Don’t Stick YOUR Neck Out: Minimizing Risk in Cervical Spine Injuries

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A Little History

- “Collar and board all trauma” has been standard EMS training for many years.
- Annually, it is estimated that 800,000 people undergo C-spine radiography at a cost of $180 million.
- About 10,000 injuries are found (almost 98% negative rate.)
A Little History

- Multiple small, prospective studies have suggested that clinical criteria could be used to identify patients with at most a minimal risk of C-spine injury.

- Estimates are that these criteria could reducing imaging by $\frac{1}{3}$, at a cost saving of $\$60$ million.
A Little History

- For years, Emergency Physicians have used individual criteria to determine the need for C-spine films.

- In September, 1994 Maine EMS implemented a set of clinical guidelines to determine the need for pre-hospital spinal immobilization.
Nothing is totally foolproof!
Shit Happens!
The 1994 Maine Protocol

- Three initial mechanism categories:
  - Positive (e.g., high speed rollover)
  - Negative (e.g. twisted ankle)
  - Indeterminate

- Indeterminate mechanisms mandated use of the protocol
The 1994 Maine Protocol

- A “Reliable” Patient
  - Alert, calm, cooperative, and free of impairments.
  - No intoxicants, no language barrier, no “Acute Stress Reaction.”

- Normal Exam
  - No tenderness, focal neuro deficits, paresthesias or dysesthesias.
Mechanism of Injury: Axial load (diving), Blunt Trauma, MVC or bicycle, fall >3 ft., adult fall from standing height

Unreliable? (Intox/Alt LOC/Acute Stress Reaction)
- **YES**
- **NO**

IMMOBILIZE
- **YES** (Spine Pain/Tenderness)
- **NO**

DISTRACTING INJURY?
- **YES** (Abnormal Sensory/Motor Exam?)
- **NO**

DON’T IMMOBILIZE
- **YES**
- **NO**
Mechanism of Injury: Axial load (diving), Blunt Trauma, MVC or bicycle, fall > 3 ft., adult fall from standing height

MVC (Motor Vehicle Collision) applies to crashes of all motorized vehicles: e.g. automobiles, motorcycles, snowmobiles, ATVs, etc.
Mechanism of Injury: Axial load (diving), Blunt Trauma, MVC or bicycle, fall > 3 ft., adult fall from standing height

Unreliable? (Intox/Alt LOC/Acute Stress Reaction)

- **YES**
  - Clearance of the spine requires the patient to be: Calm, Cooperative, Sober, and Alert.
  - IMMOBILIZE

- **NO**
  - IMMOBILIZE

NO

**IMMOBILIZE**

- **YES**
  - Clearance of the spine requires the patient to be: Calm, Cooperative, Sober, and Alert.
  - IMMOBILIZE

- **NO**
  - IMMOBILIZE

**IMMOBILIZE**

- **YES**
  - Clearance of the spine requires the patient to be: Calm, Cooperative, Sober, and Alert.
  - IMMOBILIZE

- **NO**
  - IMMOBILIZE
Mechanism of Injury: Axial load (diving), Blunt Trauma, MVC or bicycle, fall >3 ft., adult fall from standing height

Unreliable? (Intox/Alt LOC/Acute Stress Reaction)

Distracting injury includes any injury that produces clinically apparent pain that might distract the patient from the pain of a spine injury - pain would include medical as well as traumatic etiologies of pain

IMMOBILIZE

DISTRACTING INJURY?

YES

NO

YES

YES

NO
Mechanism of Injury: Axial load (diving), Blunt Trauma, MVC or bicycle, fall > 3 ft., adult fall from standing height

- IMMOBILIZE

- Disturbing Injury? NO

- Unreliable? (Intox/Alt LOC/Acute Stress Reaction) YES

- Abnormal Sensory/Motor Exam? NO

- Disturbing Injury? NO
Mechanism of Injury: Axial load (diving), Blunt Trauma, MVC or bicycle, fall>3 ft., adult fall from standing height

**Unreliable? (Intox/Alt LOC/Acute Stress Reaction)**

- **YES**
- **NO**

**Spine Pain/Tenderness**

- **YES**
- **NO**

**Abnormal Sensory/Motor Exam?**

- **YES**
- **NO**

**DISTRACTING INJURY?**

- **YES**
- **NO**

**IMMOBILIZE**
Mechanism of Injury: Axial load (diving), Blunt Trauma, MVC or bicycle, fall >3 ft., adult fall from standing height

Unreliable? (Intox/Alt LOC/ Acute Stress Reaction

DON’T IMMobilize

IMMOBILIZE

Spine Pain/ Tenderness

Abnormal Sensory/Motor Exam?

DISTRACTING INJURY?
The NEXUS Study

“Selective Cervical Spine Radiography in Blunt Trauma: Methodology of the National Emergency X-Radiography Utilization Study (NEXUS)”

The Five NEXUS Criteria

- No neurologic abnormalities
- Normal alertness
- No evidence of intoxication
- No posterior midline C-spine tenderness
- No other distracting painful injury
The NEXUS Results

“Validity of a Set of Clinical Criteria to Rule Out Injury to the Cervical Spine in Patients with Blunt Trauma.”

NEXUS Results

- 21 centers
- 34,069 patients
- Missed 8/818 patients who had injury
- Sensitivity 99.6%
- Negative predictive value 99.8%
- Injury rate 2% (818/34,069)
- Mean age of CSI patients: 40 years
- Specificity 12.9%
- Positive predictive value 2.7%
- Missed injury frequency of 1/4000
- Only 2/8 had a clinically significant injury
- 1.3% of fractures <8 years old
- 12.6% could have been spared films
NEXUS Results

- 54 y.o. hx multiple motorcycle accidents with a fx of the anteroinferior portion of C2; no anterior soft tissue swelling. Only treatment was a soft cervical collar removed at discharge. No symptoms at a six week follow-up visit.
NEXUS Results

- 57 y.o. belted MVA with transient loss of consciousness after a head-on collision. Had pain in right shoulder and paraspinous muscles and right clavicle and scapula. Had fx of right clavicle and right lamina of C6; developed paresthesias and underwent laminectomy and fusion and did well.
The 2002 Maine Criteria

- Does away with three mechanism levels
  - Mechanism suggests need to use the protocol.
- Expands tenderness from midline only to include entire spine.
The Canadian C-Spine Rule


The Canadian C-Spine Rule

For alert (GCS score = 15) and stable trauma patients when cervical spine injury is a concern
The Canadian C-Spine Rule
For Alert (GCS score=15) and stable trauma patients
When cervical spine injury is a concern

1. Any high-risk factor that mandates radiography?
   Age $\geq$ 65 y
   or
   Dangerous mechanism*  
   or
   Parasthesias in extremities
   No

2. 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
   Absent of midline cervical spine tenderness
   No
   Yes

3. Able to actively rotate neck?
   45 degrees left and right
   Able
   No Radiography
   Unable
   Radiography

1. Any high-risk factor that mandates radiography?
   Age $\geq$ 65 y
   or
   Dangerous mechanism*  
   or
   Parasthesias in extremities
1. Any high-risk factor that mandates radiography?
   Age ≥ 65 y
   or
   Dangerous mechanism*
   or
   Parasthesias in extremities

   2. 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
      Absent of midline cervical spine tenderness

      No

      Yes

      Radiography

      Unable

      3. Able to actively rotate neck?
         45 degrees left and right

         Able

         No Radiography

         No

         Yes

         Dangerous Mechanism
         • Fall from elevation ≥3ft/5 stairs
         • Axial load to head, eg, diving
         • MVC high speed (>100km/h), rollover, ejection
         • Motorized recreational vehicles
         • Bicycle crash
The Canadian C-Spine Rule
For Alert (GCS score=15) and stable trauma patients
When cervical spine injury is a concern

1. Any high-risk factor that mandates radiography?
   Age \( \geq 65 \text{ y} \)
   or
   Dangerous mechanism*
   or
   Parasthesias in extremities
   
   No

2. 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
   Absent of midline cervical spine tenderness
   
   Yes
   
   No

3. Able to actively rotate neck?
   45 degrees left and right
   
   Yes
   
   able

No Radiography

Yes

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

- Simple rear-end MVC†
- Sitting position in ED
- Ambulatory at any time
- Delayed onset of neck pain‡
- Absence of midline cervical spine tenderness
2. Any low-risk factor that allows safe assessment of range of motion?

- Simple rear-end MVC†
- Sitting position in ED
- Ambulatory at any time
- Delayed onset of neck pain‡
- Absence of midline cervical spine tenderness

† Simple rear-end MVC excludes
- Pushed into oncoming traffic
- Hit by bus/large truck
- Rollover
- Hit by high-speed vehicle

‡ Delayed
- I.e., not immediate onset of neck pain
The Canadian C-Spine Rule
For Alert (GCS score=15) and stable trauma patients
When cervical spine injury is a concern

1. Any high-risk factor that mandates radiography?
   Age $\geq$ 65 y
   or
   Dangerous mechanism*
   or
   Parasthesias in extremities
   No
   Yes

2. 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
   Absent of midline cervical spine tenderness
   No
   Yes

3. Able to actively rotate neck? 45 degrees left and right
   Able
   Unable

Radiography

No Radiography
Canadian C-Spine Results

- 10 centers
- 8,924 patients, mean age 37 years
- 151 patients had a clinically important injury (1.7%)
- 17.5% could have been spared films

- Physician Judgment
  - 92.2% sensitivity
  - 53.8% specificity

- C-Spine Rule
  - 100% sensitivity
  - 44.5% specificity
NEXUS vs. Canadian Rule

- **NEXUS**
  - 99% sensitivity
  - 12.9% specificity
  - **12.6%** could have been spared films
  - 818/34,069 injuries (2%)

- **Physician Judgment**
  - 92.2% sensitivity
  - 53.8% specificity

- **C-Spine Rule**
  - 100% sensitivity
  - 44.5% specificity
  - **17.5%** could have been spared films
  - 151/8,924 injuries (1.7%)
THE DECISION TO REMOVE IMMobilization DEVICES IS ALWAYS MADE BY THE CLINICIAN CARING FOR THE PATIENT

NO RISK
No low or high risk factors
No Neurologic Abnormalities
Normal Alertness (GCS 15)
No evidence of intoxicants
No other distracting injury
No tenderness on palpation or full range of active motion
No Dangerous Mechanism¹
Age < 65 (NO neck pain)

No Immobilization OR Collar only
Emergency imaging optional

¹Dangerous Mechanism:
- Fall ≥ 3 feet/5 stairs
- Axial load to head
- High speed MVA, rollover, ejection
- Motorized Recreational Vehicles
- Bicycle Crash
THE DECISION TO REMOVE IMMobilization DEVICES IS **ALWAYS** MADE BY THE CLINICIAN CARING FOR THE PATIENT

**LOW RISK**

Simple Rear-end MVC\(^2\) or
Sitting position in ED or
Ambulatory at any time or
Delayed onset of neck pain or
Absence of Midline cervical spine
tenderness –Paraspinous pain only
Dangerous Mechanism\(^1\) but meets ALL other NO RISK criteria
Age > 65 but NO Neck Pain

\(^2\)Simple Rear-end MVC Excludes:
  • Pushed into oncoming traffic
  • Hit by bus/large truck
  • Rollover
  • Hit at high speed

Collar Only
OR
Collar and Board

Emergency imaging
Plain radiograph or CT
if body habitus prevents Adequate plain study

\(^1\)Dangerous Mechanism:
  • Fall ≥ 3 feet/ 5 stairs
  • Axial load to head
  • High speed MVA, rollover, ejection
  • Motorized Recreational Vehicles
  • Bicycle Crash
The decision to remove immobilization devices is **always** made by the clinician caring for the patient.

**Moderate / High Risk**

- Any altered level of consciousness
- Any neurological symptoms
- Dangerous mechanism\(^1\) with neck pain
- Age \(\geq 65\) with neck pain

\(^1\)Dangerous mechanism:
- Fall \(\geq 3\) feet/5 stairs
- Axial load to head
- High speed MVA, rollover, ejection
- Motorized recreational vehicles
- Bicycle crash

**Collar and Board**

**Emergency Imaging Options**

- CTL with full series
  - Normal mental status
  - No head injury
  - Body habitus permits readable study
- CT cervical spine
  - Head injury
  - Altered mental status
  - Any focal neuro abn
  - Any abn plain xray
  - Any pt needing CT of any other region
- MRI (after CT)
  - Neurologic abnormality
Trauma C-Spine Exam Protocols

1. ED Orders C-Spine Routine
   Do Routine C-Spine Series

2. ED Orders C-Spine Low-Risk Trauma
   Do X-Table Lat, AP, Odontoid Supine with Immobilization Device(s) ON (if Present)

Take films to be cleared by RAD/ED MD
Take films to be cleared by RAD/ED MD

Per MD Additional views or CT with Immobilization Device(s) **ON**

**NOT CLEARED**

**CLEARED**

If cleared by additional views

Collar/LBB may be removed. Finish Series Upright Erect, Lat and Obliques
Collar/LBB may be removed.
Finish Series Upright Erect, Lat and Obliques

Take all films to MD for final review
3. ED Orders C-Spine High-Risk Trauma
   DO NOT REMOVE COLLAR

   Do X-Table Lat, AP, Odontoid and Trauma Obliques
   With collar ON

   Take films to be cleared by RAD/ED MD

   NOT CLEARED

   CT per MD With Collar ON

   CLEARED
Upright X-Table Lat, Additional or repeat views as requested WITH collar ON

CT per MD With Collar ON

Take films to be cleared by RAD/ED MD

NOT CLEARED

CLEARED and DONE
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