Cervical Spine

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Contents:

- Spine:
  - Anatomy & Biomechanics
  - Assessment / Diagnosis:
    - Hx
    - P/E
    - Ix
    - DDx
  - Cervical Spine

- Lumbar Spine:
  - Lumbar Spine Injuries
  - Common degenerative conditions:
    - Spondylolysis
    - Spondylolisthesis
    - LBP

Key Components in Management:

- Look out for Red Flag Signs
- Components of Symptoms and signs:
  - Local: Pain, Deformity
  - Neurological: Sensory, Motor
- Components of problems:
  - Compression +/- Deformity +/- Instability

Anatomy of the Spine:

- Bony Vertebral Column:
- Spinal Cord and Spinal Nerves:

Basic Anatomy of the Spine:

- The vertebral column:
  - 33 vertebrae
  - 5 segments
    - Cervical
    - Thoracic
    - Lumbar
    - Sacral
    - Coccygeal

Basic Anatomy of the Spine:

- The vertebral column:
  - 33 vertebrae
  - 5 segments
    - Cervical -7
    - Thoracic -12
    - Lumbar -5
    - Sacral -5
    - Coccygeal -4

Anatomy- The vertebra:

- The vertebra of each segment:
  - A Body
  - A Spinous process
  - 2 Transverse processes
  - 2 Pedicles
  - 2 Arches
  - 2 Laminae

Anatomy- C1 and C2:

- C1: being a ring
- C2: a bony peg that articulates with the ring of C1

- The atlantoaxial and atlanto-occipital joint:
  - Contributes significantly to rotation and flexion / extension of the skull on the neck

Anatomy- Spinal Cord

- Gray matter:
  - A cellular core

- White matter:
  - A fibrous layer
  - 4 funiculi:
    - right lateral, left lateral, ventral and dorsal
  - Axons of lower motor neurons & afferent sensory neuron axons
  - Tracts of ascending and descending axons- pathways

•Lateral spinothalamic tract
•Dorsal column
•Lateral corticospinal tract

Assessment / Diagnosis:

- History:
- P/E:
- Investigations:

Assessment / Diagnosis:

- Proceeds as follows:
  - Quantitate the morbidity
  - Delineate the psychological factors
  - Eliminate tumors and infections
  - Identify the clinical syndrome
    - » Robert G. Watkins. The Spine in Sports. 1996

Red Flags for Acute Low Back Pain:

- History
  - Cancer, Unexplained weight loss, Immunosuppression, Prolonged use of steroids, Intravenous drug use, Urinary tract infection, Pain that is increased or unrelieved by rest
  - Fever
  - Significant trauma
  - Bladder or bowel incontinence, Urinary retention (with overflow incontinence)

- Physical examination
  - Saddle anesthesia
  - Loss of anal sphincter tone
  - Major motor weakness in lower extremities
  - Fever
  - Vertebral tenderness
  - Limited spinal range of motion
  - Neurologic findings persisting beyond one month

P/E:

- Look:
- Feel:
- Move:
- Specific tests:
  - Neurological Assessment

P/E- Look:

- General:
  - Patient's attitude
  - In pain, irritated, angry, or frustrated.
- Watch the patient,
  - Note any kyphosis, scoliosis, torticollis, difference in shoulder height or other abnormalities
  - Much can be learned from observing the patient undress
- Look for:
  - Any signs of trauma, blisters, scars, discoloration, contusions, limb asymmetry and atrophy

P/E- Kyphosis Vs Lordosis

P/E- Principles of Neurological Assessment:

- Systemic evaluation and documentation of results
  - motor ….including anal sphincter
  - sensory…including proprioception
  - deep tendon reflexes …. presence and quality
  - long tract signs
  - presence of sacral sparing….incomplete
  - bulbocavernosus reflex
- In patients with neurological deficit:
  - Key is to distinguish between *complete and incomplete neurological deficits +/- progression*

P/E- Muscle Grading:

- Grade 0:
  - total paralysis
- Grade 1:
  - (trace) palpable or visual contraction without joint motion
- Grade 2:
  - (poor) complete range of motion of joint with gravity eliminated
- Grade 3:
  - (fair) complete range of motion of joint against gravity
- Grade 4:
  - (good) complete range of motion of joint against gravity with some resistance
- Grade 5:
  - (normal) complete range of motion of joint against gravity and resistance

P/E- Sensory:

- Dermatomal and sensory distribution

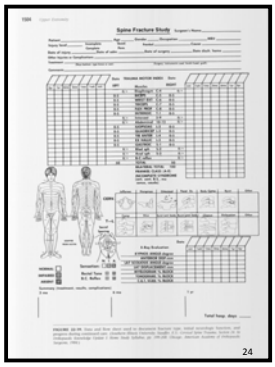
• *Redrawn from Patton HD, Sundsten JW, Crill WE, et al, eds: Introduction to basic neurology, Philadelphia, 1976, Saunders.*

P/E- Sensory:

- Spinal nerves exit the canal at each level
  - Spinal nerves C2-7 exit above the pedicle for which they are named
    - the C6 nerve root exits the foramen between the C5 and C6 pedicles
  - The C8 nerve root exits the foramen between the C7 and T1 pedicles.
  - All spinal nerves caudal to C8 exit the foramen below the pedicle for which they are named
    - the L4 nerve root exits the foramen between the L4 and L5 pedicles

P/E- Neurological Assessment:

- Can use various forms to facilitate clear documentation



P/E- Cervical spine:

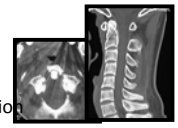
- Look:
  - Importance ?

Cervical spine injury- Classification (1):

- Mechanism of cervical spine injury:
  - Flexion
  - Flexion rotation
  - Extension rotation
  - Vertical compression
  - Hyperextension
  - Lateral Flexion
  - Diverse or imprecisely understood mechanisms

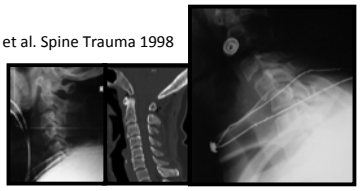
Cervical spine injury- Classification (2):

- Upper cervical spine:
  - Occipital condyle fracture
  - Occipital-cervical instability / dislocation
  - Atlas fracture
  - Atlatoaxial rotatory instability
  - Rupture of transverse ligament
  - Odontoid fracture
  - Traumatic spondylolisthesis of axis
  - Extension teardrop fractures of C2
  - Lateral mass fracture of C2



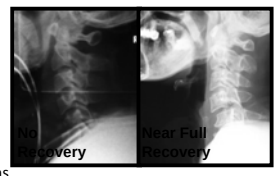
Cervical spine injury- Classification (2):

- Lower cervical spine:
  - Compression
  - Burst fracture
  - Teardrop
  - Facet fractures and dislocation
  - Extension
    - Alan M Levine et al. Spine Trauma 1998



Cervical spine injury- Classification (3) Components to be included ?:

- A comprehensive classification is difficult…
  - **Aims:**
    - predicting outcome
    - assisting treatment
    - standardizing nomenclature
  - **Approaches:**
    - 1. mechanistic considerations
    - 2. radiological description of fracture pattern / displacement
    - 3. injury prognosis



Cervical spine injury- Classification (3) Components to be included ?:

- A comprehensive classification is difficult…
  - Anatomical segments: upper cervical Vs lower cervical
  - Mechanism: multiple components
  - Stability: no accurate and definable concept
  - Anatomical structures: bony Vs ligamentous (some are occult)
  - Neurological deficit:
  - Ix: XR / CT / MRI / different positioning

Look

Move

Feel

P/E- Cervical spine:

- Feel:

Greater Occipital Nerve

P/E- Cervical spine:

- Move- active:

P/E- Cervical spine:

- Move- passive:

P/E- Cervical spine:

- Move- resisted:

Cervical spine- Neurological assessment:

Cervical spine- Neurological assessment:

- Shoulder abduction: C5
  - Deltoid (C5, C6)
  - Supraspinatus (suprascapualr nerve C5, C6)
  - Biceps reflex: C5
- Elbow Flexion: C5, C6
- Wrist extension: C6
  - Brachioradialis reflex: C6
- Elbow extension: C7
- Wrist flexion: C7
  - Triceps reflex: C7

Cervical spine- Neurological assessment:

- Shoulder abduction: C5
  - Biceps reflex: C5
- Elbow Flexion: C5, C6
  - BR (MCN, C5, C6)
  - Biceps (MCN, C5, C6)
- Wrist extension: C6
  - ECRL + ECRB (RN, C5, C6)
  - ECU (RN, C6)
  - Brachioradialis reflex: C6
- Elbow extension: C7
- Wrist flexion: C7
  - Triceps reflex: C7

Cervical spine- Neurological assessment:

- Shoulder abduction: C5
  - Biceps reflex: C5
- Elbow Flexion: C5, C6
- Wrist extension: C6
  - Brachioradialis reflex: C6
- Elbow extension: C7
  - Triceps (RN, C7)
- Wrist flexion: C7, C8
  - FCR (MN, C7)
  - FCU (UN, C8)
  - Triceps reflex: C7

Cervical spine- Neurological assessment:

- Finger flexion: C8
  - FDP (UN + MN, C8, T1)
  - FDS (MN, C7, C8, T1)
- Thumb adduction: C8
  - Adductor pollicis (UN, C8)
- Finger abduction: T1
- Finger adduction: T1

Cervical spine- Neurological assessment:

- Finger flexion: C8
- Thumb adduction: C8
- Finger abduction: T1
  - Dorsal interossei (UN, C8, T1)
  - Adbuctor digiti minimi (UN, C8, T1)
- Finger adduction: T1
  - Palmar interossei (UN, C8, T1)

Cervical spine- Special test:

- Foramina Compression test (Modified Spurling's Maneuver):
  - Test: Extension + slight rotation and bending + a brief axial pressure to the head
  - +ve
    - =>: A root compression (inadequate intervertebral foramina)

Cervical spine- Special test:

- Axial Separation (Distraction) test:
  - Test:
    - In slight flexion and extension and in neutral position
  - Principle:
    - Distraction cause opening of foramina
  - Key:
    - Helps to determine appropriate treatment and effects of neck traction

Cervical spine- Special test:

- Lhermitte's Test (or phenomenon):
  - Test:
    - Flexion
  - Principle:
    - Caused by anterior compressive lesions
  - +ve:
    - Reported as shocks or weakness (arms +/- legs)
    - A shooting fashion down
    - =>: A sign for myelopathy

Cervical spine- Special test:

- Hoffman's test:
  - Test:
    - Flick the nail of middle finger
  - +ve:
    - thumb and muscles of the hand flex
    - =>: a sign for myelopathy / upper motor neuron lesion in upper limb

Cervical spine- Special test:

- Pathological reflexes (1):
- A sign for cord irritation / myelopathy
- Crossed radial reflex:
  - percussing the biceps tendon
  - +ve: Both a biceps and a wrist extensor reflex are elicited

Cervical spine- Special test:

- Pathological reflexes (2):
- A sign for cord irritation / myelopathy
- Inverted radial reflex:
  - percussing the BR
  - +ve: Both a wrist extensor reflex and finger flexor responses are elicited

Cervical spine- Special test:

- A sign of proprioception deficit:
  - Static Romberg's test:
    - Closed eyes
  - Dynamic Romberg's test:
    - Heel-to-toe walking
  - +ve:
    - => either from central (cerebellar) or from myelopathy

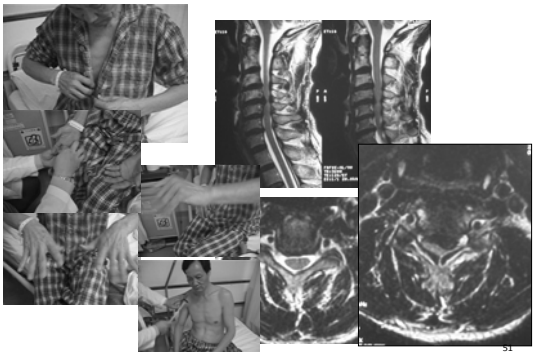
CS- PID- Myelopathy:

- Case I.1:
- M/52
- Progressive onset of unsteady gait + clumsiness of hands (Left side more severe)

CS- PID- Myelopathy:

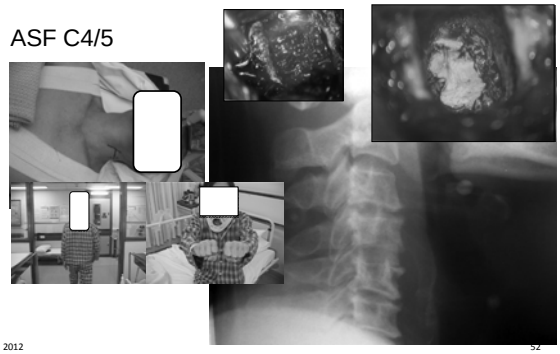
- Buttoning and unbuttoning:
- Hoffman's sign:
- 10 second test:
- Brisk Jerks:

CS- PID- Myelopathy:



CS- PID- Myelopathy:

ASF C4/5



Ix- XR:

XR- Cases with Infection or Metastasis:

- Case I.2:
- F/50
- Recent travel to China
- Progressive neck pain
- Systemic symptoms: +:
- Questions:
  - What do you find in the XR ?
  - Symptoms of TB Spine ?

TB Spine – Symptoms:

- Highly variable
- Pain is the most common symptom,
- Systemic symptoms:
  - malaise, fevers, night sweats and weight loss,
- Rarely nowadays:
  - cutaneous sinuses, neurological deficits and kyphotic deformities.

TB Septic Spondylitis at C6/7 level:

TB Spine:

- Mycobacterium tuberculosis is the pathogen responsible for spinal tuberculosis.
- The spinal focus is usually secondary to an extra-spinal source of infection.

TB Spine:

- The classic description: Percival Pott in 1779.
- Chemotherapeutic agents in 1944
- Active surgical intervention:
  - 1944 by Wilkinson,
  - 1950s popularized by Hodgson.
- Ambulatory Chemotherapy:
  - 1958 by Konstam and Konstam in Nigeria
- antituberculosis drugs and improved public health measures;
  - infrequent problem in Western nations.
  - diagnostic challenges

TB Spine:

- At risk persons groups:
  - recent immigrants,
  - AIDS,
  - homeless,
  - ethanol and drug abusers ,
  - …in correctional institutions or long-term care facilities.

TB Spine:

- 1974/ 1976 / 1978 -MRC-JBJS:
  - in Rhodesia, Korea, HK
  - for outcome assessment with 'favourable status' only
  - exclusion - significant neurology & cannot walk across the room / antiTB treatment > 1year / significant extraspinal disease / > 3 levels
  - HK RADICAL VS DERRIDEMENT VS AMBULATORY TREATMENT
    - 5, 10, 15 year reports
  - all give similar result of 87% in terms of favorable outcome (no CNS involvement / no sinus /no abscess/ no XR evidence of activity of disease / no restriction of ADL)

TB Spine:

FUSION:

I. HKOT - much higher (earlier) fusion rate of 85% at 5 years & 94% at 15years
   - CONSERVATIVE - 46% (at 5 years) & 72% (at 5 years) only

2. According to Prof. J Leong:
   - bony union is a definite sign for healing- avoid subsequent recurrence.

A Case with Pyogenic Infection:

- Case I.3:
- M/42
- IVDA
- Progressive neck pain
- Fever +

- Question:
  - Mechanisms that allow bacteria to spread to the spine ?
  - People at risk ?
  - Ix ?

Mechanisms of Spread to Spine:

- 1. Haematogenous route:
  - Venous theory:
    - by Batson, a retrograde flow from pelvic venous plexus to the perivertebral venous plexus via valveless veins.
  - Arteriolar theory:
    - by Wiley and Trueta
- 2: Contiguous spread:
- 3: Direct implantation:
  - Trauma, puncture, or operative procedure.

Patients at risks:

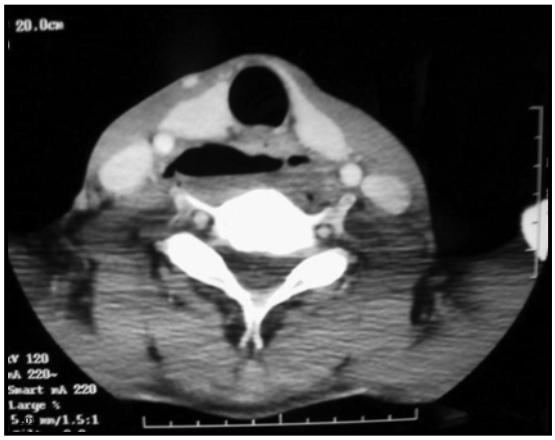
- IVDA,
- Elderly,
- DM, Renal impairment, RA, Chronic steroid user…,
- Patients who have undergone spinal surgery.

Diagnostic Tests for Suspicious Cases:

- Lab. Tests: CBP (WBC + ve in 42%), ESR (+ ve in 92%), C-reactive proteins, +/- Blood culture (+ ve in 6-24%),
- Imaging Tests: XRs, Contrast CT, MRI, Technetium bone scan,
- Biopsy:

Diagnostic Tests for Suspicious Cases:

- Biopsy:
  - In the absence of +ve blood culture,
  - To identify the causative organism,
  - Should be performed before start of antibiotics
  - CT guided biopsy, closed Craig needle, yielded 68-82%,
  - If a closed biopsy is negative after two attempts, an open biopsy can be considered.



Cervical Spine – Infection: Goals of treatment:

- Early definitive diagnosis
- Eradication of infection
- Preservation of spinal stability
- Prevention or reversal of neurological deficit
- Relief of pain
- Correction of spinal deformity

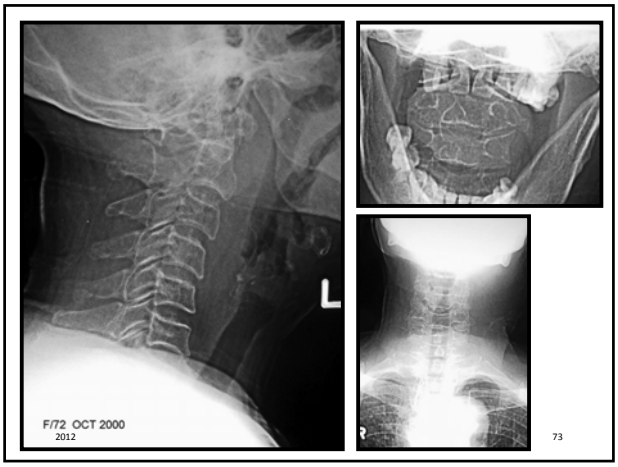
Pyogenic Septic Spondylitis C5/6:

Indications for operative treatment:

- Open Biopsy (failed closed biopsy)
- Drainage of abscesses
- Failure of medical management
- Decompression of spinal cord compression associated with neurological deficit
- Correction of progressive or unacceptable spinal deformity
- Correction of progressive or unacceptable spinal instability

A Case with Neoplasm:

- Case I.4:
- F/72,
- Insidious onset of neck pain,
- Rest pain,
- Constitutional symtpoms: +
- No fever…



Cervical Spine – Neoplasm:

- Case I.5:
- M/43
- Insidious onset of severe neck pain
- Rest pain: +
- Constitutional symptoms: +

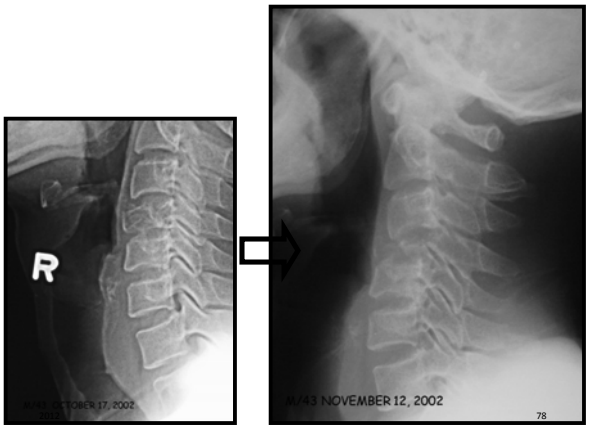
- Questions:
  - Where is the primary ?

Commonest Tumor Metastasize to Spine?

- Prostate (osteoblastic lesion)
- Thyroid
- Breast
- Lung
- Kidney

XR Changes:

- Most are osteolytic lesions
- Not demonstrated on XR until more than 30% destruction of the vertebral body has occurred,
- Absent pedicle (in lumbar spine => “winking owl” sign), vertebral cortex erosion / expansion,
- Vertebral collapse.



What causes pain ?

- Possible causes:
  - Hyperemia and edema secondary to tumor,
  - Expansion of the tumor into periosteum,
  - Direct compression of nerve roots,
  - Spinal cord compression,
  - Pathological fractures with subsequent segmental instability.

Cervical Spine - ?

- Case I.6:
- M/66
- Severe neck pain and right shoulder pain for 2/7
- …

Septic Spondylitis C5/6:

Cervical spine injury:

- Introduction
- Acute management
- Fractures and dislocations
- Clinical conditions with sensory and motor disturbance
- Prevention

Cervical spine injury- Introduction:

- 1.4 million football players (HS & colleges)
- 14% players suffer C-spine injuries
- Overwhelming majority self limited
- 1977-1989: 127 players suffered permanent spinal cord injury
  - » NCAA study. Spinal Disorders 1990;3:227
- 50% college players with history of neck injury showed XR changes
  - » JAMA 1976;236:1243

Heirarchy of injuries:

- Cervical myofascial strain:
- Cervical ligamentous sprain:
  - Stable
  - Unstable
- Cervical spine fractures:
  - Stable
  - Unstable +/- neurological deficit

Instability ?:

- Definition:
  - White and colleagues described clinical stability as the ability of the **spine** to limit its patterns of displacement of physiologic loads to prevent damage or irritation of the spinal cord or the nerve roots
    - » White A.A., Punjabi M.M.: *Clinical Biomechanics of the **Spine***. Philadelphia, JB Lippincott, 1978

Instability- Clinical criteria:

- ***Element*** ***Point Value***

Anterior elements destroyed or unable to function	2
Posterior elements destroyed or unable to function	2
Relative sagittal plane translation >3.5 mm	2
Relative sagittal plane rotation > 11 degrees	2
Positive stretch test	2
Medullary (cord) damage	2
Root damage	1
Abnormal disc narrowing	1
Dangerous loading anticipated	1

- » *From White AA, Southwick WO, Panjabi MM: Clinical instability in the lower cervical **spine**: a review of past and current concepts, **Spine** 1:15, 1976.*
- Total of 5 or more = unstable.

Cervical Spine- Trauma:

- Case I.7:
  - M/73
  - Fell down stairs
  - Head Injury and Upper Neck pain
  - Initial assessment ?

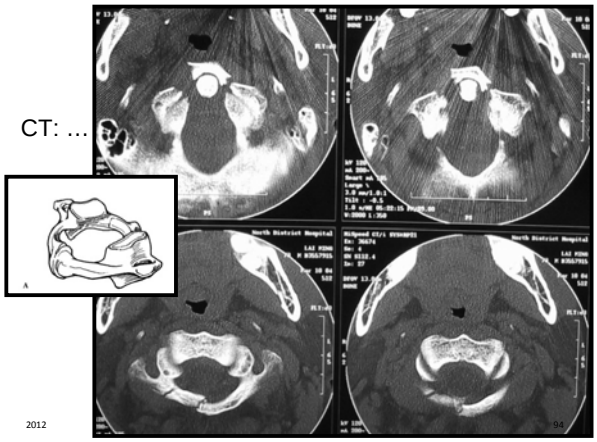
Cervical Spine- Trauma:

- Require thorough evaluation;
- Frequently no specific symptoms or findings on P/E;
- Symptoms are notoriously vague and may include headaches or suboccipital pain;
- Sometimes, the patient may be unconcious following head injury;
- Neurological evaluation:
  - ASIA (American Spinal Injury Association) guidelines.

- Lateral XR:
  - …
- Further Radiological Investigation:
  - …

- Open Mouth View: …

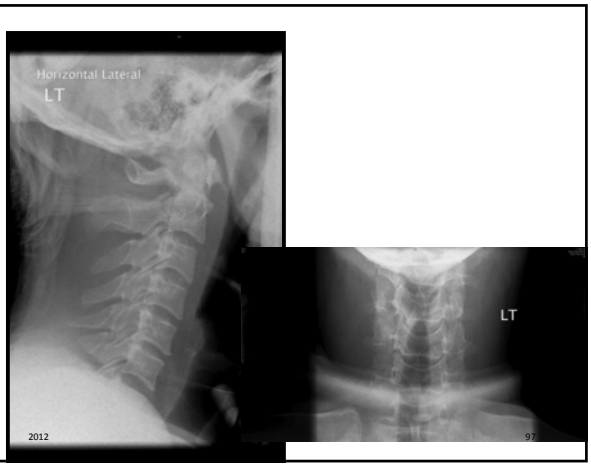
CT: …



Jefferson's Fracture: Burst fracture of Atlas

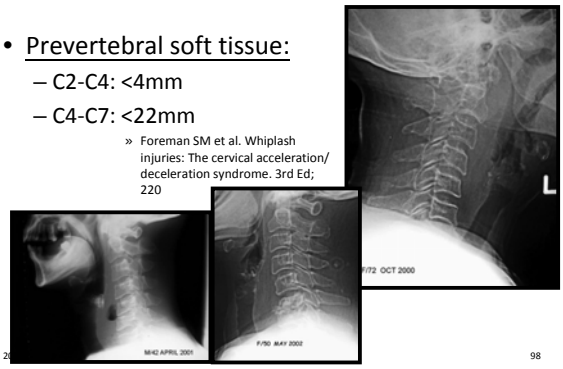
Cervical Spine- Trauma:

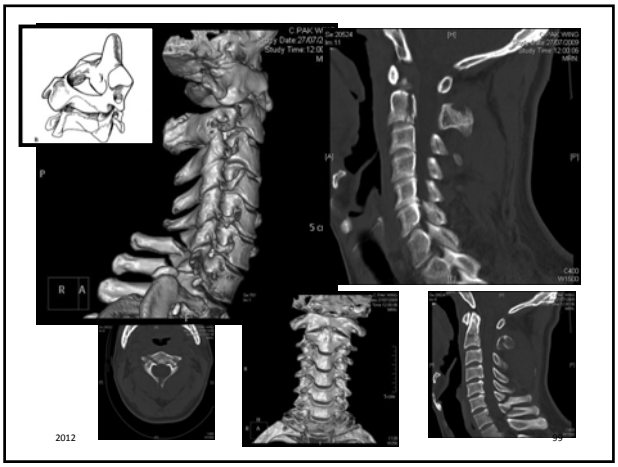
- Case I.9:
  - M/40
  - Fell from height
  - Bilateral UL numbness



Cervical Spine- Lateral XR:

- Prevertebral soft tissue:
  - C2-C4: <4mm
  - C4-C7: <22mm
    - » Foreman SM et al. Whiplash injuries: The cervical acceleration/ deceleration syndrome. 3rd Ed; 220





SP-CS- #- Hangman's #:

- Judicial hanging:
  - *A posterior (suboccipital) knots* => asphyxiation (long time)
    - + a long drop +/- weight => cord transection.
    - too much => decapitation
  - *Submental knot:*
    - => #/ dislocation of axis with cord transection
    - Precisely, a bilateral pedicle fracture of C2, along with distraction of C2 from C3 secondary to complete disruption of the disk and ligaments between C2 and C3
    - recommended for English judicial hangings

SP-CS- #- Traumatic spondylolisthesis:

- Classification:
  - I. # at pars interarticularis - hyperextension & axial load
  - II. >3mm translation + angulation - initial hyperextension (bilateral pars #) then sudden secondary flexion (disrupt C2-3 disc + PLL + ALL)
    - II A. Levine & Edwards modification (1985) - Angulation only - flexion distraction injury - intact ALL
  - III. + unilateral / bilateral facet dislocation
  - VARIANT (# line to body).
    - => (part of the body remain) canal compromise
      - » Effendi (1981) + Levine & Edwards (1985)

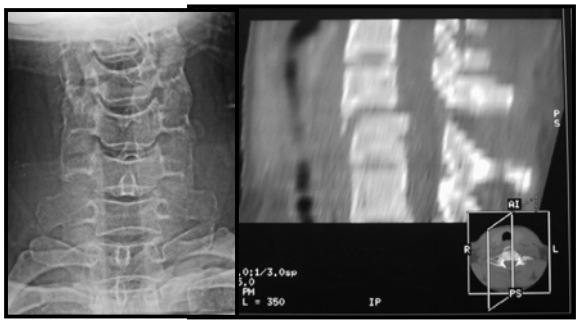
Traumatic spondylolisthesis- Treatment:

- I. Cervical orthosis: 3/12
- II. Skull tongs + traction in slight extension:
  - adequate period of traction until stable (4-6/52 for >4mm or 15 degree angulation).
- IIA. No traction + use of halo vest
  - => gravity continue compress the #.
- III. Extremely unstable: OT
  - manual reduction of facet joints + spinous process wiring or sublaminar wiring C1-C3
  - then halo-vest immobilization.

Cervical Spine- Trauma:

- Case I.10:
- F/40
- Fell from height and landed on occipital region (a flexion injury)
- Neck pain (at lower cervical region)
- Initial XR taken at A&E:

AP XR: …



CT: sagittal reconstruction view

Unilateral Locked Facet Dislocation at C6/7 (left side)

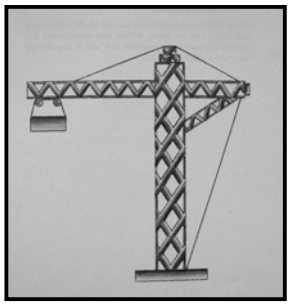
SP-CS- #- Facet dislocation:

•Key:

– Unilateral Vs Bilateral

– Facet fractures Vs Dislocations (of subaxial spine)

J Harms:



- Harris JH. Orthop CNA. 1986:17:15
- Harms J, Tabasso G. Instrumented Spinal Surgery: Principles and Technique

Restore Posterior Tensile Force:

⇨

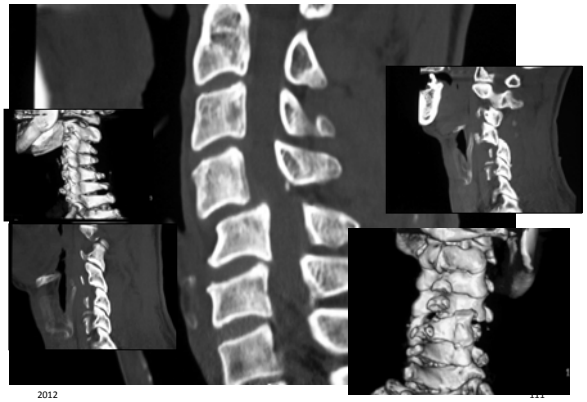
2012

Restore posterior tensile strength 109

Cervical Spine-Trauma:

- Case I.11:
  - 50/M
  - RTA
  - Neck pain
  - Could not move limbs, except pronation of the left UL

2012 110

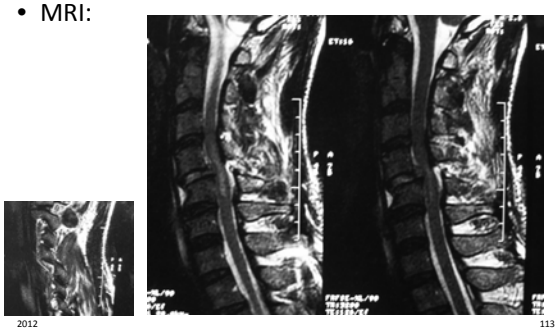


2012 111

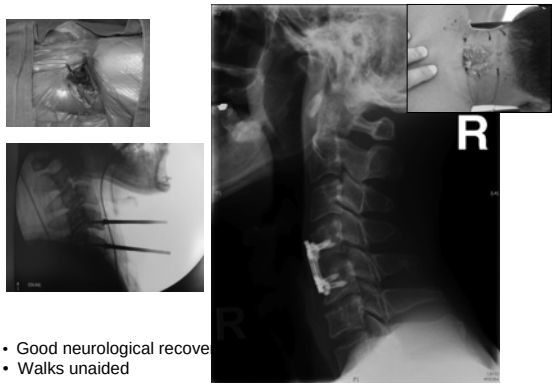
- Failed CR ?

2012 112

- MRI:



2012 113



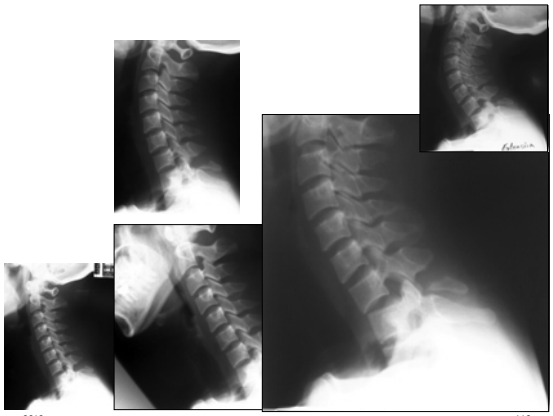
- Good neurological recove
- Walks unaided

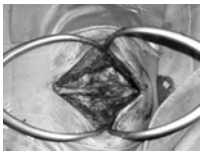
2012 114

Cervical Spine- Trauma:

- Case I.12:
- F/39
- Fell from horse
- Neck pain
- No neurologic deficit








SP-CS- Spinous Process Fracture:

- Anterior subluxation:
  - Also known as hyperflexion sprain
  - The posterior ligamentous structures fail
    - A pure subluxation injury has no associated fractures
  - XR:
    - Widening of the spinous processes
    - The disc space may be widened posteriorly and narrowed anteriorly

SP-CS- Spinous Process Fracture:

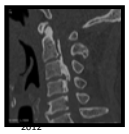
- Flexion and extension views:

- Delayed instability and pain syndromes

Central Cord Syndrome:

- First by Schneider and colleagues in 1954:
- Features:
  - A disproportionate upper extremity impairment of motor function in the upper extremities than in the lower ones
  - Bladder dysfunction
  - A variable amount of sensory loss below the level of injury
    - Schneider RC, et al. J Neurosurg. 1954;11(6):546-577
- Common in elderly
  - pre-morbid cervical spondylosis, stenosis, disc factor
  - Spinal stability is not an issue

- Thought to be due to **hyperextension**
  - **=> pincer type** injury to cervical cord
  - (between osteophytes & infold ligamentum flavum)



Central Cord Syndrome:

- The most common cause of central cord syndrome (CCS) is trauma.
- Other similar situations:
  - Acute traumatic disc herniation
  - # +/- dislocations
    - younger pts with # or acute disc herniation did achieve better motor recovery with early decompression)

Central Cord Syndrome:

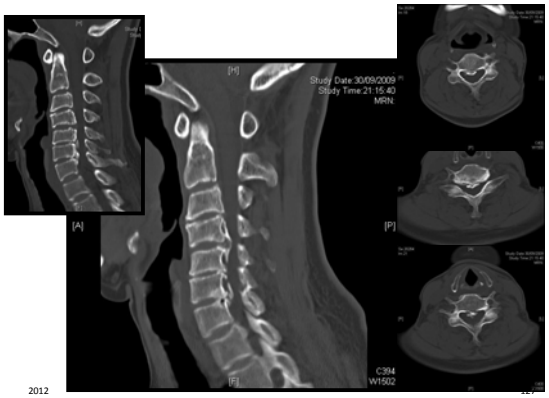
- Corticospinal tract:
  - Schneider: medial fibers of the tract + central cord haemorrhage
  - Lamination of the tract: central part => hand involvement > LL
- Others:
  - more profound reliance of hand function on intact tract

Central Cord Syndrome:

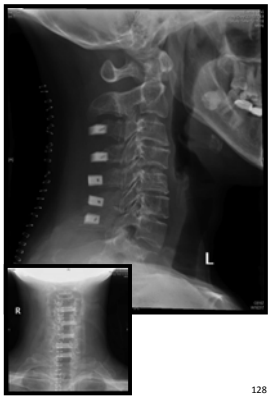
- Controversial point- early decompression in patients with Central Cord syndrome:
  - Common in elderly
  - Spinal stability is not an issue
  - No prospective randomized study
  - No neurological benefit to eary decompression (<24 hours) in eldery patients with spondylosis
    - » Guest J et al: Neurosurg 2002;97:25-32

Case I.13

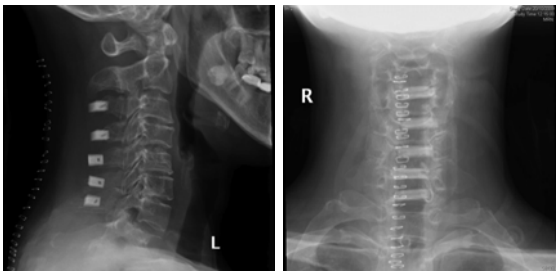
- Madam Tung
- "E" admission for sudden onset of numbness and clumsiness of limbs after swimming on September 24



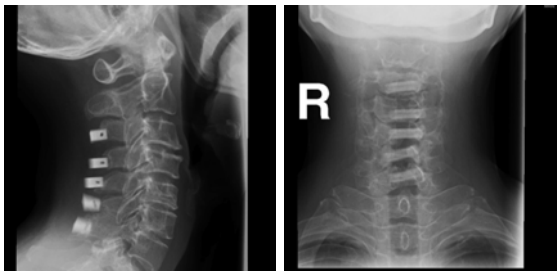
- Difficult in intubation (awake intubation)
  - Noticed increased numbness after intubation
- OT uneventful:
  - Laminoplasty C3 to C7
- Post OT:
  - Right hand and bilateral LL numbness improved
  - Left hand numbness persisted



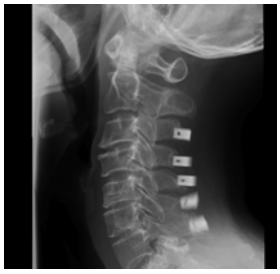
2009



2011



Decompression (2011)

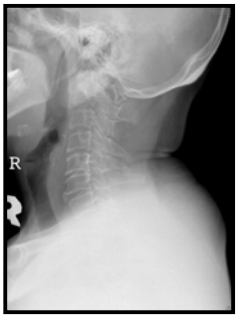


Compression => Neurological deficit

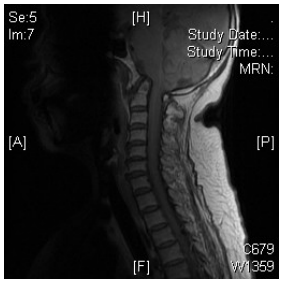
Deformity with Pain

Case I.14

- Madam Hui
- First seen in 2007 for neck pain
- Admitted for OC Fusion for basilar invagination
- No evidence of inflammatory joint diseases
- Mainly neck pain
- No neurological deficit

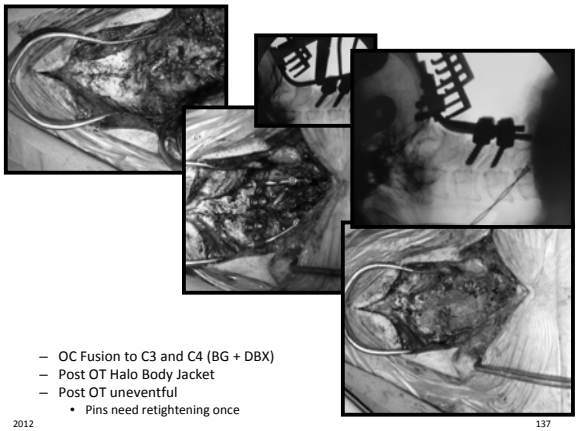


- MRI OPINIONS:
  - Occipitalization of atlas
  - Mild anterior atlantoaxial subluxation
  - Basilar impression with impaction of the medullocervical junction
  - Subaxial cervical spondylosis minimal



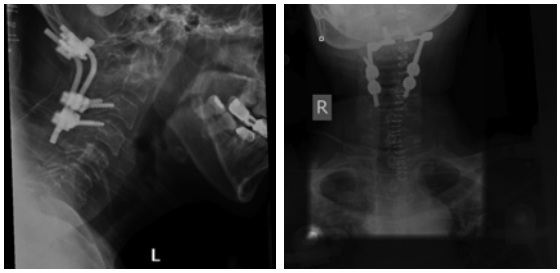
- CT scan:
  - Occipitalization of atlas with secondary right atlantoaxial joint degeneration and bony ankylosis.
  - Mild anterior atlantoaxial subluxation and atlantoaxial impaction
  - Basilar impression with impaction of the medullocervical junction
  - Subaxial cervical spondylosis.

- Flexion and extension view:
- Plan for OC Fusion to C3 and C4 + Post OT Halo Body Jacket

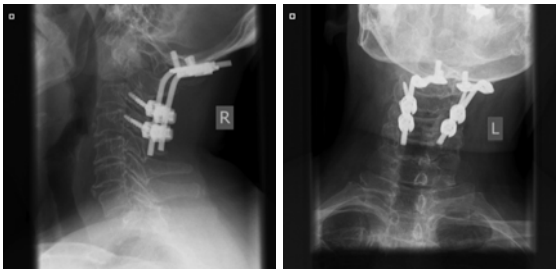


- OC Fusion to C3 and C4 (BG + DBX)
- Post OT Halo Body Jacket
- Post OT uneventful
  - Pins need retightening once

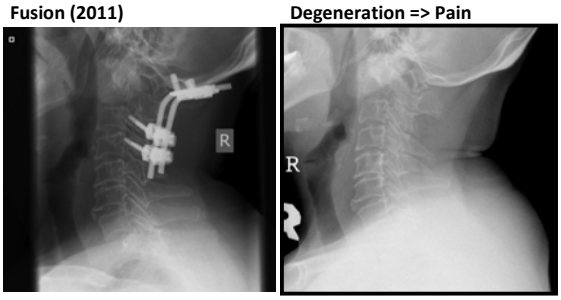
2009



2011



Fusion (2011) **Degeneration => Pain**



End of Part I