Cervical Spinal Injuries

- Common mechanism is extension or axial compression with buckling into extension.
- Structures most often injured are discs & facets.
- Disc & facet injuries are equally frequent.
- Major vertebral fractures are relatively unusual
- Other soft tissue injuries - exception of muscle bruising, these injuries were less frequent than injuries to the discs, facets and neural structures

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Mechanisms of injury to discs and facet joints:

In **extension** there is anterior distraction. In **flexion** there is anterior comp posterior compression & shear.

In head impact there is also, as a rule,:
- axial compression.

A rear impact also causes axial compression since straightening the thoracic kyphosis transmits an axial compressive force to the cervical spine.
Acute facet joint injuries are signalled by bleeding into the joint, from a ruptured synovial fold, damaged articular surface, or a facet fracture. They are often multi-level injuries due to compression extension forces. In this woman haemarthroses are seen in C4-5, C5-6 & C6-7.
Facet joint injuries: summary

- Most facet injuries are due to compression extension.

- Synovial folds (SF) or articular cartilages (AC) are frequently injured. SF move freely in & out of the joint but in the few milliseconds after motor vehicle impact they are trapped by the sudden movement.

- The AC may be fractured or stripped from the underlying bone. In survivors, AC damage is slow to heal & may lead to accelerated degeneration.

- In well aligned spines most facet fractures were not visible on post-mortem x-rays & only became evident on sectioning.
Central cord haemorrhage in 67 year old man (surfing injury): note haemorrhages opposite disc ruptures
Upper Cervical Injuries

• 1. Fractures and fracture dislocations:
Fractures of the dens of C2 are the most common of these injuries, but in this fatal series, atlanto-occipital dislocations with brain stem injury are also common.

• 2. Soft tissue injuries:
The most common of all cervical injuries is bruising of the synovial folds in the lateral atlanto-axial joints. Injuries to the alar or transverse ligaments are more serious but less common, except as part of a fracture dislocation.
Sagittal sections of cervical spine showing dens fracture in 86 year old woman

The stiff degenerate segments from C4 to T1 predisposed to upper cervical injury when the woman fell forward & struck her head with forcible neck extension.
Signs & symptoms

• What would expect with a cord injury?
• What would you expect with a upper cervical soft tissue injury?
• Clinical Tests?
• Patient example!
The most common soft tissue injury in the upper cervical spine is bruising of the posterior synovial fold, often with a haematoma around C2 (DRG= dorsal; root ganglion).

The 66 year old man sustained a head injury when the car he was driving hit a kangaroo.
Dorsal Root Ganglion.

- Role in neuropathic long term pain.
- How would this patient present?
Cervical Disc injuries

1. Rim Lesions (anterior annular tears at the vertebral rim)

2. Disc Avulsions along disc vertebral junction (young spines)

3. Disc Disruptions: jagged irregular tears (old spines)

4. Traumatic Herniations - into the spinal canal
Rim Lesion

- The most common disc injury
- A horizontal annular tear at the anterior vertebral rim, without tearing the anterior longitudinal ligament (ALL).
- Often a multilevel injury
Rim lesions from motor vehicle accidents

42M

C2-3: 19M

C 4-5

Anterior annulus of C5-6
Disc Avulsions

- Separation of disc from vertebral body along disc vertebral junction.
- The most common severe disc injury in subjects under age 55 years
- Variable extent of ALL damage
- Usually leaves anterior muscles intact
Two thirds of the disc is avulsed from the vertebral end plate in this 42 year old man, injured in an MVA; cause of death = traumatic subarachnoid haemorrhage.

The ALL is partly torn;
The disc is avulsed, but the longus colli muscle is intact
There is also a posterior disc contusion
Disc Disruption

- Irregular tear through disc
- Occurs in middle aged and elderly subjects
- Variable extent of damage to anterior or posterior longitudinal ligaments (ALL + PLL)
Disc disruption from distraction-extension injury (62 year old man) with # of anterior inferior osteophyte
Traumatic Disc Herniation

- Posterior longitudinal ligament may be intact
- Engorged veins above and below disc hernia
- Disc may impinge on dura or spinal cord
- Disc hernia may migrate downwards from level of origin
C2-3 traumatic herniation in a 22 year old woman killed in a head on car collision with anterior head impact and neck extension injury.

- Tear of ligamentum flavum
- Indentation of spinal cord
- Herniation causes tenting of PLL & dilation of veins
Do the lesions of Neck sprain seen in fatal accidents also occur in whiplash?

- Whiplash is not usually fatal and imaging is inefficient in demonstrating soft tissue pathology.
- The neck sprain lesions in fatal head injuries are similar to those in fatal torso injuries with no evidence of head impact.
- Similar lesions to those described at autopsy have been observed in living patients & in survivors of other causes of head trauma.
Rim lesion with annulus calcification, in C5-6: in autopsy specimen 14 months after injury & in the X-ray of a patient after a similar injury.

The Alizarin has stained new bone in the anterior annulus, formed since the injury. There is an age related fissure.
C5-6 rim lesion 3.5 years after whiplash injury (autopsy after suicide - chronic pain + depression)

At this stage, the original linear rim lesion has become cystic.
Vascular changes with chronic headaches:
Dilated, thin-walled veins behind C1-2 lateral joints in 2 young adult subjects who died of drug overdoses; there was a history of chronic neck pain & headaches following whiplash.
X-ray & MRI scan in 20 year old woman after whiplash

The injury was not initially investigated except by plain x-ray, though there were clinical signs of a C6 radiculopathy; the initial x-ray shows slight flattening of the uncus at C5-6; 4 years later, with continuing C5-6 symptoms & signs, the MRI showed a C5-6 herniation.

there is slight flattening of the spinal cord
Poor Prognosis in whiplash

- after a rear-end collision
- with early onset of pain
- with neck stiffness, abnormal curves,
- with the presence of neurological signs,
- in older patients with degenerative changes
- in females

Average duration of symptoms in survey of 2627 WAD:
Young men = 17 days; older women = 262 days (Suissa, 2002)
Physical Injury or psychopathology? Chronic Neck Pain May Persist

- It is mistaken to blame most chronic pain and disability from whiplash on psychosocial factors. These are generally sequelae of the injury, not the cause of the pain and disability.

- **Nociception may persist**, months or years after an injury and its segmental origin should be investigated.

- **Increased pain sensitivity**
  - central changes
  - hyperalgesia
  - allodynia

- **Psychosocial influences**
Thoracic Spine

• Ribs attach at costovertebral & costotransverse joints
• Spine stiffened & strengthened by thoracic cage
• Facets favour axial rotation
• Vulnerable to:
  » growth-related deformities,
  » age-related osteoporosis.
  » flexion-compression fractures
Costo-vertebral joint histology in coronal section:
The synovial joint in a 100 micron stained section shows that hyaline articular cartilages (AC) line the head of the rib and the vertebral margins but (green-staining) fibrocartilage (FC) lines the disc surface.
An old spine contrasts gross degeneration of C6-7 disc with good preservation of C7-T1 & T1-2 discs.
Age changes in the thoracic spine

**Osteoporosis**

- Vertebral bodies lose trabeculae
- Loss of transverse ties -> collapse of load bearing beams
- Vertebral end plates collapse -> concavity
- Increased kyphosis & loss of stature with ageing
Osteoporosis:

Predominantly affects post-menopausal women and generally affects men about a decade later.

The x-ray shows collapse of the vertebral endplates with marked increase in endplate concavity or loss of vertebral height. The decreased bone density of the internal cancellous bone contrasts with the preservation of the peripheral compact shell.

Adequate **exercise**, calcium & hormones & can prevent it.
Osteoporotic Fracture.

• What must you consider?
• What can be done?
• What are the risk factors?
Thoracic injuries

- Disc injuries predominate in Cx
- Vertebral body injuries predominate in the Tx
- L1 vertebral body injuries occur with similar high frequency to T12 injuries
- Facet injuries are common in Cx & Tx regions
Axial compression injury: bone bruising in T 12 with bleeding into the disc above through an endplate #. 

Bone bruising
Wedge compression fractures:
left - acute ;
right - similar fracture
long term result
Vertebral body metastasis from lung cancer:

Cancer can reach vertebral bodies through segmental veins, which connect through the IV foramen with the internal vertebral venous plexus and the basivertebral veins. The vertebral veins are valveless and blood can flow in any direction (according to local pressures).
Spinal Ca.

- PH – CA. – at anytime especially Breast, lung and Prostate.
- 30% patients with cancer – develop spinal mets.
- Tx>Lx>Cx>Sx
- Can also be transferred via CSF after Brain mets.
- Paravertebral soft – tissue tumours can also extend into the spine. i.e Lung-Tx