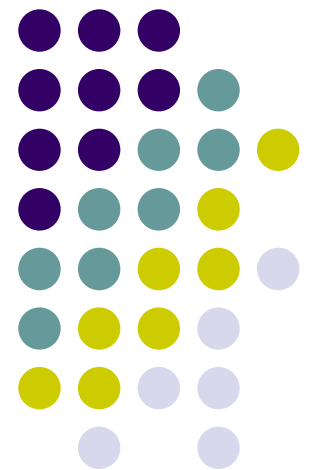


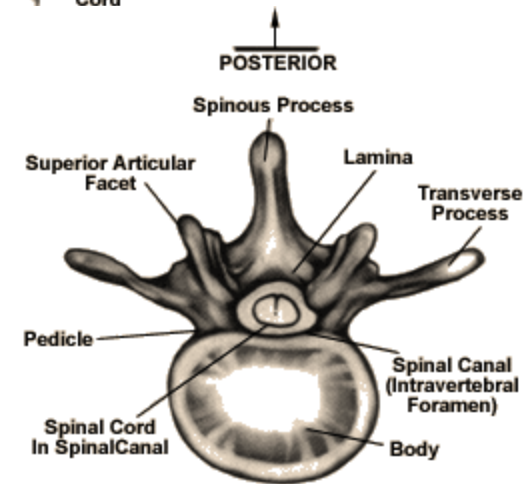
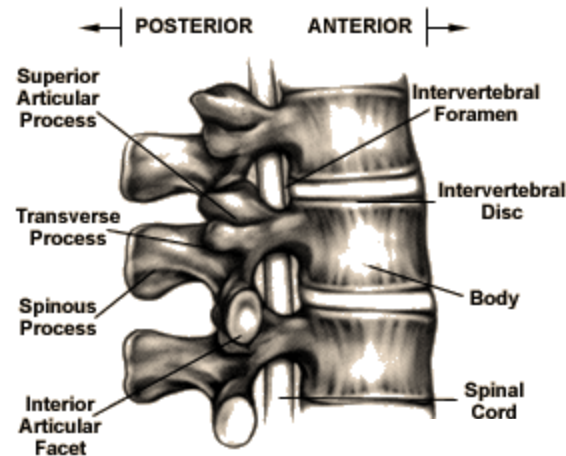
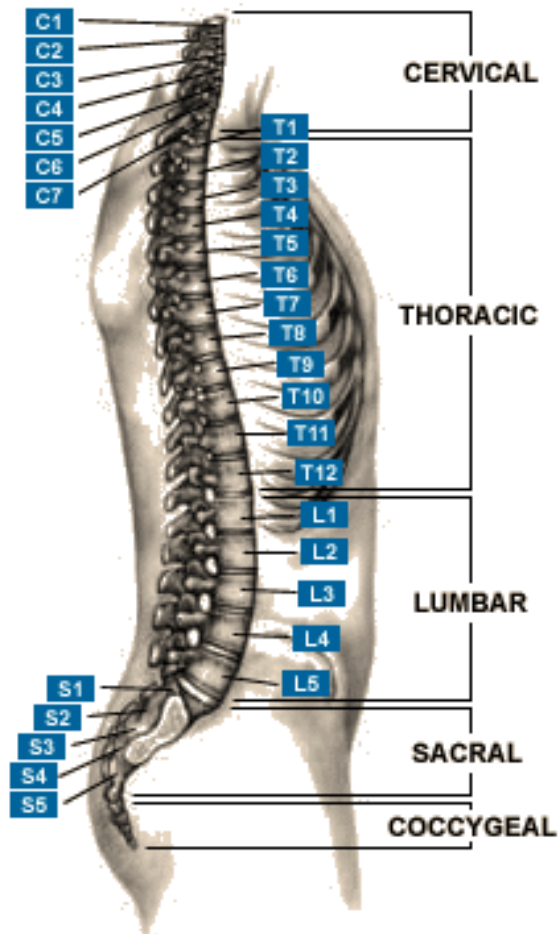
SPINE TRAUMA

Approach to the Patient and Diagnostic Evaluation

Harman Singh, MD
Jim Harrop, MD

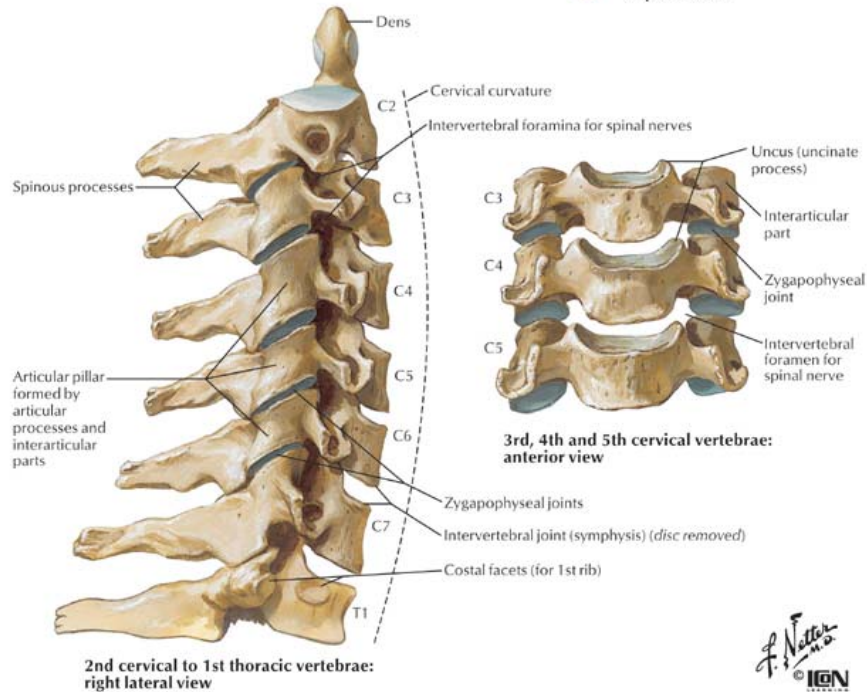
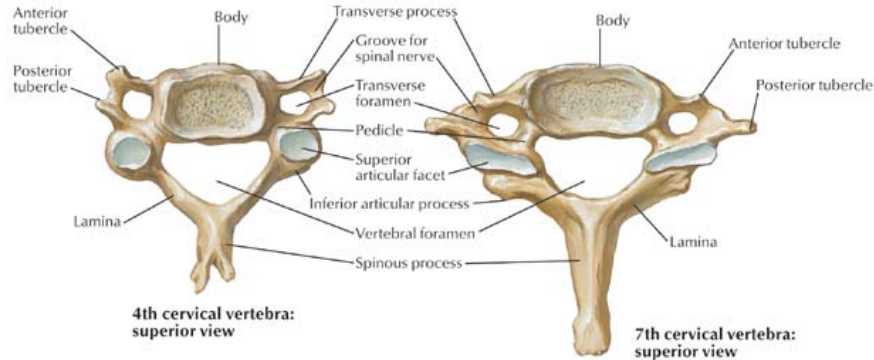


Normal Spinal Anatomy





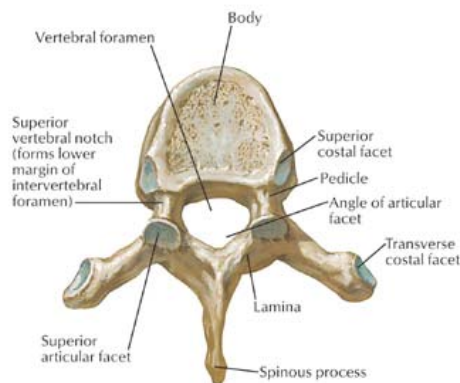
Cervical Vertebrae



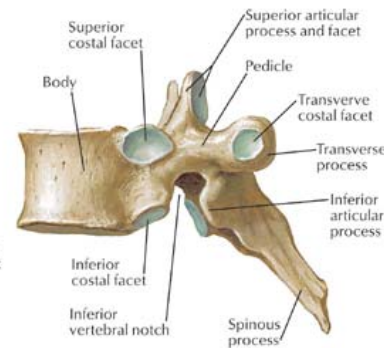
- Small vertebral bodies
 - less weight to carry
- Extensive joint surfaces
 - greater ROM



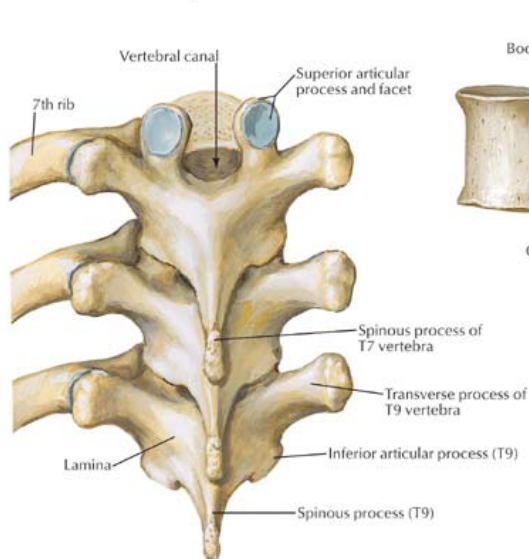
Thoracic Vertebrae



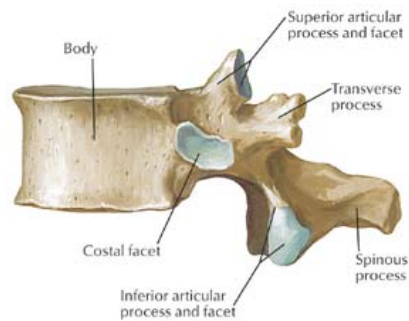
T6 vertebra:
superior view



T6 vertebra:
lateral view



T7, T8 and T9 vertebrae:
posterior view



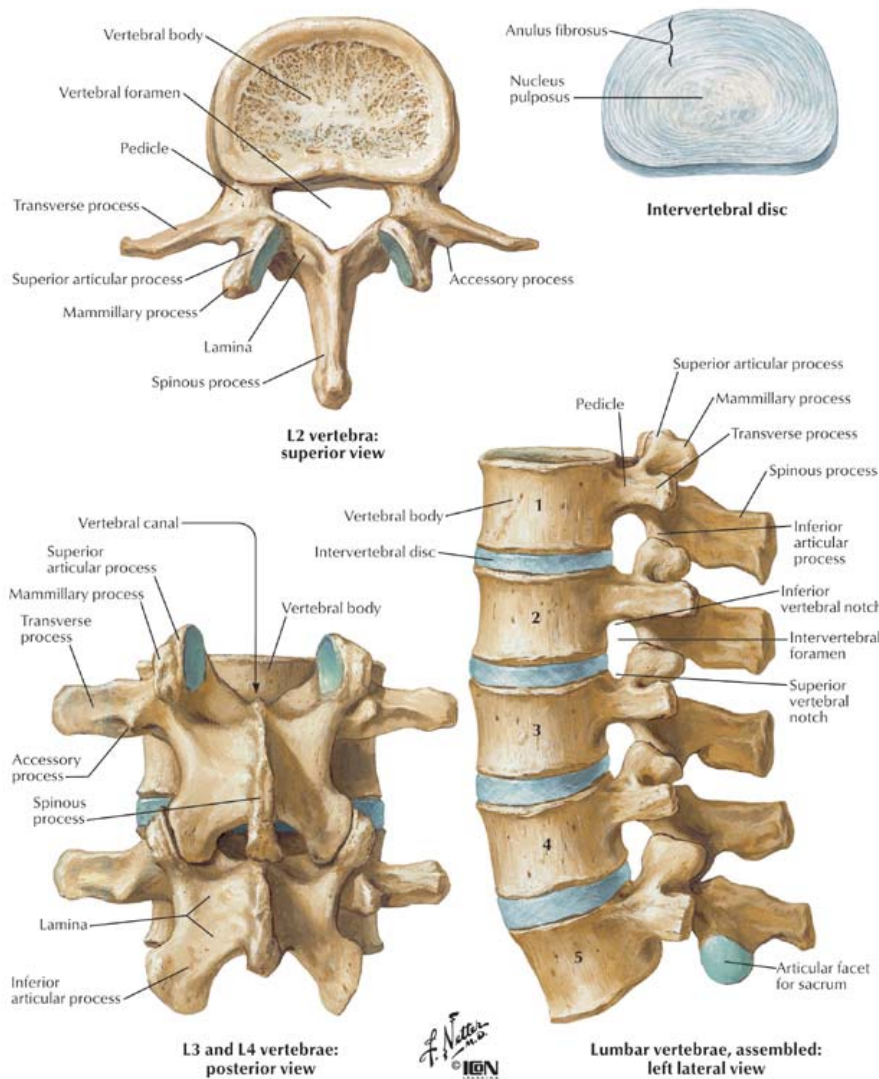
T12 vertebra:
lateral view



- Rib bearing vertebrae
- Designed to remain stiff and straight

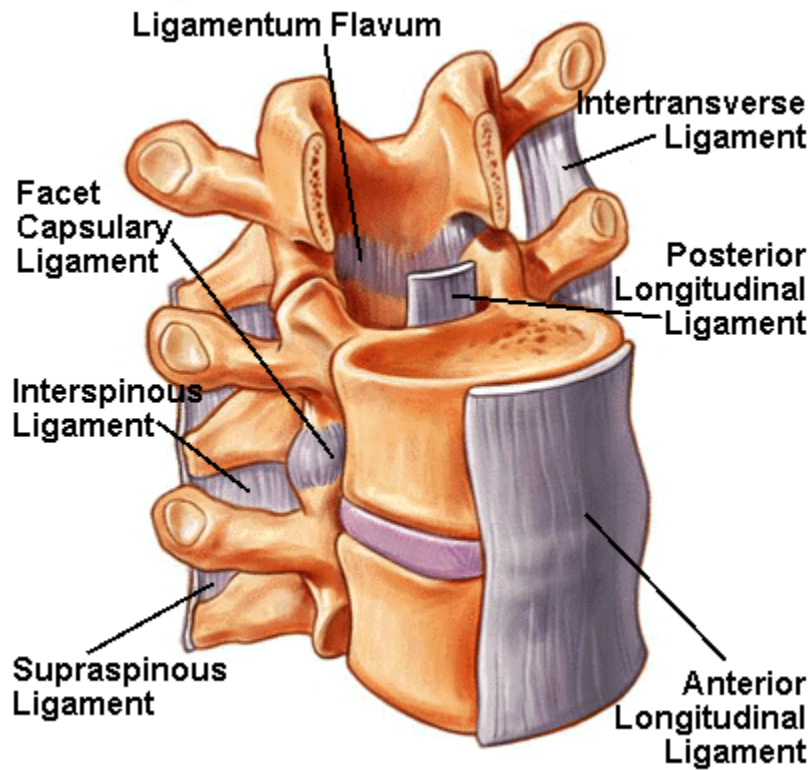
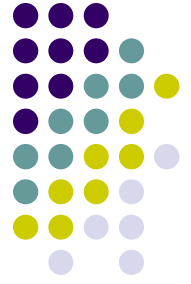


Lumbar Vertebrae



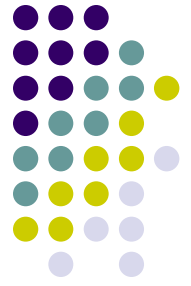
- Weight bearing vertebrae
- Lamina, facets and SPs are major parts of posterior elements

Spinal ligaments



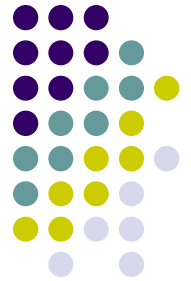
- Intrasegmental
 - Ligamentum flavum
 - Intertransverse ligament
 - Interspinous ligament
- Intersegmental
 - ALL
 - PLL
 - Supraspinous ligament

Epidemiology



- Incidence: 10,000 new cases/year
- Prevalence: 191,000 cases and rising
- Prime occurrence: males, peak of their productive lives
- Cost: \$ 5.6 billion/year in the US
- Cost per person: directly related to the level of SCI and patient's age

**Most important spinal cord
injury indicator...**



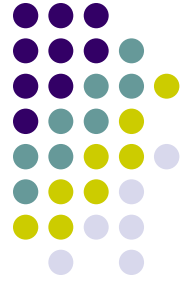
MECHANISM

Common Mechanisms



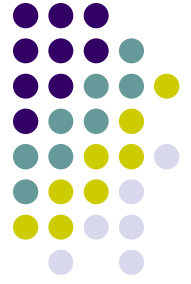
- Compression
- Flexion
- Extension
- Rotation
- Lateral bending
- Distraction
- Penetration





Suspect spinal injury with...

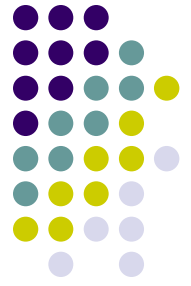
- Sudden decelerations (MVCs, falls)
- Compression injuries (diving, falls onto feet/buttocks)
- Significant blunt trauma (football, hockey, snowboarding, jet skis)
- Very violent mechanisms (explosions, cave-ins, lightning strike)
- Unconscious patient
- Neurological deficit
- Spinal tenderness



High index of suspicion...

- Missed or delayed diagnosis most often attributed to:
 - failure to suspect injury
 - inadequate radiology
 - incorrect interpretation of radiographs
- A missed spinal injury can have devastating long term consequences
- As such, spinal column injury must therefore be presumed until it is excluded

Spinal stabilization and management



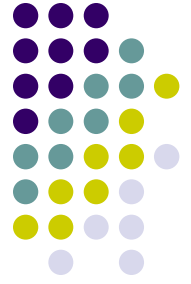
- Protect spine at all times during the management of patients with multiple injuries.
- Up to 5% of spinal injuries have a second, possibly non adjacent, fracture elsewhere in the spine
- Ideally, whole spine should be immobilized in neutral position on a firm surface.
- Can be done manually or with a combination of semi-rigid cervical collar, side head supports, long spine board and strapping.



Immobilization in the pre hospital setting

- Application of definitive immobilization devices should **not** take precedence over life saving procedures
- If neck is not in the neutral position, attempt should be made to achieve alignment.
- If the patient is awake and cooperative, encourage them to actively move their neck into line





Immobilization in the pre hospital setting

- Initial immobilization of C-spine with a hard-collar is a priority during extrication
- Long spine boards are valuable primarily for extrication from vehicles.
- Rapid evacuation to a level 1 trauma center





Immobilization in hospital

PROTECTION => **PRIORITY**
DETECTION => **SECONDARY**

- Rigid cervical collar
- “Log-rolling”
- Rigid transportation board (remove ASAP)
- Rigid transfer slides

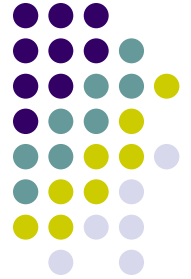


Log roll (incorrect)

Log roll (correct)



Spinal clearance – KEY POINTS



1. Spinal immobilization is a priority in multiple trauma, spinal clearance is not
2. The spine should be assessed and cleared when appropriate, given the injury characteristics and physiological state
3. Imaging the spine does not take precedence over life saving diagnostic and therapeutic procedures

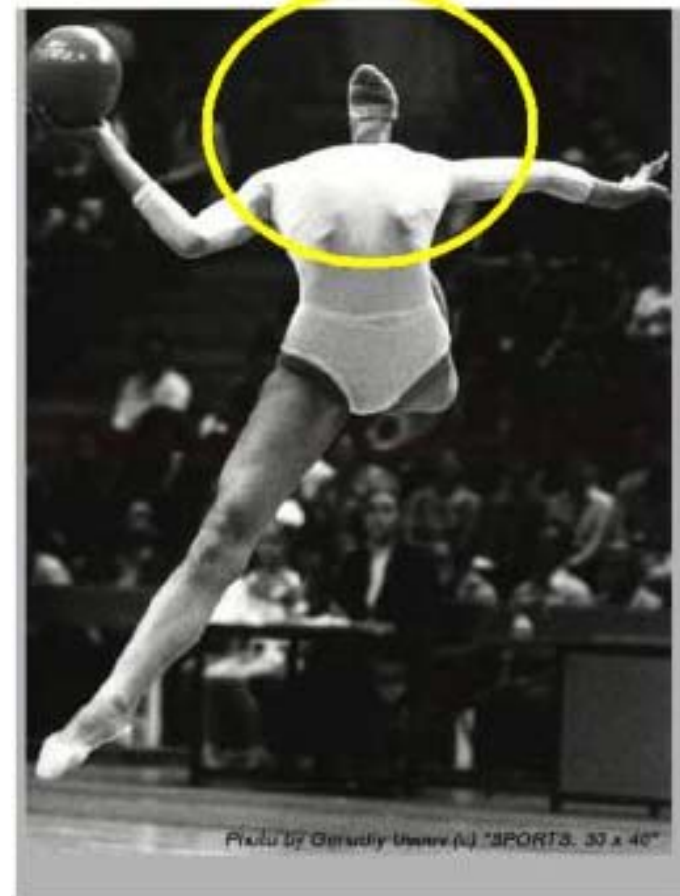


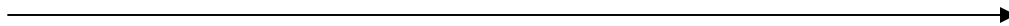
Photo by Getty Images (A) "SPORTS. 33 x 40"

Diagnosis of spinal injuries: clinical evaluation

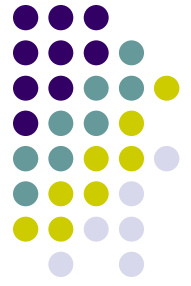


- Inspection and palpation: **Occiput to Coccyx**

- Tenderness
- Gap or Step
- Edema and bruising
- Spasm of associated muscles

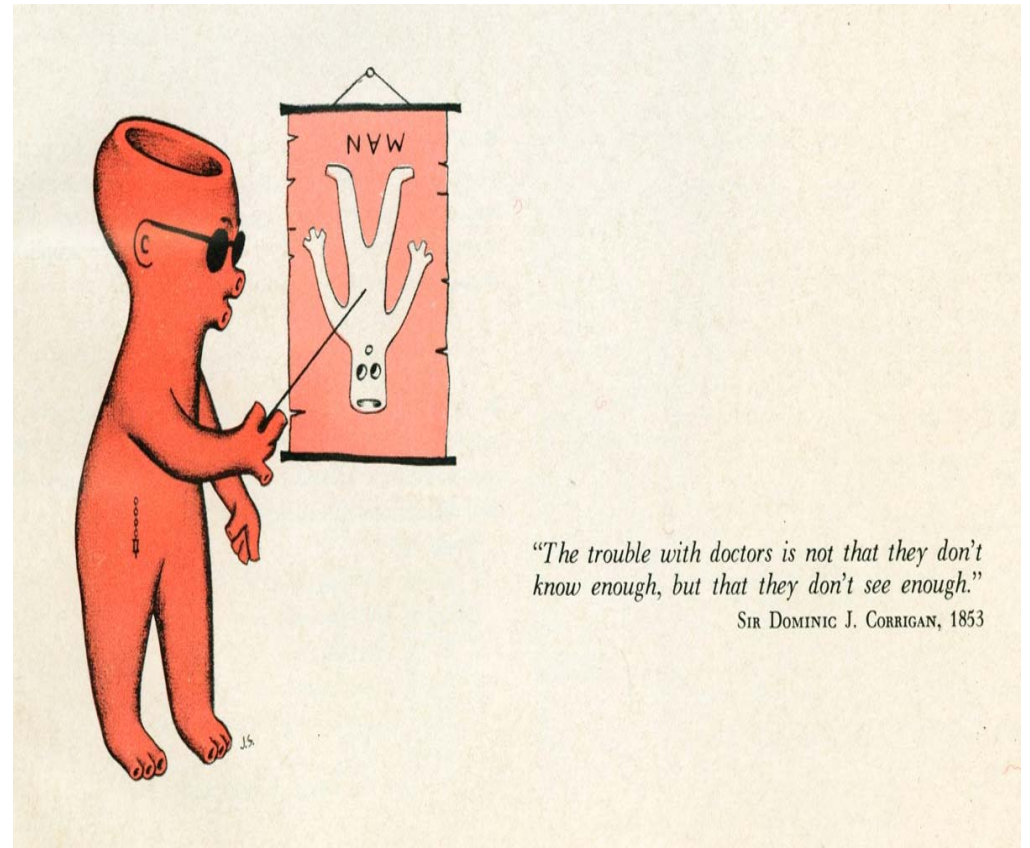


Diagnosis of spinal injuries: clinical evaluation



- Neurological assessment

- Sensation
- Motor function
- Reflexes
- Rectal examination



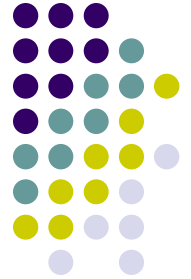
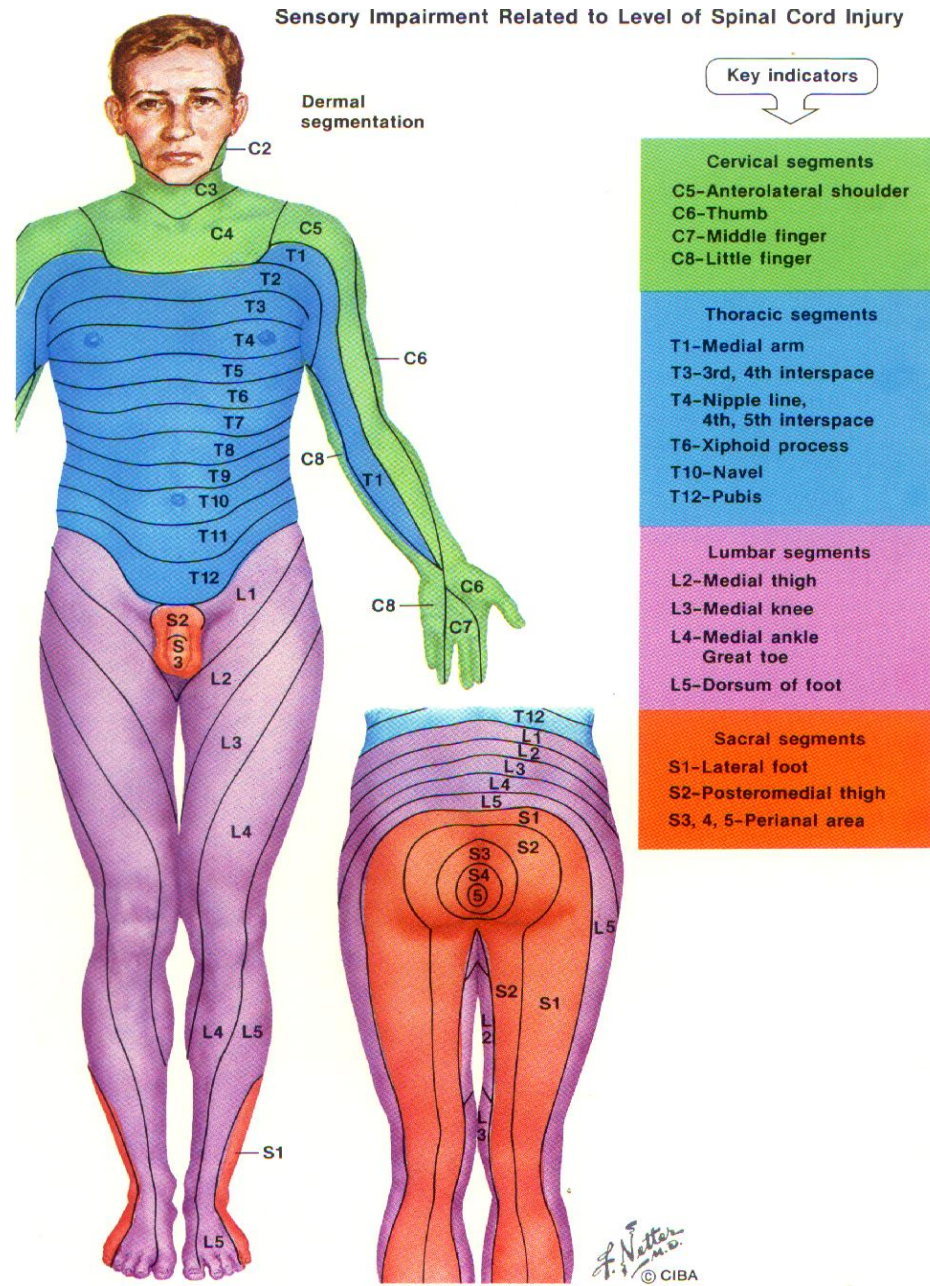
"The trouble with doctors is not that they don't know enough, but that they don't see enough."

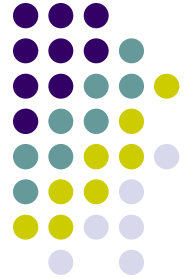
SIR DOMINIC J. CORRIGAN, 1853

Neurological assessment: Sensory

Grading scale: 0-2

- 0: absent
- 1: impaired
- 2: normal
- 3: not testable





Neurological assessment: Motor

C5: Deltoids/biceps

C6: Wrist extensors

C7: Elbow extensors

C8: Finger flexors

T1: Finger Abductors

- L2: Hip flexors
- L3: Knee extensors
- L4: Ankle dorsiflexors
- L5: Long toe extensors
- S1: Ankle plantar flexors

Grading Scale: 0-5

0: total paralysis

1: palpable or visible contraction

2: active movement; gravity eliminated

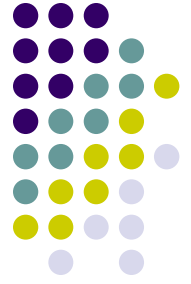
3: active movement: against gravity

4: active movement: against some resistance

5: active movement: against full resistance

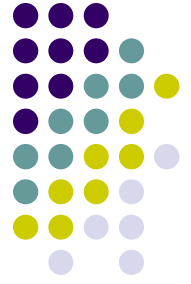
NT: not testable

Neurological assessment: Rectal

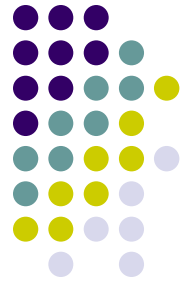


- Tone: the presence of rectal tone in itself **does not** indicate an incomplete injury
- Sensation
- Volition: A voluntary contraction of the sphincter or the presence of rectal sensation supports the presence of a communication between the lower spinal cord and supraspinal centers – favorable prognosis
- Bulbocavernosus reflex:
 - Positive: the presence of this reflex implies the lack of supraspinal input to the sacral outflow and is suggestive of a complete spinal injury
 - Negative: absent in spinal shock

SCI grading systems



- Frankel grading system (outdated)
 - A: complete loss of motor-sensory function below level of lesion
 - B: complete motor paralysis with some sensory preservation (including sacral sparing)
 - C: retained motor function but useless
 - D: retained useful motor function
 - E: recovery (free of neurological symptoms)

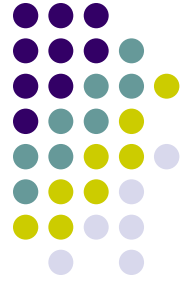


- Neurological Classification:
 - Use the ASIA **International** standards
 - Motor and sensory assessment
 - ASIA Impairment Scale (A-E)
 - Clinical Syndromes (patterns of incomplete injury)

SCI grading systems



- American Spinal Injury Association and the International Medical Society of Paraplegia (ASIA/IMSOP) impairment scale
 - Motor level: most caudal key muscle with at least grade 3 power
 - Sensory level: most caudal segment with normal sensory function
 - Complete versus Incomplete: evidence of neurological function distally, including preservation of perineal sensation (sacral sparing)



ASIA IMPAIRMENT SCALE

- **A = Complete:** No motor or sensory function is preserved in the sacral segments S4-S5
- **B = Incomplete:** Sensory but not motor function is preserved below the neurological level and includes sacral segments S4-5
- **C = Incomplete:** Motor function is preserved below the neurological level, and more than half of key muscles below the neurological level have a muscle grade less than 3
- **D = Incomplete:** Motor function is preserved below the neurological level, and at least half of key muscles below the neurological level have a muscle grade of 3 or more
- **E = Normal:** motor and sensory function are normal

CLINICAL SYNDROMES



- Central Cord
- Brown-Sequard
- Anterior Cord
- Conus Medullaris
- Cauda Equina

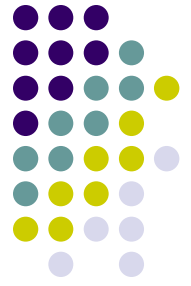
IMAGING



Numerous large prospective studies have described the large cost and low yield of the indiscriminate use of c-spine radiology in trauma patients.

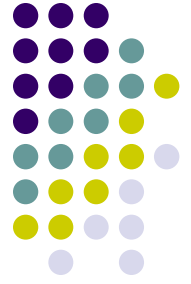
WHO NEEDS AN X-RAY???

Two papers have attempted to address this question

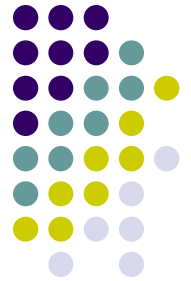


- NEXUS -The National Emergency X-Radiograph Utilization Study
- Canadian C-Spine rules

NEXUS



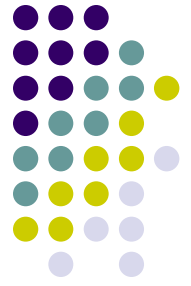
This was a prospective study put forth to validate a rule for the decision whether to x-ray in low risk patients



Criteria were as follows.....

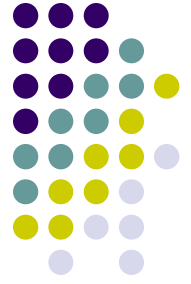
- 1. Absence of tenderness in the posterior midline
- 2. Absence of a neurological deficit
- 3. Normal level of alertness (GCS15)
- 4. No evidence of intoxication
- 5. No distracting pain elsewhere

NEXUS



- Any patient who fulfilled all 5 of the aforementioned criteria were considered low risk for C-spine injury and as such did not receive C-spine radiography
- For patients who had any of the 5 criteria, radiographic imaging was indicated in the form of AP, lateral, and odontoid C-spine views

Results of NEXUS study



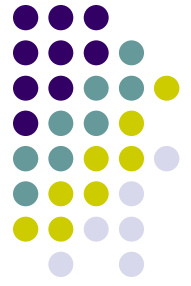
- 34069 patients were enrolled
- 818 had significant C-spine injury
- 810 were identified as potential spinal injury patients by the decision rule
- 8 patients were identified as low risk but in fact had radiographic injury

NEXUS

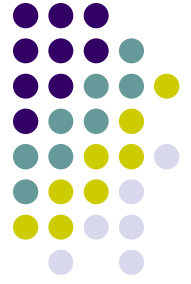


- Sensitivity 99%
- Negative predictive value 99.8%
- Specificity 12.9%
- Positive predictive value 2.7%
- Study was well received
- But.....some felt criteria to be too ambiguous and open to interpretation

Canadian C-Spine Rules



Prospective study whereby patients were evaluated for 20 standardized clinical findings as a basis for formulating a decision as to the need for subsequent radiography

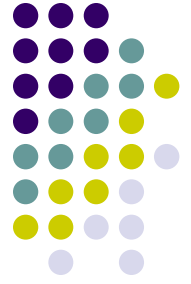


Rules were as follows.....

- **1. Was there any high risk factor that mandates radiography?**
 - Age>65
 - Dangerous mechanism of injury
 - Presence of paresthesias

IF YES -> X-RAY

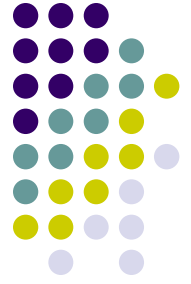
Rules...



- **2. Were there any low risk factors that allow some assessment of range of motion?**
 - Simple rear end MVC
 - Sitting position in ER
 - Ambulatory at any time
 - Delayed onset of neck pain
 - Absence of midline c-spine tenderness

IF NONE -> X-RAY

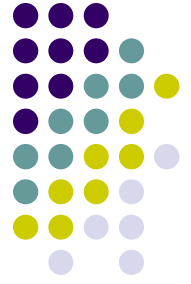
Rules...



- **3. Was the patient actively able to move their neck?**

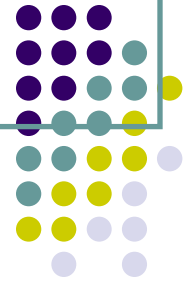
IF YES -> NO X-RAY

Results of Canadian C-Spine Study



- 8924 patients enrolled
- 100 % sensitivity for identifying 151 clinically important C-spine injuries
- 42.5 % specificity
- deemed a highly sensitive decision rule for use of C-spine radiography in alert and stable trauma patients

The Canadian C-spine Rule for alert and stable trauma patients where cervical spine injury is a concern.



Any high-risk factor that mandates radiography?

- Age > 65 yrs, or
- Dangerous mechanism, or
- Paresthesias in extremities

No

Yes

Any low-risk factor that allows safe assessment of range of motion?

- Simple rear-end MVC, or
- Sitting position in ED, or
- Ambulatory at any time, or
- Delayed onset of neck pain, or
- Absence of midline C-spine tenderness

No

Radiography

Yes

Unable

Able to actively rotate neck?

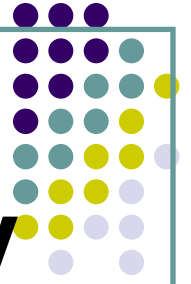
- 45 degrees left and right

Able

No Radiography

From Stiell I et al JAMA Oct 2001

National Emergency X- Radiography Utilization Study (NEXUS)



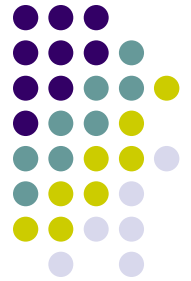
Vs

The Canadian C-spine rule?

Both have:

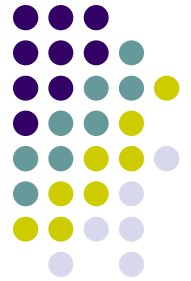
- Excellent negative predictive value for excluding patients identified as low risk
- Poor positive predictive value as most 'no-low-risk' patients do not have a fracture

Clearance of Cervical Spine Injury in Conscious, Symptomatic Patients



- 1. Radiological evaluation of the cervical spine is indicated for all patients who do not meet the criteria for clinical clearance as described above
- 2. Imaging studies should be technically adequate and interpreted by experienced clinicians

Plain Film Radiology



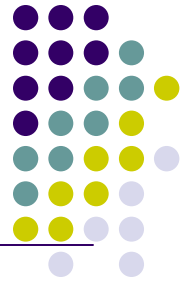
- The standard 3 view plain film series is the lateral, antero-posterior, and open-mouth view
- The lateral cervical spine film must include the base of the occiput and the top of the first thoracic vertebra
- The lateral view alone is inadequate and will miss up to 15% of cervical spine injuries.

Plain Film Radiology



- If lower cervical spine difficult to see, caudal traction on the arms may be used to improve visualization
- Repeated attempts at plain radiography are usually unsuccessful
- If the lower cervical spine is not visible, a CT scan of the region is then indicated

Complex spinal trauma

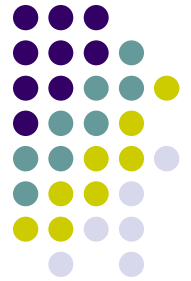


Radiological evaluation

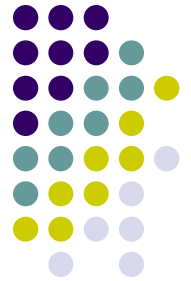
X-ray Guidelines (cervical)

- Adequacy, Alignment
- Bone abnormality, Base of skull
- Cartilage, Contours
- Disc space
- Soft tissue

How to read the Lateral Cervical Spine X-Ray



- Lateral cervical spine x-ray must visualize entire cervical spine .
- A film that does not show the upper border of T1 is inadequate
- Caudal traction on the arms may help



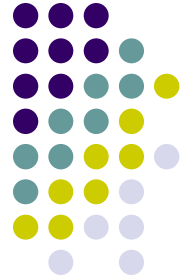
Lateral Cervical Spine X-Ray

- The anterior vertebral line, posterior vertebral line, and spinolaminar line should have a smooth curve with no steps or discontinuities
- Malalignment of the posterior vertebral bodies is more significant than that anteriorly, which may be due to rotation
- A step of $>3.5\text{mm}$ is significant anywhere



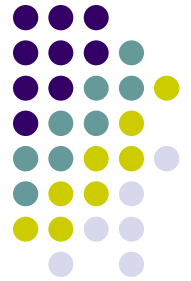
Lateral C-Sp X-ray

- Anterior subluxation of one vertebra on another indicates facet dislocation
- Less than 50% of the width of a vertebral body implies unifacet dislocation
- Greater than 50% implies bilateral facet dislocation
- This is usually accompanied by widening of the interspinous and interlaminar spaces



Lateral C-Sp X-ray

- Vertebral body and intervertebral disc examination reveal compression and burst type injuries
- Bodies normally regular cuboids similar in size and shape to the vertebrae immediately above and below (not C1/C2)
- Anterior wedging of vertebral body or teardrop fractures of antero-inferior portion of body implies compression fracture



Lateral C-Sp X-ray



Anterior compression of greater than 40% of normal vertebral body height indicates a burst fracture with retropulsion of fragments of the vertebral body into the spinal canal

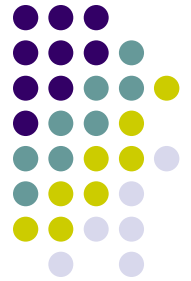


Lateral C-Sp X-ray

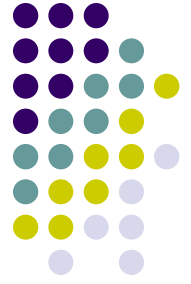
- Loss of height of an intervertebral disc space may indicate disc herniation
- Analysis of prevertebral soft tissues may allow the diagnosis of cervical injuries
- Soft tissue shadow is created by pharyngeal and prevertebral tissues



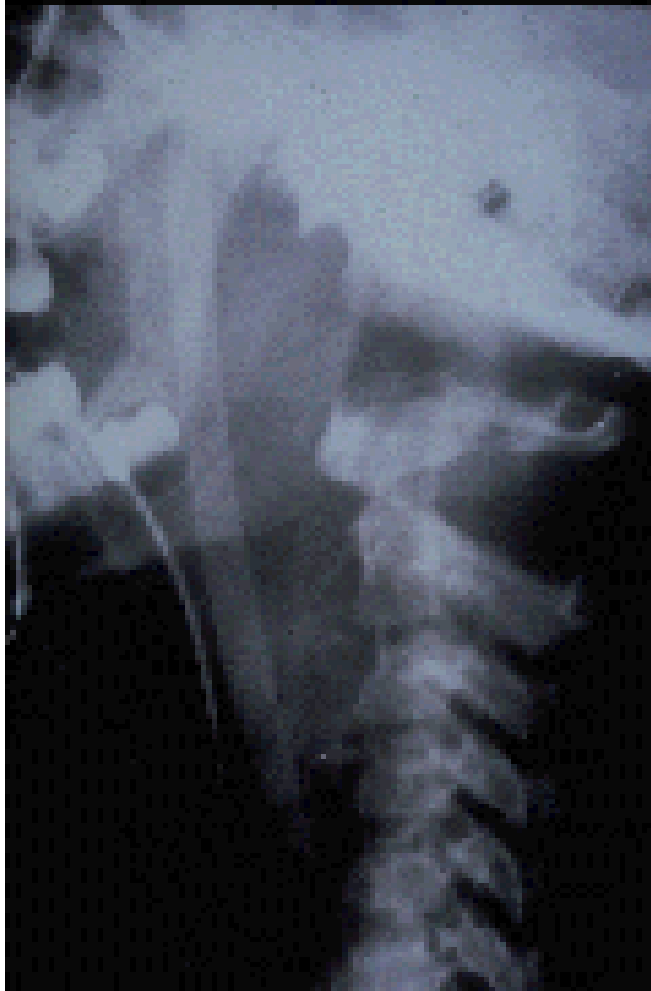
Atlanto–Occipital dissociation



- Atlanto-occipital dissociation can be very difficult to diagnose and is easily missed
- The distance from the occiput to the atlas should not exceed 5mm anywhere on the film



A-O dissociation



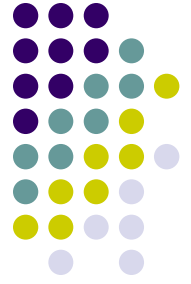
- Odontoid peg must also be examined for fractures
- Soft tissue swelling anterior to arch of C1 suggests fracture at this level.
- Atlanto-Dens Interval (ADI) in adults should be $<3\text{mm}$ (in flexion)
- Shift of $> 3.5\text{mm}$ implies injury to transverse ligament, and $> 5\text{mm}$ indicates complete rupture and instability
- C1-C2 interspinous space should not be $>10\text{mm}$ wide



The Antero-Posterior View

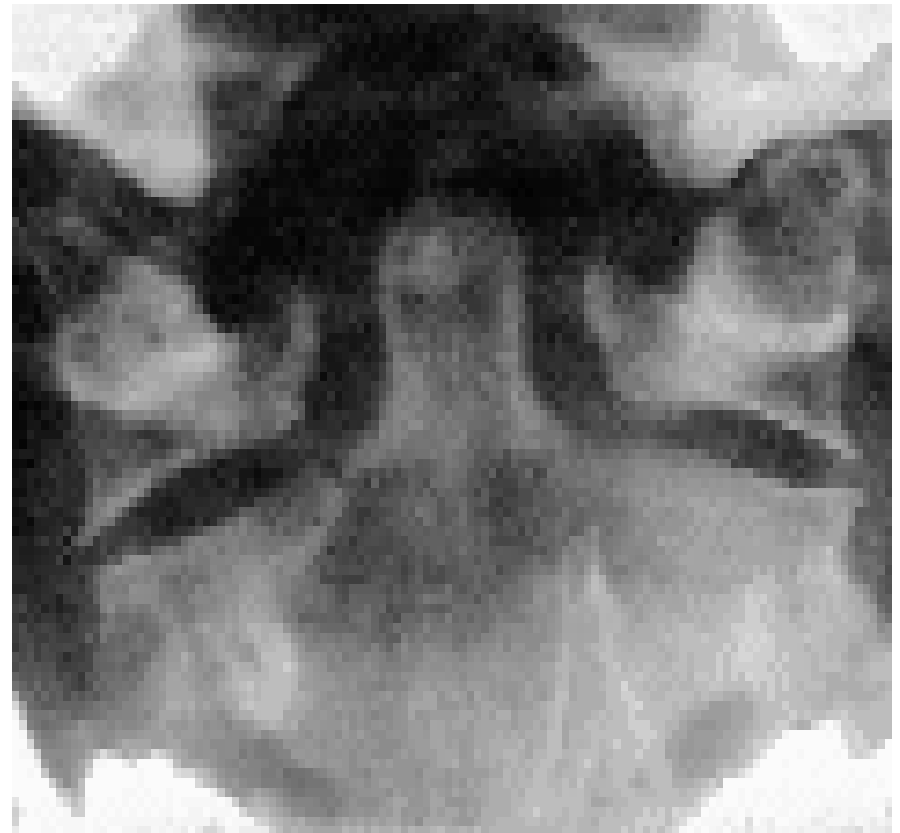
- Antero-posterior view must include spinous processes of all cervical vertebrae from C2 to T1



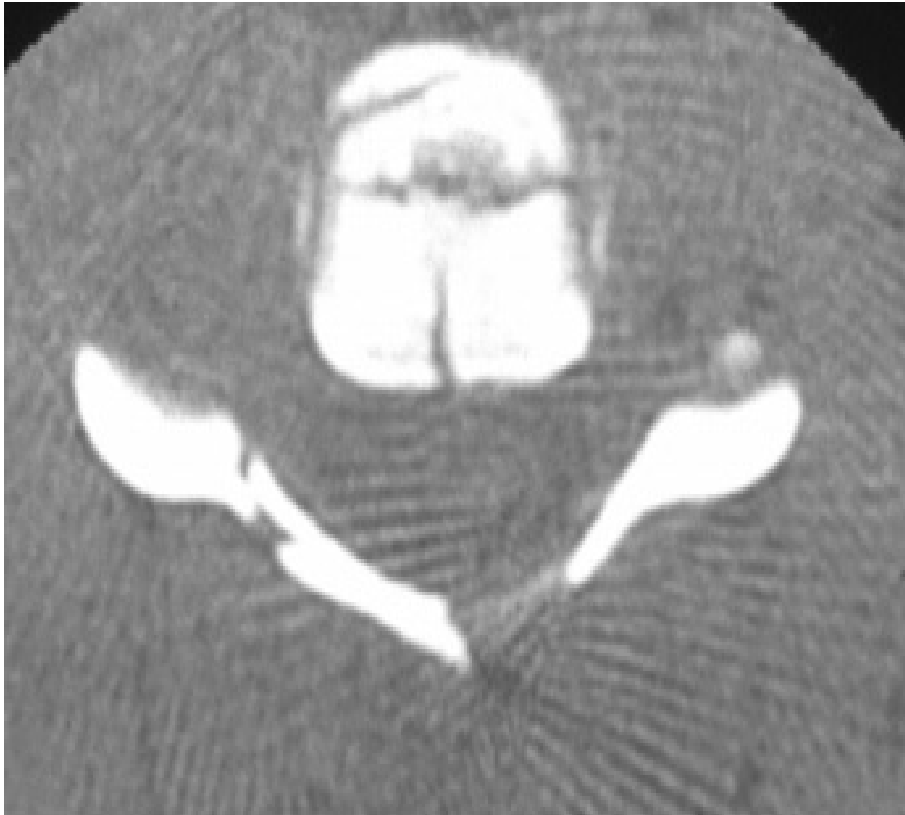


The Open Mouth View

- The open mouth view should visualise the lateral masses of C1 and the entire odontoid peg
- Bite blocks may improve viewing
- In the unconscious, intubated patient the open mouth view is inadequate and occiput to C2 CT scan is recommended

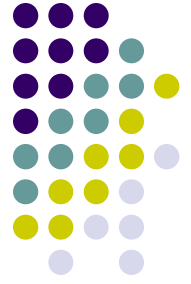


CT Scanning



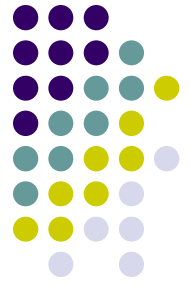
- Thin cut CT scanning should be used to evaluate abnormal, suspicious or poorly visualized areas on plain radiology
- The combination of plain radiology and directed CT scanning provides a false negative rate of less than 0.1%

MRI



- Ideally (ie. US) all patients with an abnormal neurological examination should be evaluated with an MRI scan
- Patients who report transient neurological symptoms but who have a normal exam should also undergo an MRI assessment of their spinal cord

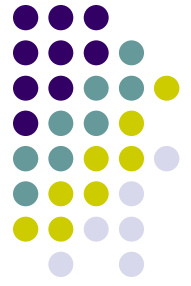
Radiographic Examination and Clearance of Cervical Spine Injury - Unconscious, Intubated Patients



- **Key Points**

- 1. The odontoid view is unreliable in intubated patients**
- 2. Clinical examination is impossible in the unconscious patient**
- 3. Plain film radiology cannot exclude ligamentous instability**

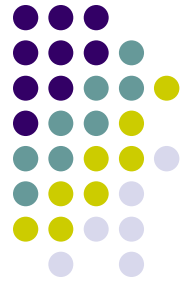
C-spine clearance in unconscious, intubated patients



- Standard radiological examination of cervical spine in unconscious, intubated patients is
 1. Lateral cervical spine film
 2. Antero-posterior cervical spine film
 3. CT scan of occiput-C3

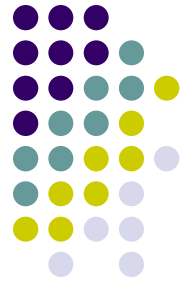
The open mouth odontoid radiograph is inadequate in intubated patients and will miss up to 17% of injuries to the upper cervical spine

C-spine clearance in unconscious, intubated patients



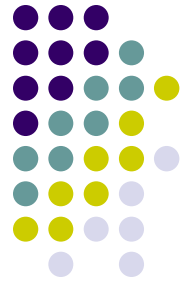
- Clearance of the spine in unconscious patients is limited by the lack of clinical information
- Incidence of unstable spinal injury in adult, intubated trauma patients is about 10.2%
- Incidence of unstable, occult spinal trauma (not visible on plain films) is about 2.5%

Unconscious patient

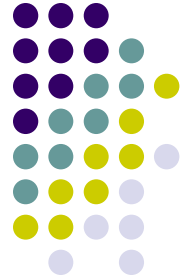


- Continue spinal precautions until fully conscious
- If patient is expected to regain full consciousness within 24-48 hrs, patient can be nursed with full spinal precautions
- Collar not necessary in adequately sedated, ventilated patient

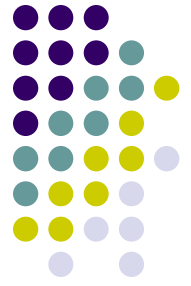
Magnetic Resonance Imaging in unconscious C-Sp Trauma



- Extremely sensitive at detecting soft tissue injuries without stressing cervical spine
- High false positive rate
- Few good studies on the use of MRI in clearing the cervical spine in unconscious patients



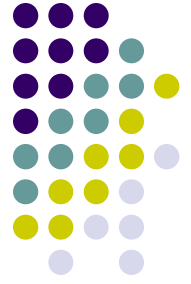
In any case, regardless of the injury suspected, protect yourself.....



Four Basic Reasons Why Cervical Spine Fractures Are Missed By Physicians

- 1. Failure to obtain indicated films
- 2. Inadequate films
- 3. Misinterpretation of the films
- 4. Films fail to adequately visualize the injuries

Acute SCI Care: What is the Evidence?



- Collected Wisdom...
 - From clinical experts
- Evidence-Based Practice...
 - Standards – Class I evidence
 - Guidelines – Class II evidence
 - Options – Class III evidence



**Section on Disorders of the Spine and
Peripheral Nerves of the AANS and the CNS.
Pub Neurosurgery Supp, March 2002 “Neurosurgery”**

System Oriented Approach to SCI



- Airway
- Breathing
- Circulatory
- ✓ Neurologic Classification
- ✓ Spinal Imaging
- Gastrointestinal System
- Genitourinary System
- Skin

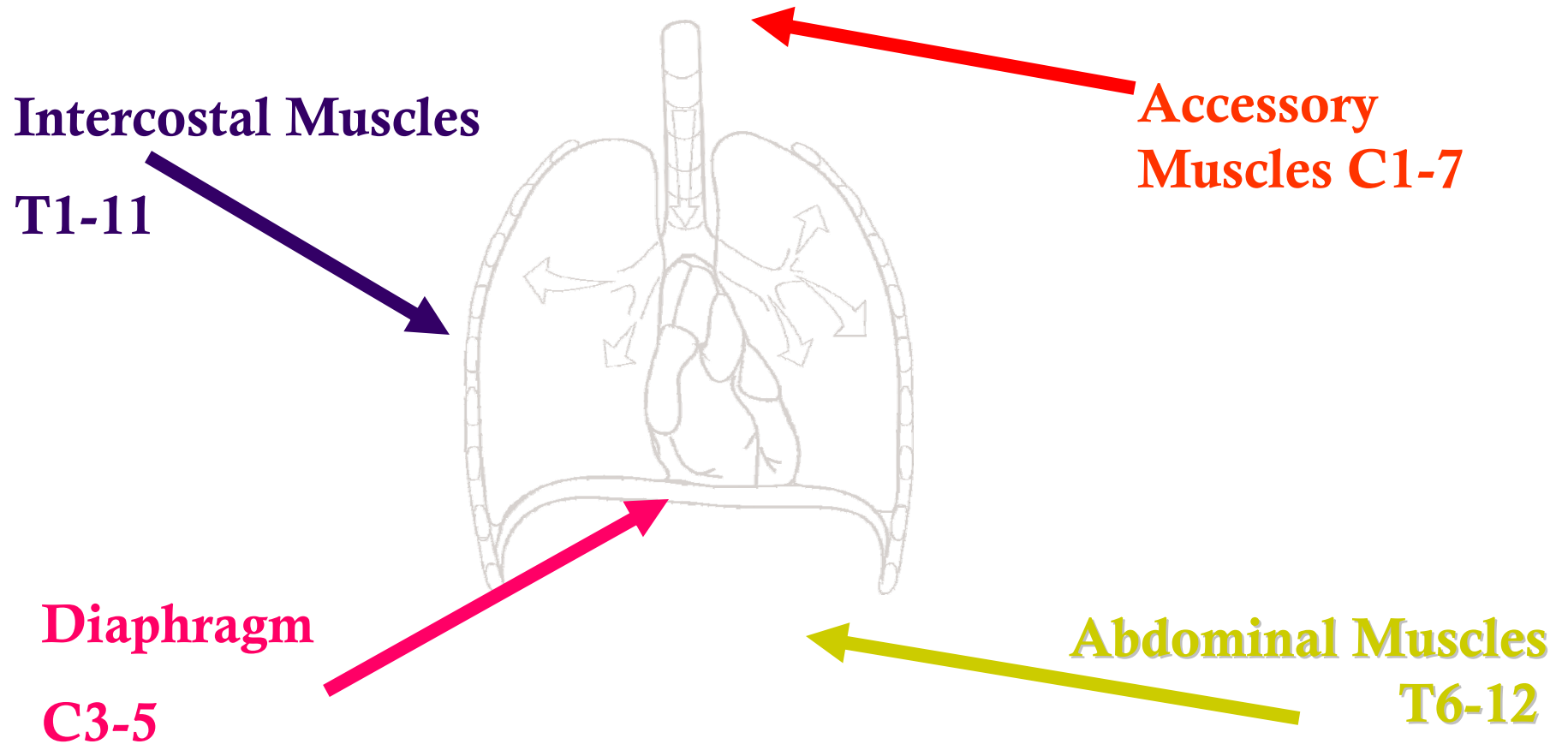
Airway



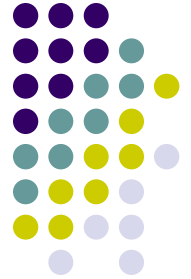
- Risk Associated with Level of Injury
- Decision to Intubate
- Airway Intervention



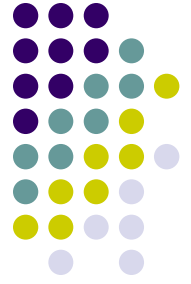
Risk Associated with Level of Injury



Risk Associated with Level of Injury cont'd



- Ventilatory Function
 - C1 - C7 = accessory muscles
 - C3 - C5 = diaphragm
 - *“C3-4-5 keeps the diaphragm alive!”*
 - T1 - T11 = intercostals
 - T6 - L1 = abdominals

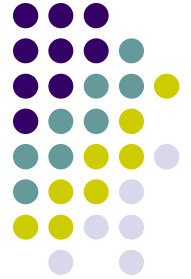


Decision to Intubate

Need for Artificial Airway is Usually Related to Respiratory Compromise e.g.

- Loss of innervation of the diaphragm
- Fatigue of innervated resp muscles
- Hypoventilation
- V/Q mismatch
- Secretion retention
- Associated injuries

Decision to Intubate Related to Neurological Level



- Occiput - C3 Injuries
(ASIA A & B)
 - Require **immediate** intubation and ventilation due to loss of innervation of diaphragm

Decision to Intubate Related to Neurological Level

cont'd



- C4-C6 Injuries (ASIA A & B)
 - Serious consideration for prophylactic intubation and ventilation if:
 - Ascending injury (requires serial M/S assessment by a trained clinician)
 - Fatigue of unassisted diaphragm
 - Inability to clear secretions

Co-Morbidities to Consider...



- Advanced age
- Premorbid conditions
- Chest trauma
- Hx of aspiration
- Head injury or substance abuse
- Acute ileus

Airway Intervention cont'd



- Manual Stabilization of C-spine
 - 2 person technique:
 - 1st person to provide **manual in-line stabilization** (not traction) of C-spine
 - 2nd person intubates

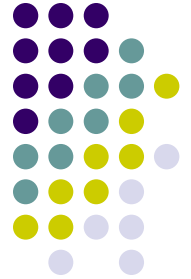
Breathing



Cough Function

- C1-C3 = absent
- C4 = non-functional
- C5-T1 = non-functional
- T2-T4 = weak
- T5-T10 = poor
- T11 & below = normal

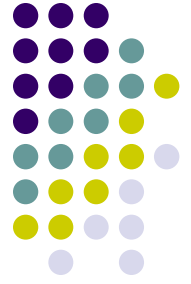
Breathing cont'd



Vital Capacity (acute phase)

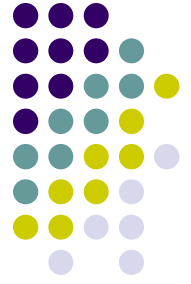
- C1-C3 = 0 - 5% of normal
- C4 = 10-15% of normal
- C5-T1 = 30-40% of normal
- T2-T4 = 40-50% of normal
- T5-T10 = 75-100% of normal
- T11 and below = normal

Breathing cont'd



- Ongoing Monitoring
 - SpO₂
 - EtCO₂
 - ABGs
 - Daily CXR
 - VCs

Breathing cont'd



- **Intervention**
 - O₂ therapy
 - Assisted ventilation PRN
 - Medications (bronchodilators)
 - Positioning and mobilizing
 - Chest physio
 - Assisted Cough

Circulatory



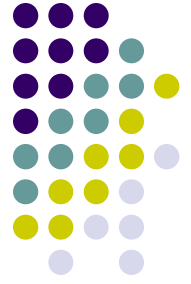
Spinal Shock

- Temporary suppression of all reflex activity below the level of injury
- Occurs immediately after injury
- Intensity & duration vary with the level & degree of injury
- Once BCR returns, spinal shock is over

Neurogenic Shock

- The body's response to the sudden loss of sympathetic control
- Distributive shock
- Occurs in people who have SCI above T6 (> 50% loss of sympathetic innervation)

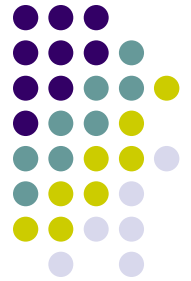
Clinical Signs of Neurogenic Shock



Clinical Triad

- Hypotension
- Bradycardia
- Hypothermia

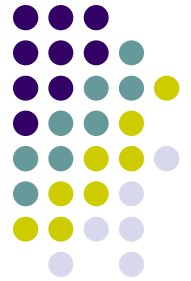
Hemodynamic State in neurogenic shock



Unopposed parasympathetic outflow can lead to cardiac dysrhythmias and hypotension (most common within first 14 days)

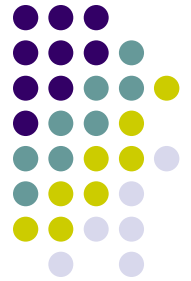
- Hypotension is due to loss of vasomotor tone → peripheral pooling of blood and decreased preload
- Most common dysrhythmia is bradycardia

Hemodynamic Instability: Intervention



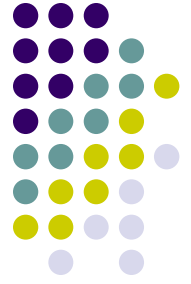
- **First Line:**
Volume Resuscitation (1-2 L)
- **Second line:**
Vasopressors-
(dopamine/norepinephrine) to
counter loss of sympathetic tone
and provide chronotropic support to
the heart

Hemodynamics and Cord Perfusion



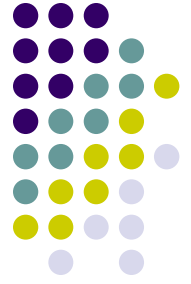
- Options:
 - Avoid hypotension
 - Maintain MAP 85-90mmHg for first 7 days if possible (**Vale et al, 1997**)

Bradycardia: Intervention



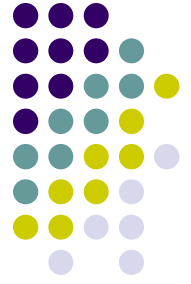
- Prevention:
 - Avoid vagal stimulation
 - Hyperventilate and hyperoxygenate prior to suctioning
 - Pre-medicate patients with known hypersensitivity to vagal stimuli
- Treatment of Symptomatic Bradycardia:
 - Atropine 0.5 - 1.0 mg IV

GI System



- Risk of aspiration is high due to:
 - cervical immobilization
 - local cervical soft tissue swelling
 - delayed gastric emptying
- Parasympathetic reflex activity is altered, resulting in:
 - decreased gut motility and
 - often prolonged paralytic ileus.

GI Intervention



- Minimizing Risk for Aspiration:
 - Nasogastric tube
- Minimizing Risk of Gastric Ulceration:
 - IV Ranitidine 50mg IV q8h

Pain Management

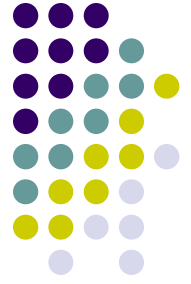


IASP Proposed 2 Broad Types:

- Nociceptive: Musculoskeletal and Visceral
 - Responds well to opioids and NSAIDS

www.iasp-pain.org

Pain Management



- Neuropathic: Above Injury/At Injury Level/Below Injury Level
 - Somewhat sensitive to Morphine
 - More sensitive to anticonvulsants (gabapentin) and tricyclics (nortryptiline)

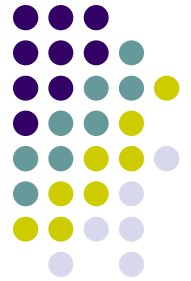
www.iasp-pain.org

Pharmacologic Therapy



- Option: Methylprednisolone

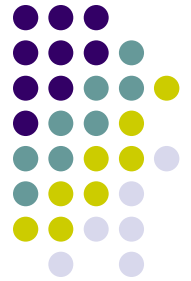
MPSS Evidence



- NASCIS II (1992)
 - 30mg/kg IV loading dose + 5.4 mg/kg/hr (over 23hrs) effective if administered within 8 hours of injury
- NASCIS III (1997)
 - If initiated < 3hrs continue for 24 hrs, if 3-8 hrs after injury, continue for 48hrs (morbidity higher - increased sepsis and pneumonia)

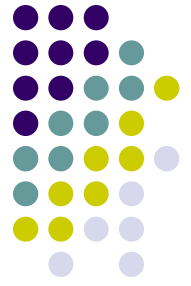
Both studies criticized for methodology

MPS Clinically Effective?



- Meta-analysis showed **insufficient evidence** to support use of high dose MPSS in ASCI as a treatment **standard** or **guideline** for treatment.
- **Weak clinical evidence** to support MPSS as per NASCIS II but not NASCIS III protocol as an **option** for treatment.

Canadian Association of Emergency Physicians Jan 2003



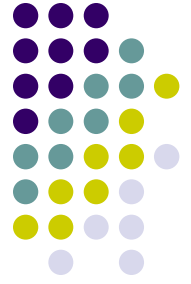
Cervical traction

- To realign and stabilize the spine
- Fastest method of increasing the diameter of the spinal canal
- Muscle relaxants and the reverse Trendelenberg position may facilitate reduction



Cervical traction

- Considerable controversy exists regarding the role of pretraction MRI in patients with cervical fracture dislocations
- Absolute contraindications:
 - Occipitoatlantal dislocations
 - Concomittant open skull fracture
- Most neurosurgeons believe that prompt restoration of the diameter of the spinal canal plays an important role in neurologic recovery



Indications for surgery

- Deformity correction
- Stabilization of the spine
- Decompression of neurologic elements (controversial)
 - Does decompression improve neurologic outcome?
 - Does timing of spinal cord decompression after trauma in patients with complete SCI's improve outcome?

PROGNOSTIC FACTORS for recovery



- Patients with complete cervical injuries that remain complete within the first 24 hours of admission are unlikely to regain significant ambulatory function (1% to 3%)
- Cervical injuries have a higher potential for recovery than do thoracic or thoracolumbar injuries
- Younger patients fare much better than older folks
- Intermedullary hemorrhage signifies a worse neurologic and functional outcome.



THANK YOU