DO PLAIN FILMS STILL HAVE A ROLE IN THE EVALUATION OF POTENTIAL C-SPINE INJURIES?

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Injury Prevalence

- In North America > 13M patients treated for injuries that put them at risk of injury to cervical spine (2-6% all trauma)

- Crucial to identify # as outcomes when these are missed are potentially devastating for patients and expensive for society

Routine Trauma Series

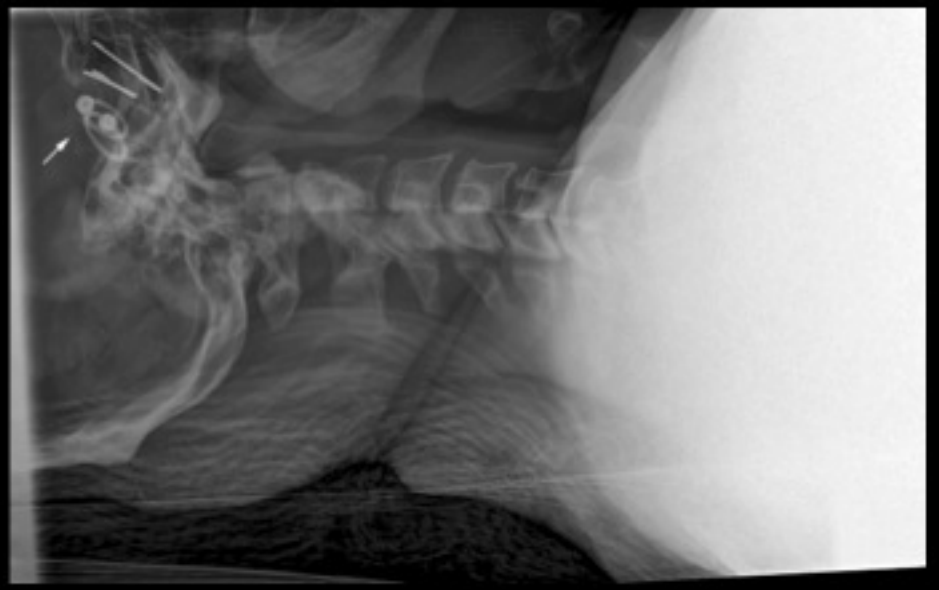
- Chest
- Pelvis
- Lateral C-Spine (cross table)

Plain films

- Screening radiography
  - is expensive - $140M USD annually
  - is low yield - only 1- 5% studies show a #
  - often leads to further imaging

C Spine Lateral

C Spine Lateral



C Spine Peg

C Spine Peg

C Spine AP

Increased use of CT

- From 1998 - 2007 prevalence of CT/MRI use in "injury-related conditions" increased three fold (from 6% to 15%) without any significant increase in diagnosis of life threatening conditions (1.7% to 2%) or change in disposition of patients

- Waiting times for patients undergoing CT/MRI were significantly increased (126 minutes longer)

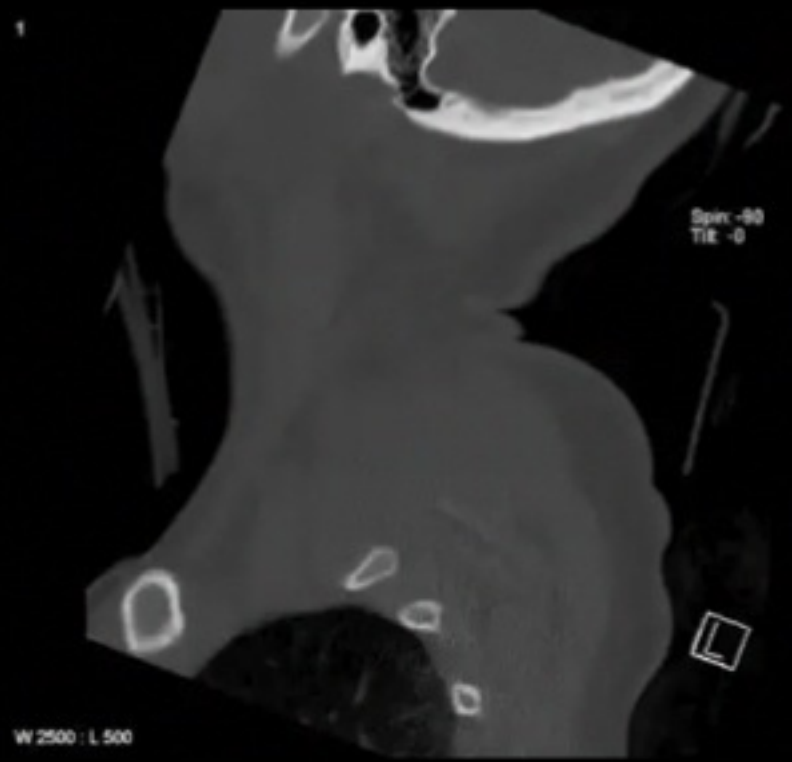
JAMA. 2010;304(13):1465-1471

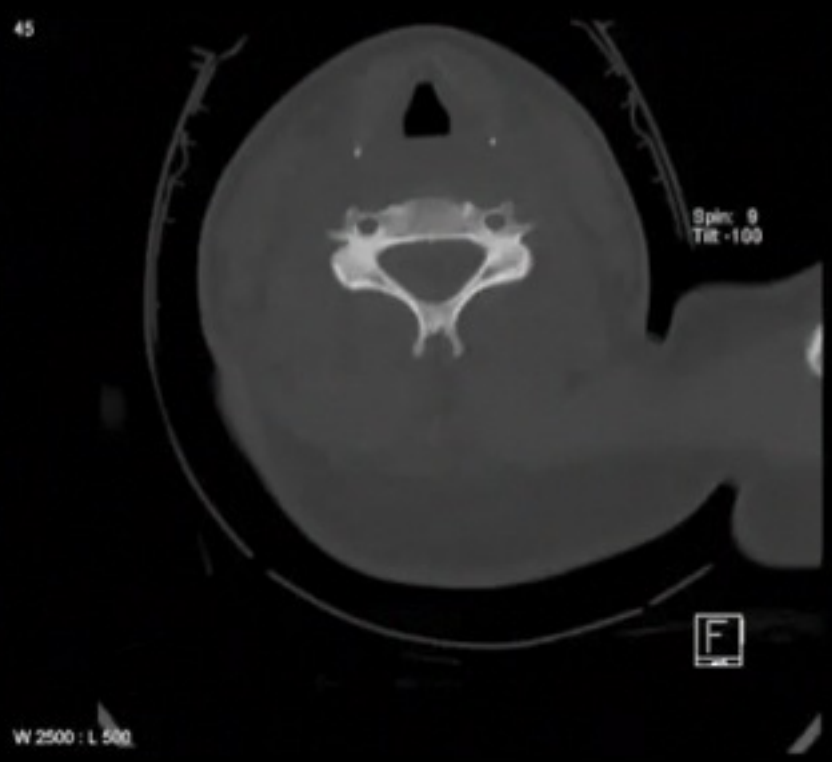
Increased use of CT

- Between 2001 and 2005 there was a 460% increase in the use of CT for C-spine injuries in US EDs with a stable number of true C-spine trauma cases

Kokabi N et al. Emerg Radiol (2011) 18:31-38

CT





Increased CT use - why?

- availability of CT
- proximity to ED
- superiority of CT in diagnosis
- reduced tolerance for potentially "missed" diagnoses
- patient expectation

Risks of CT

- Significant ionising radiation dose
- Contrast reactions
- Cost to health care system in terms of resource use
- Unnecessarily increased waiting times for patients in EDs

- "...X-ray alone is inadequate to detect all cases of serious cervical injury, routine use of CT is unnecessary with the application of a validated risk stratification algorithm."

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Clinical guidelines

The NEXUS Criteria

- C-spine imaging is recommended for patients with trauma unless they meet all of the following criteria:
  - Absence of posterior midline cervical-spine tenderness
  - No evidence of intoxication
  - Normal level of alertness
  - Absence of focal neurological deficit
  - No clinically apparent painful injuries that might distract from pain of a cervical spine injury

Risk of a clinically significant cervical spine injury is <0.1% if all questions are negative

Hoffman et al. N Engl J Med 2000;343:94–99

Canadian C-Spine Rules (CCR)†

No imaging is necessary if the following criteria are met:

- Absence of high-risk factors:
  - Age >65 years
  - "Dangerous mechanism"‡
  - Paresthesias in extremities

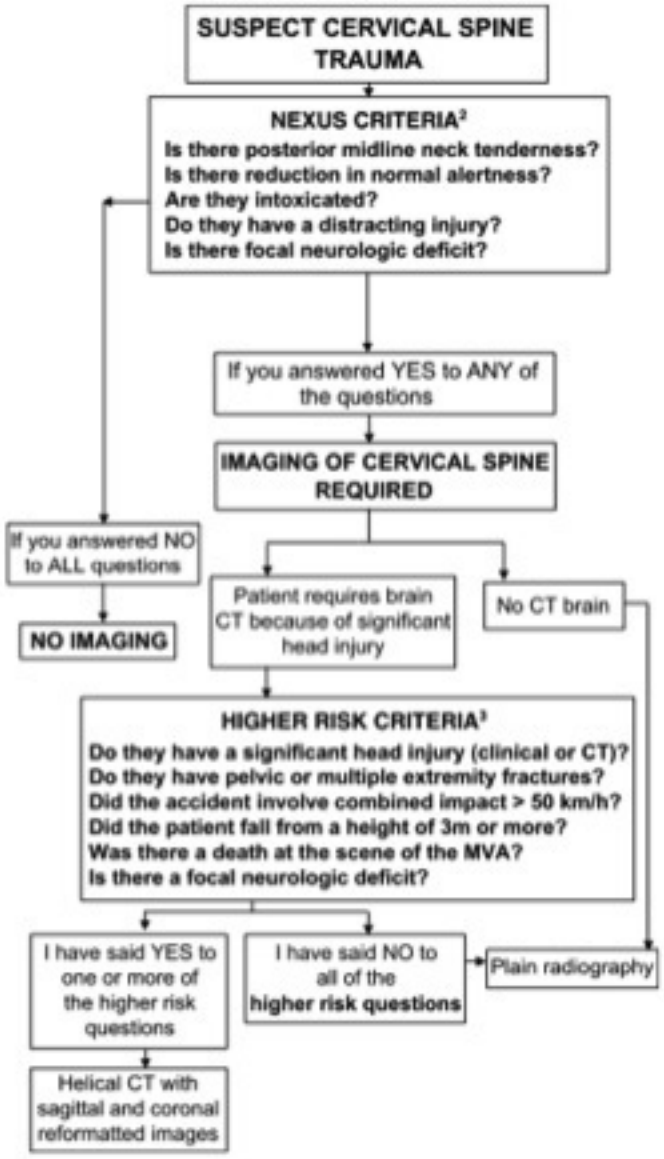
- When low-risk factors allow safe assessment of range of motion:
  - Simple rear-end motor vehicle collision**
  - Sitting position in ED
  - Ambulatory at any time
  - Delayed onset of neck pain
  - Absence of midline cervical tenderness
  - Able to actively rotate neck 45° left and right

- ‡"Dangerous mechanism" defined as: Fall from an elevation of 3 feet or 5 stairs, axial load to the head (e.g. diving), motor vehicle collision at high speed (>100 km/hr) or with rollover or ejection, collision involving a motorized recreational vehicle or bicycle
- † From Stiell et al., 2009.
- **A simple rear-end motor vehicle collision excludes being pushed into oncoming traffic, being hit by a bus or a large truck, a rollover, and being hit by a high speed vehicle.

High risk criteria

- Blackmore (1999) and Hanson (2000) developed High Risk Criteria to identify those with a >5% risk of having C-spine injury:
- Clinical parameters based on primary survey
  - Significant closed head injury or ICH seen on CT
  - Neurological symptoms/signs referable to cervical spine
  - Pelvic or multiple extremities #
- Injury mechanism based on initial report from patient/witness/on site personnel
  - High speed (55kph combined impact) MVA
  - Crash with death at scene of MVA
  - Fall from height >3m

Goergen's guideline



Minor Head Injury (GCS 13 to 15):

1. Risk Factors for surgical lesion:
   a) Increasing age – more than 65
   b) Vomiting – more than one episode
   c) Prolonged loss of consciousness (more than 2 to 5 minutes)
   d) On Examination
      i. Increasing headaches
      ii. Significant associated injuries
      iii. Ongoing confusion and/or amnesia
      iv. Focal neurological signs
      v. Suspected open or depressed fracture
      vi. Signs of basal skull fracture: cerebrospinal fluid leak bleeding from ear canal or hematoma behind ear
   e) Other factors to consider
      i. Intoxication
      ii. Anticoagulants
      iii. Dangerous mechanism, e.g. fall from a height of more than 1 meter, pedestrian struck by car
      iv. Amnesia for more than 30 minutes before impact
2. Any of the above risk factors for a surgical lesion is an indication for CT and observation

Moderate Head Injury (GCS 9 to 12)

Normally require early CT and admission (unless there is some immediately irreversible condition such as hypoglycemia or other complicating factors such as intoxication). Often the clinical state will improve after assessment.

Major Head Injury (GCS less than 9)

Patients with a GCS score less than 9 after trauma will all be referred to a trauma neurosurgical center. All will require an urgent CT scan.

*Adapted from Therapeutic Guidelines: Emergency, version 1, 2008 – endorsed by the Australian College for Emergency Medicine and Royal Australasian College of Physicians and/or its specialist bodies.

Goergen, S. 2004; Australasian Radiology, 48(3), 287.

Australasian experience

Validation of Goergen's guideline (with provisos!) has been recently published by Kokabi et al who found

- Up to 53% of the patients had unnecessary CT where 3 view plain radiographs alone would suffice, had the criteria been applied appropriately
- There was a significantly higher rate of over-investigation among elderly patients than younger patients. Application of Goergen's criteria would have reduced this over-investigation substantially, while retaining sensitivity and specificity in the identification of significant injury in the elderly.

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DO PLAIN FILMS STILL HAVE A ROLE IN THE EVALUATION OF POTENTIAL C-SPINE INJURIES?

YES

...in the right circumstances!

Getting guidelines into clinical practice

Often difficult to implement and apply consistently

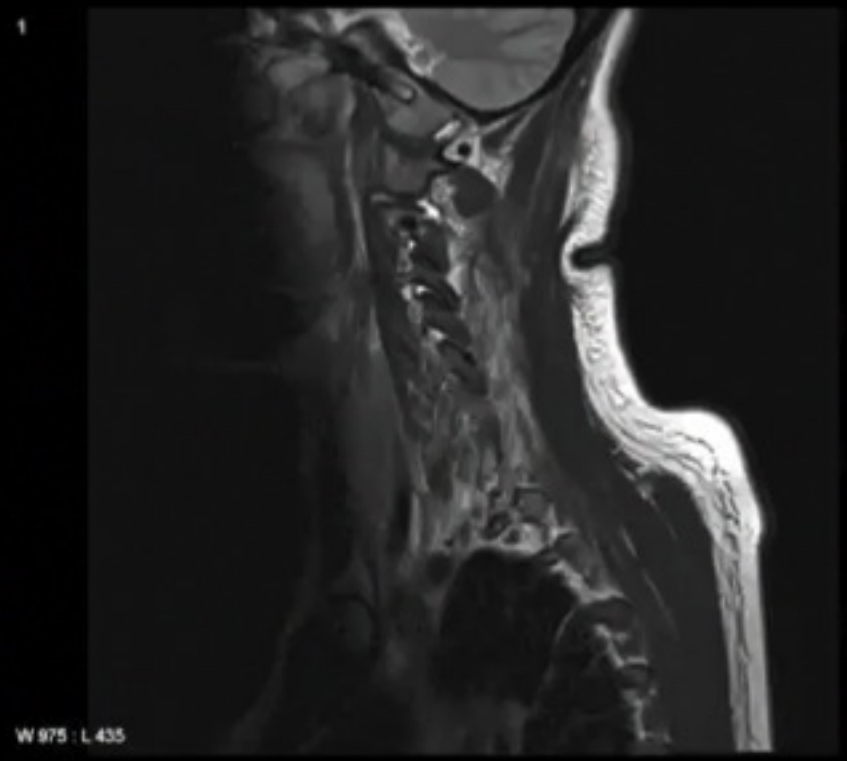
- *"We use the canadian C spine rules (mixed with a pinch of nexus to personal taste!). Increasingly though we are moving to CT as first line in patients who are getting a CT head anyway, have any neuro signs or symptoms, a bad mechanism and pain, or will be technically difficult such as obese or elderly. Therefore plain film is becoming a bit of an anachronism and reserved for low risk rule out where we cannot clear clinically according to decision rules"*

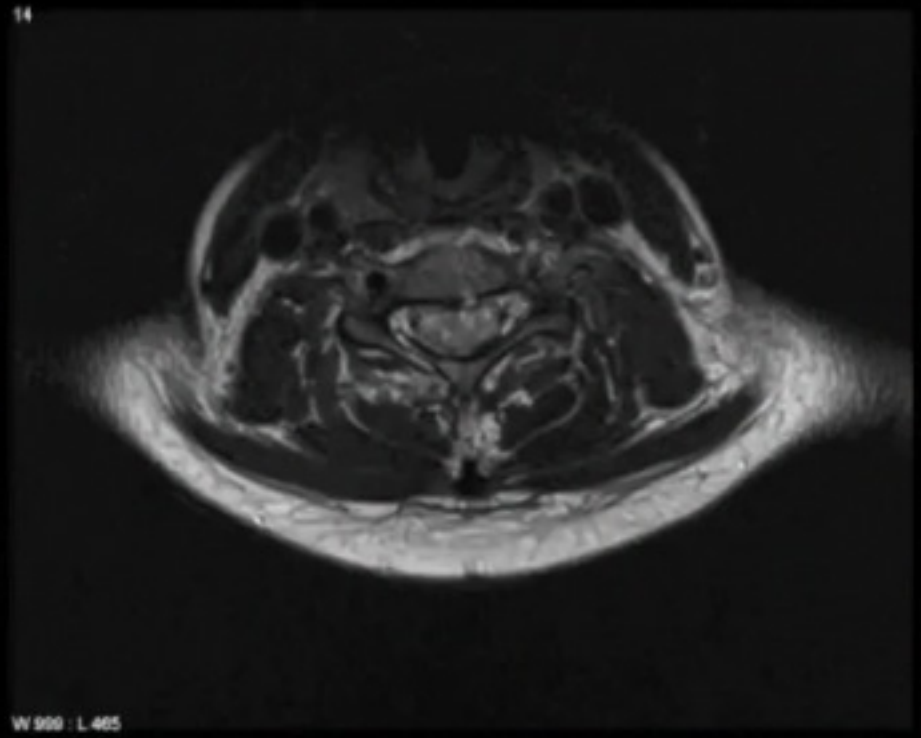
I propose that the Goergen guideline be formally trialled at ACH - project anyone?

MRI

- Not used in acute trauma room setting
- May overestimate ligamentous injury
- Useful when
  - ~ CT negative but persisting neurology (SCIWORA)
  - ~ CT shows fracture or instability and spinal cord/canal needs to be assessed

MRI





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