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

James A. Vafier, M.D.

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 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!

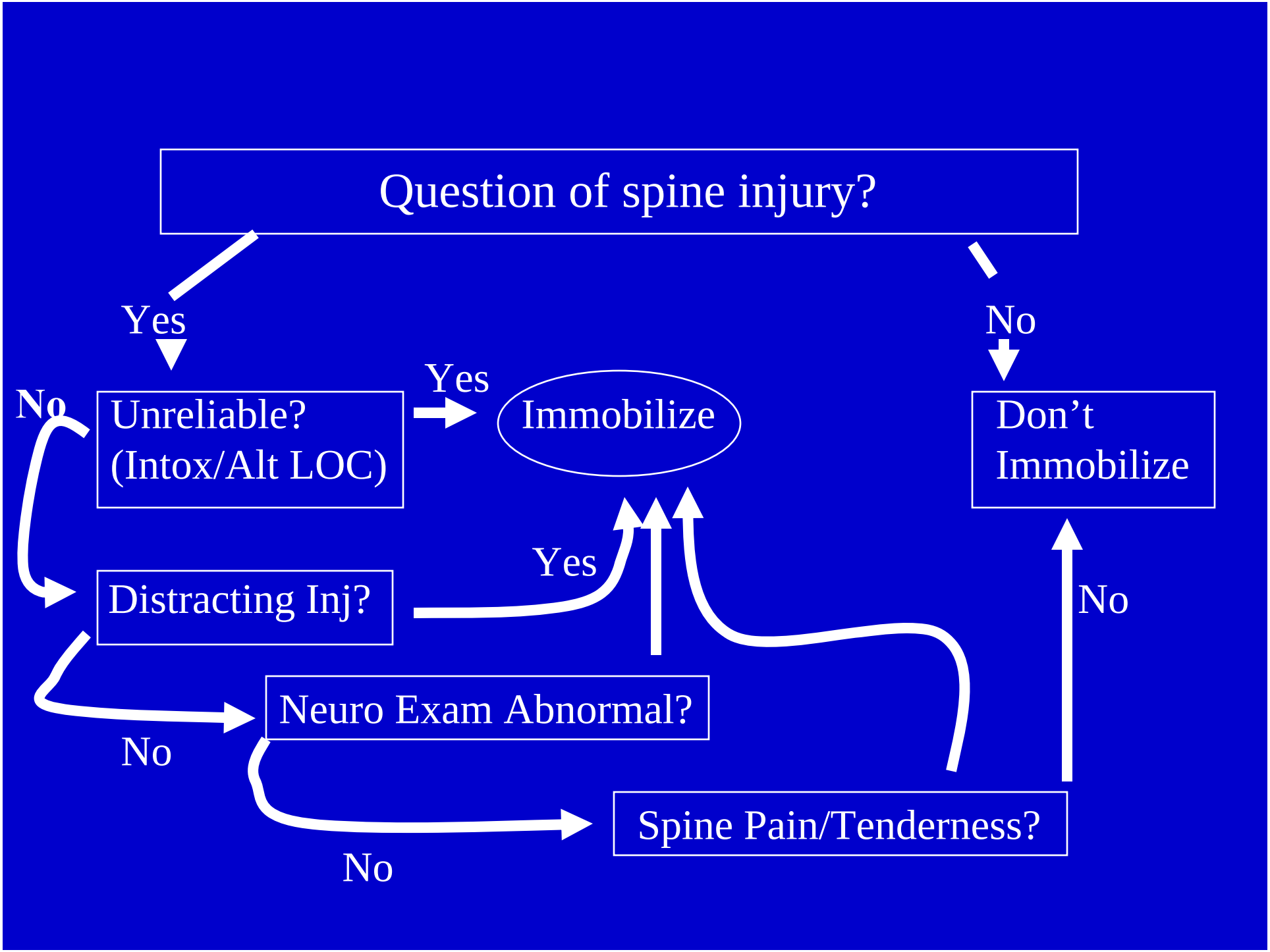
Shit Happens!

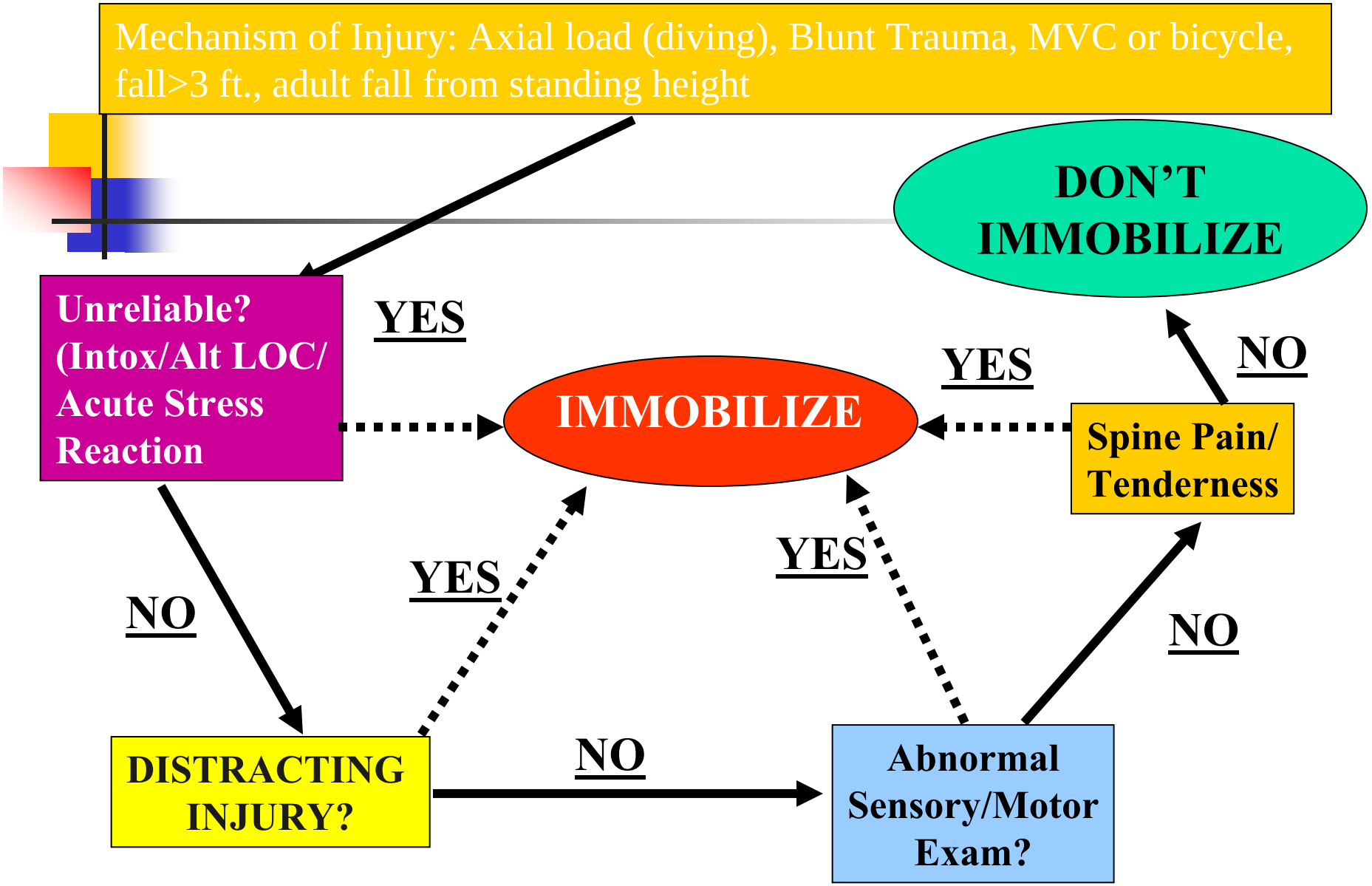
The 1994 Maine Protocol

- 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

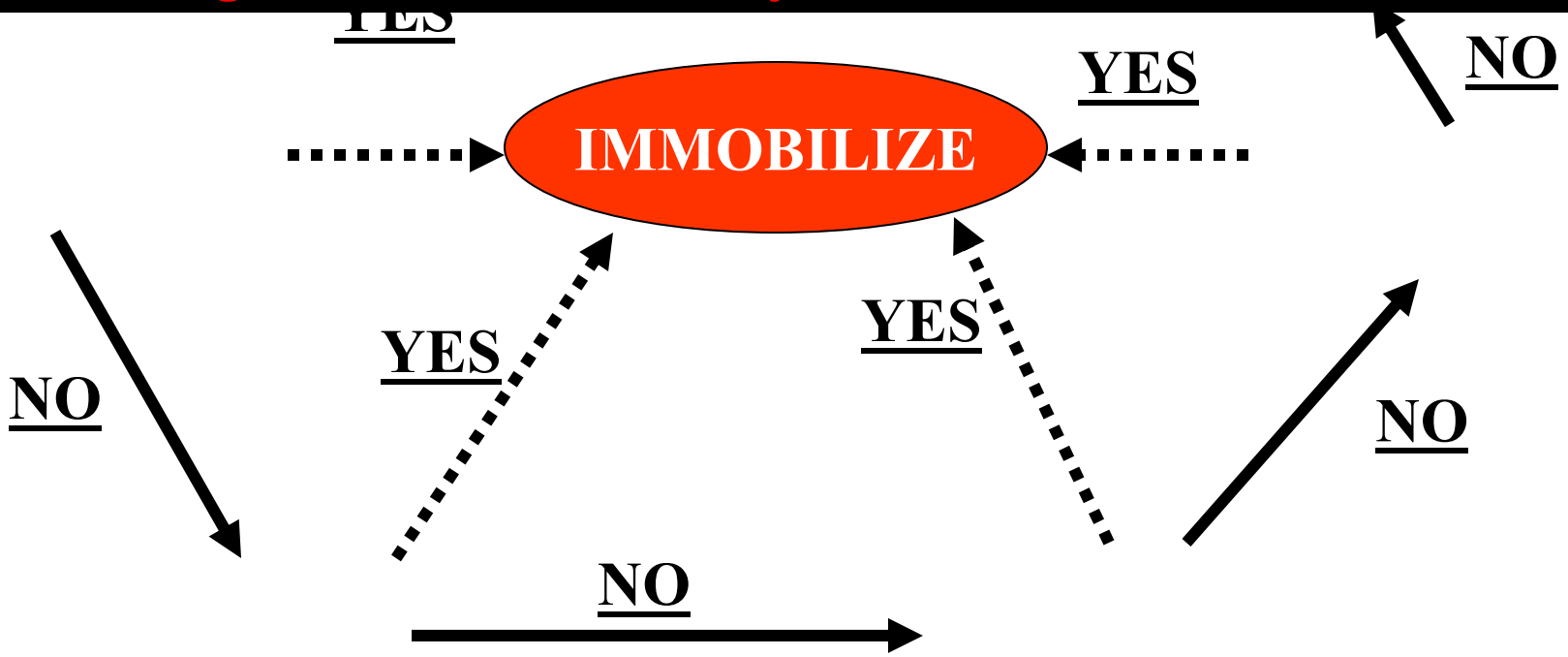
- A “Reliable” Patient
  - Alert, calm, cooperative, and free of impairments.
  - No intoxicants, no language barrier, no “Acute Stress Reaction.”
- Normal Exam
  - No tenderness, focal neuro deficits, paresthesias or dysesthesias.

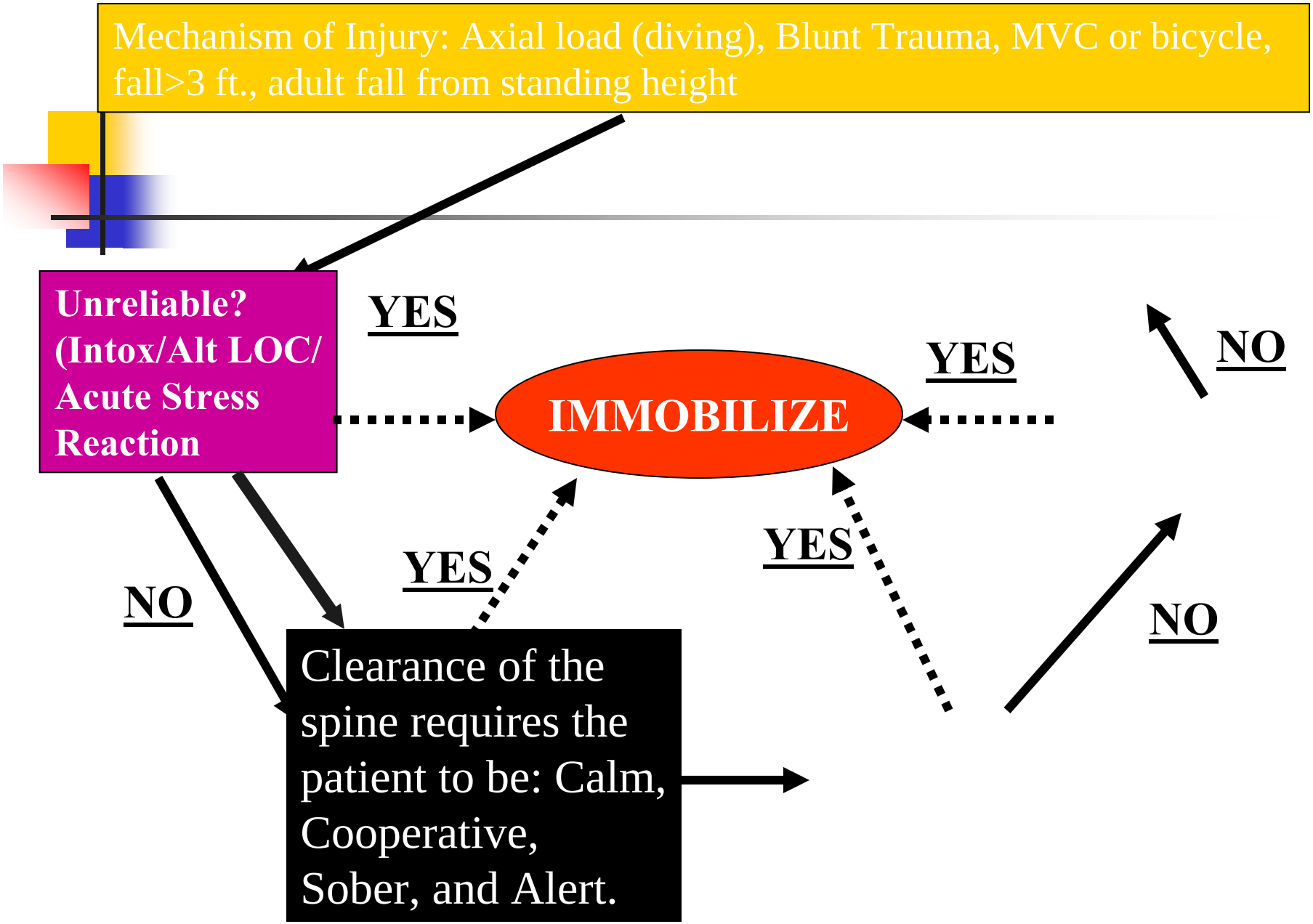

Question of spine injury?
Yes
No
Unreliable? (Intox/Alt LOC)
Yes
Immobilize
No
Don't Immobilize
Distracting Inj?
Yes
No
Neuro Exam Abnormal?
No
Spine Pain/Tenderness?
No


Mechanism of Injury: Axial load (diving), Blunt Trauma, MVC or bicycle, fall>3 ft., adult fall from standing height
DON'T IMMOBILIZE
Unreliable? (Intox/Alt LOC/ Acute Stress Reaction
YES
IMMOBILIZE
YES
NO
Spine Pain/ Tenderness
NO
YES
YES
NO
NO
DISTRACTING INJURY?
NO
Abnormal Sensory/Motor Exam?

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.

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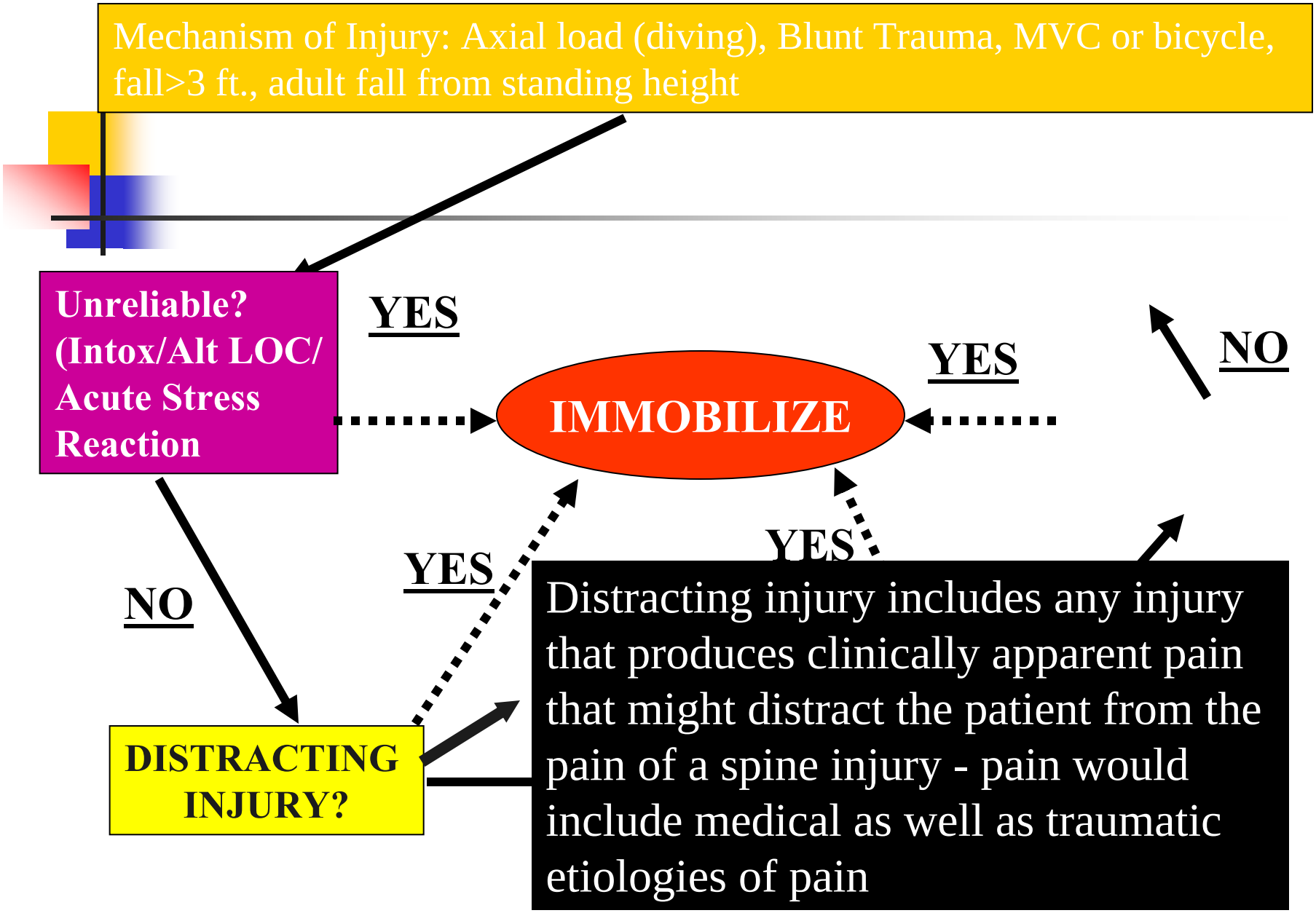
Unreliable? (Intox/Alt LOC/ Acute Stress Reaction
YES
IMMOBILIZE
YES
NO
NO
YES
YES
NO
Clearance of the spine requires the patient to be: Calm, Cooperative, Sober, and Alert.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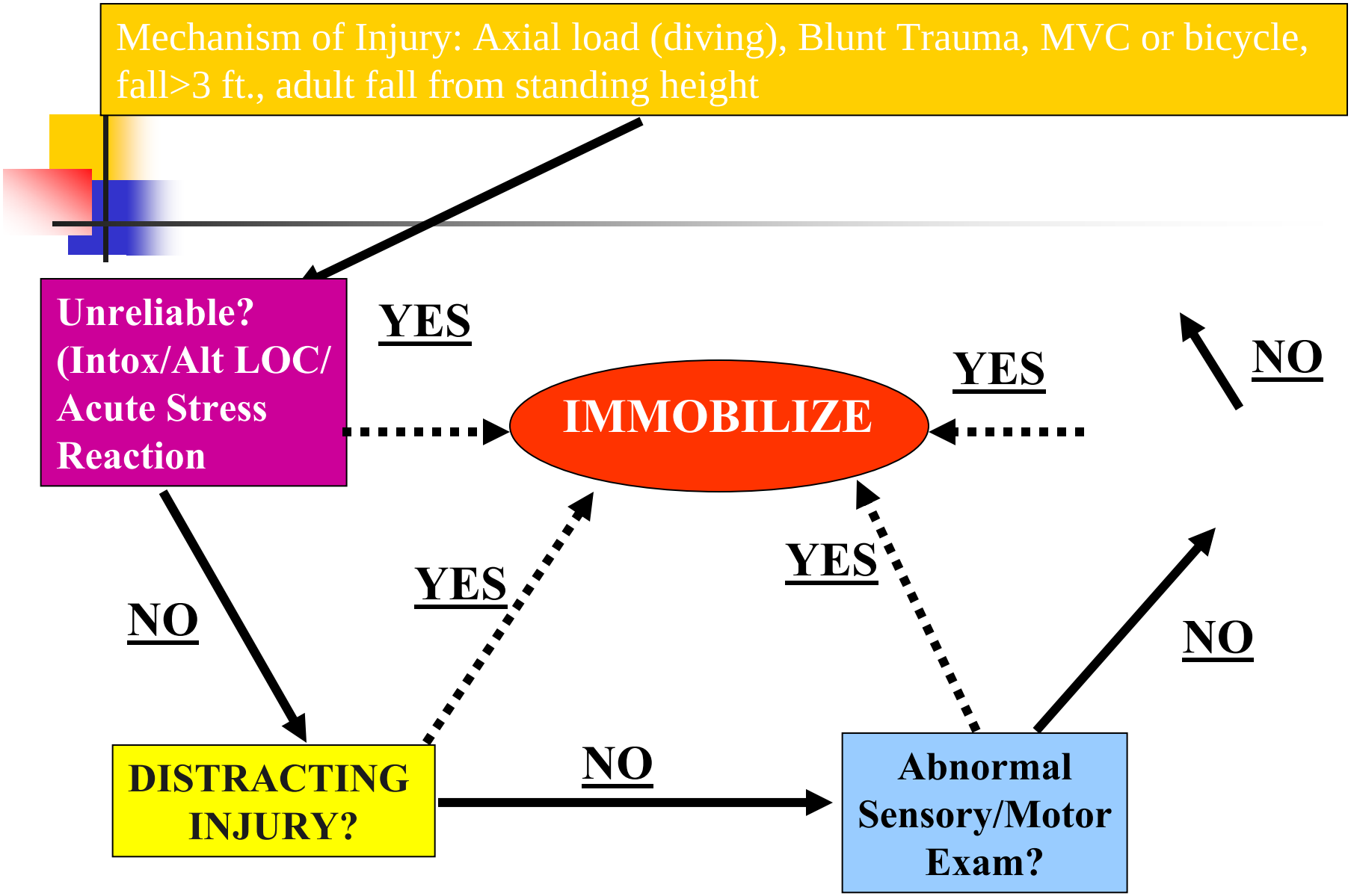
IMMOBILIZE
YES
NO
NO
YES
YES
DISTRACTING INJURY?
Distracting injury includes any injury that produces clinically apparent pain that might distract the patient from the pain of a spine injury - pain would include medical as well as traumatic etiologies of pain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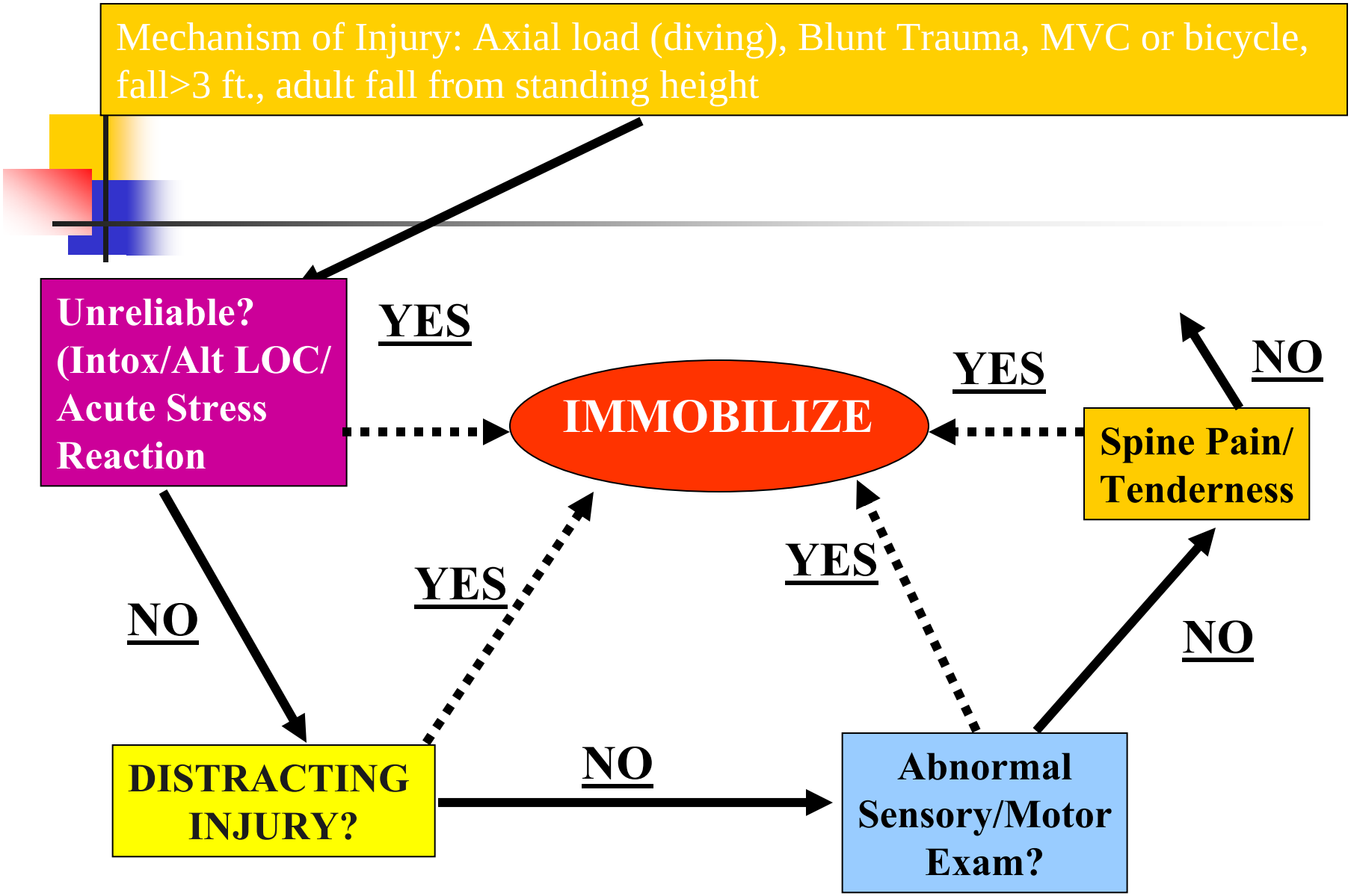
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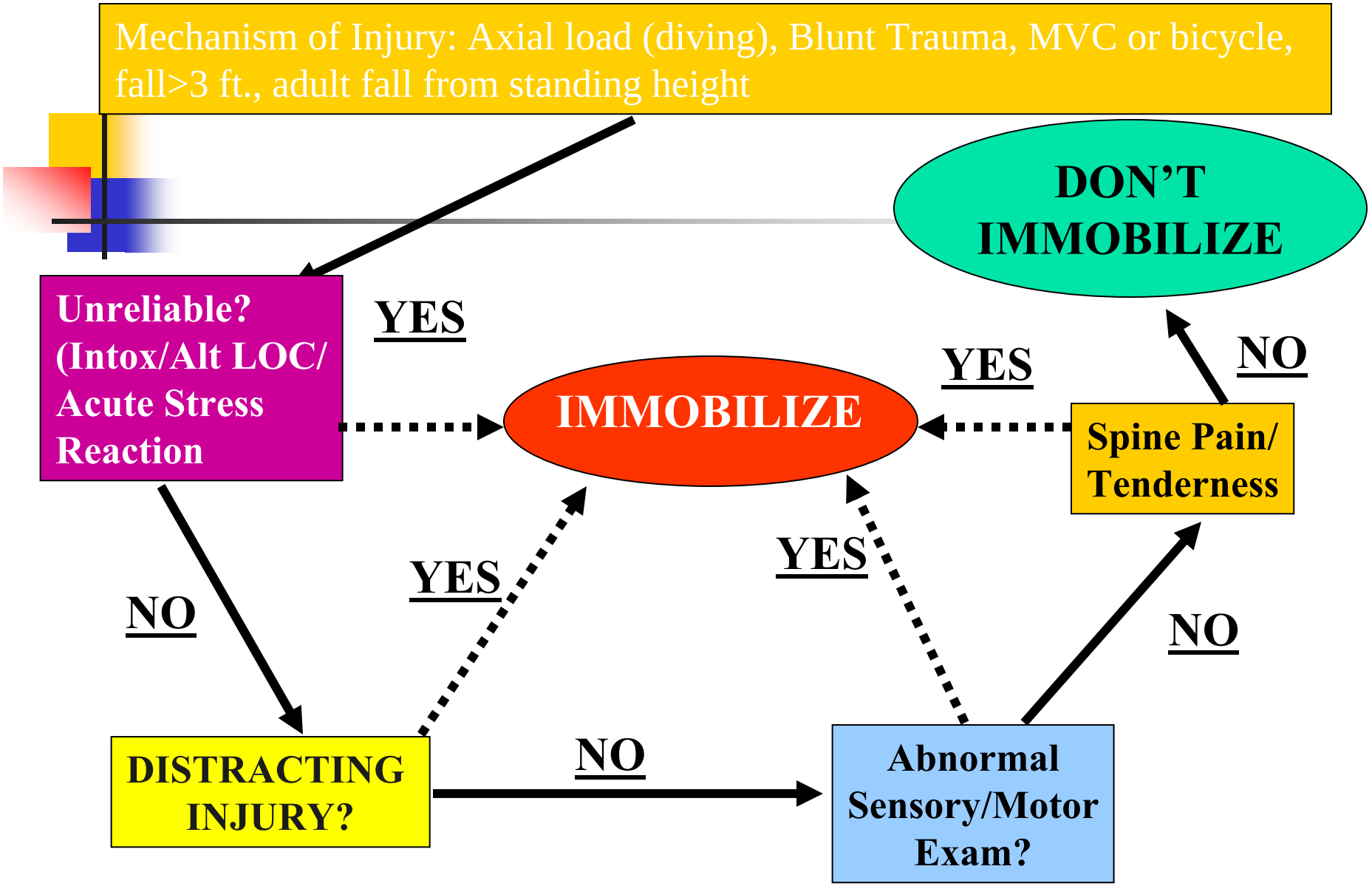
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IMMOBILIZE
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Spine Pain/ Tenderness
NO
YES
YES
NO
NO
DISTRACTING INJURY?
NO
Abnormal Sensory/Motor Exam?

The NEXUS Study

- "Selective Cervical Spine Radiography in Blunt Trauma: Methodology of the National Emergency X-Radiography Utilization Study (NEXUS)"
  - *Annals of Emergency Medicine* ***32:4, 461-469. 1998.***

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."
  - *New England Journal of Medicine* ***343:2, 94-99. 2000.***

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.

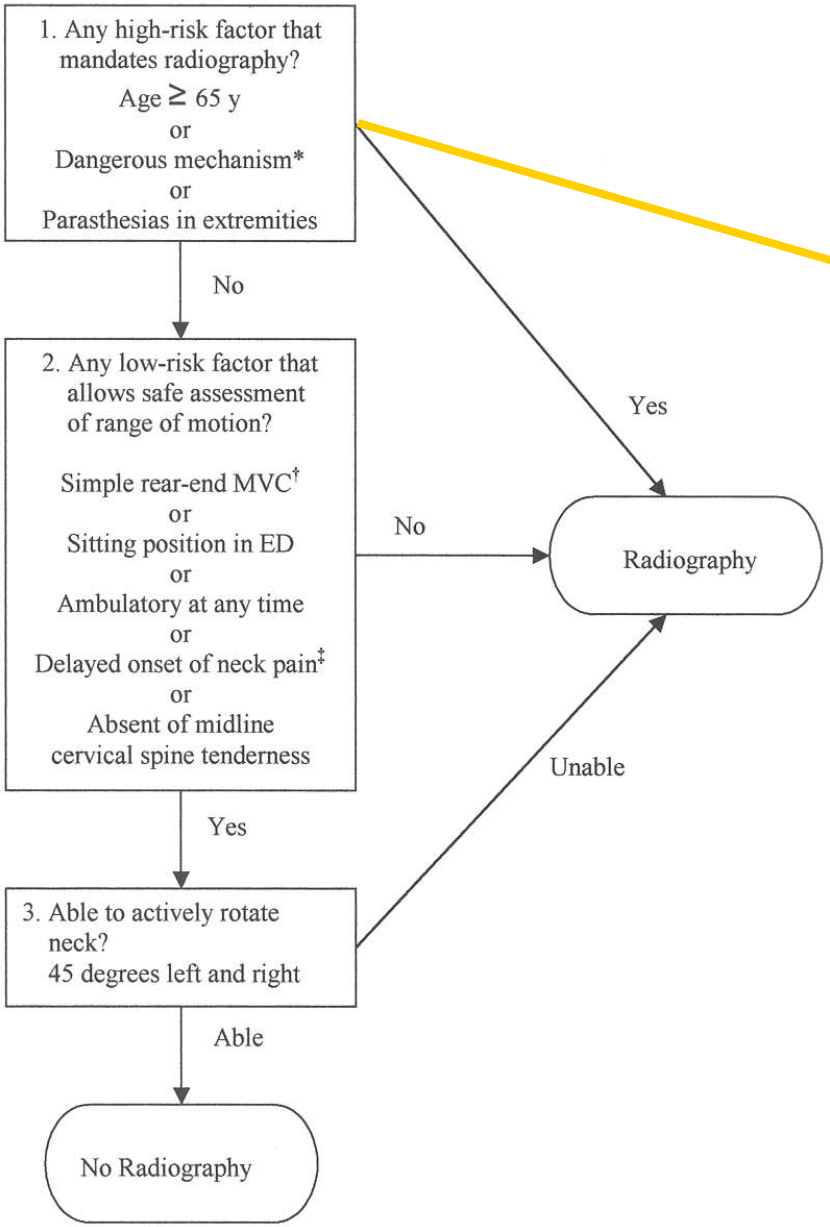
The Canadian C-Spine Rule

- "The Canadian C-Spine Rule Performs Better Than Unstructured Physician Judgment."
  - *Annals of Emergency Medicine* **42:3, 395-402. 2003.**

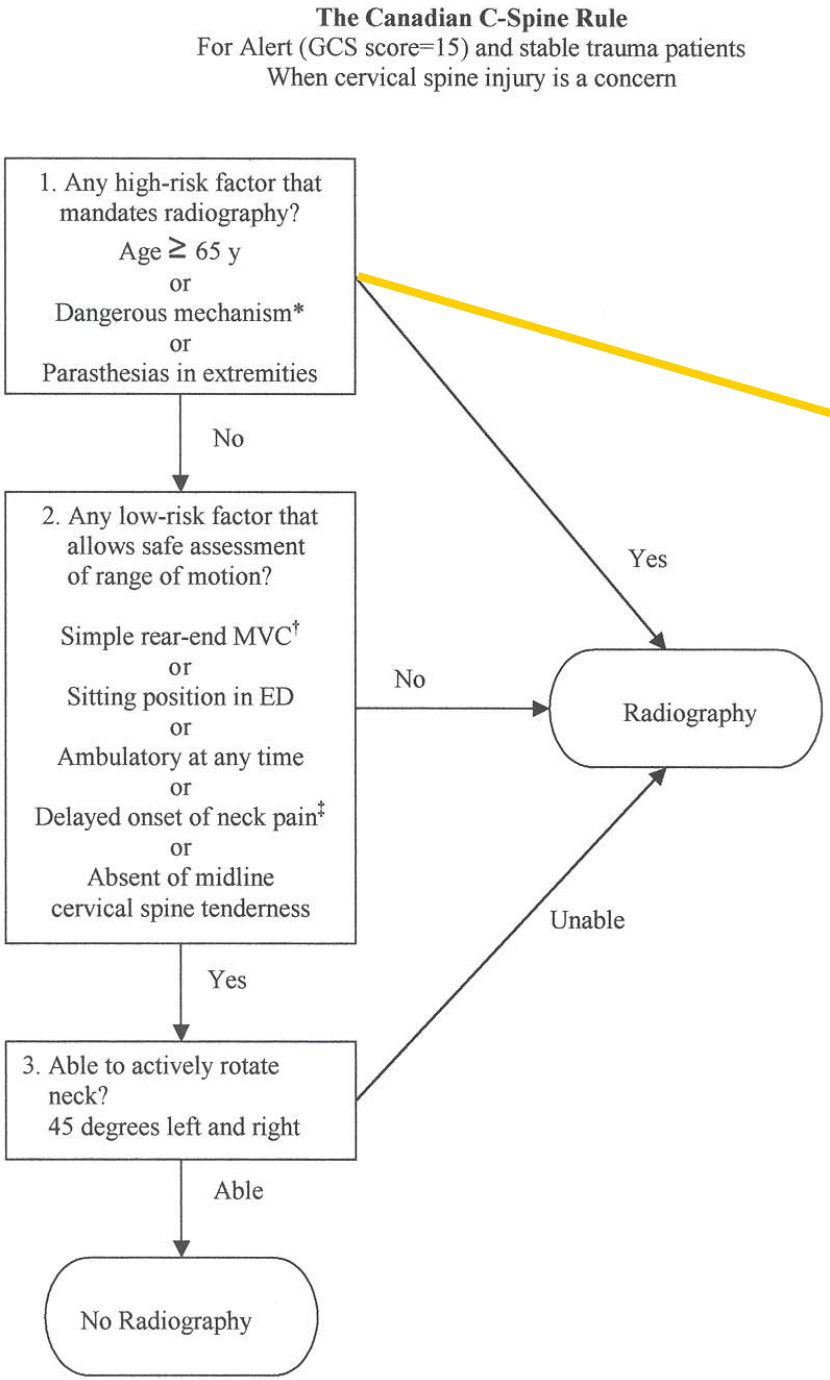
The Canadian C-Spine Rule

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 ≥ 65 y
or
Dangerous mechanism*
or
Parasthesias in extremities

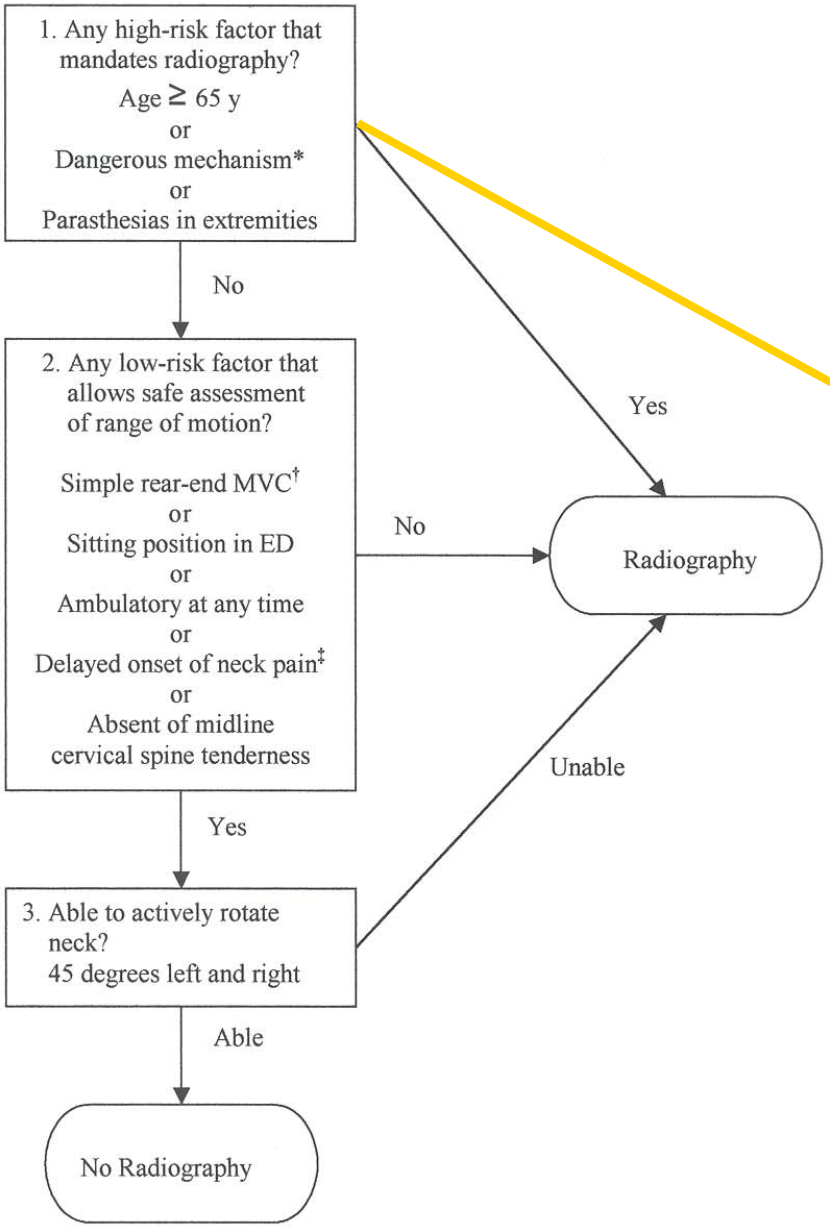


1. Any high-risk factor that mandates radiography?
Age ≥ 65 y
or
Dangerous mechanism*
or
Parasthesias in extremities

***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

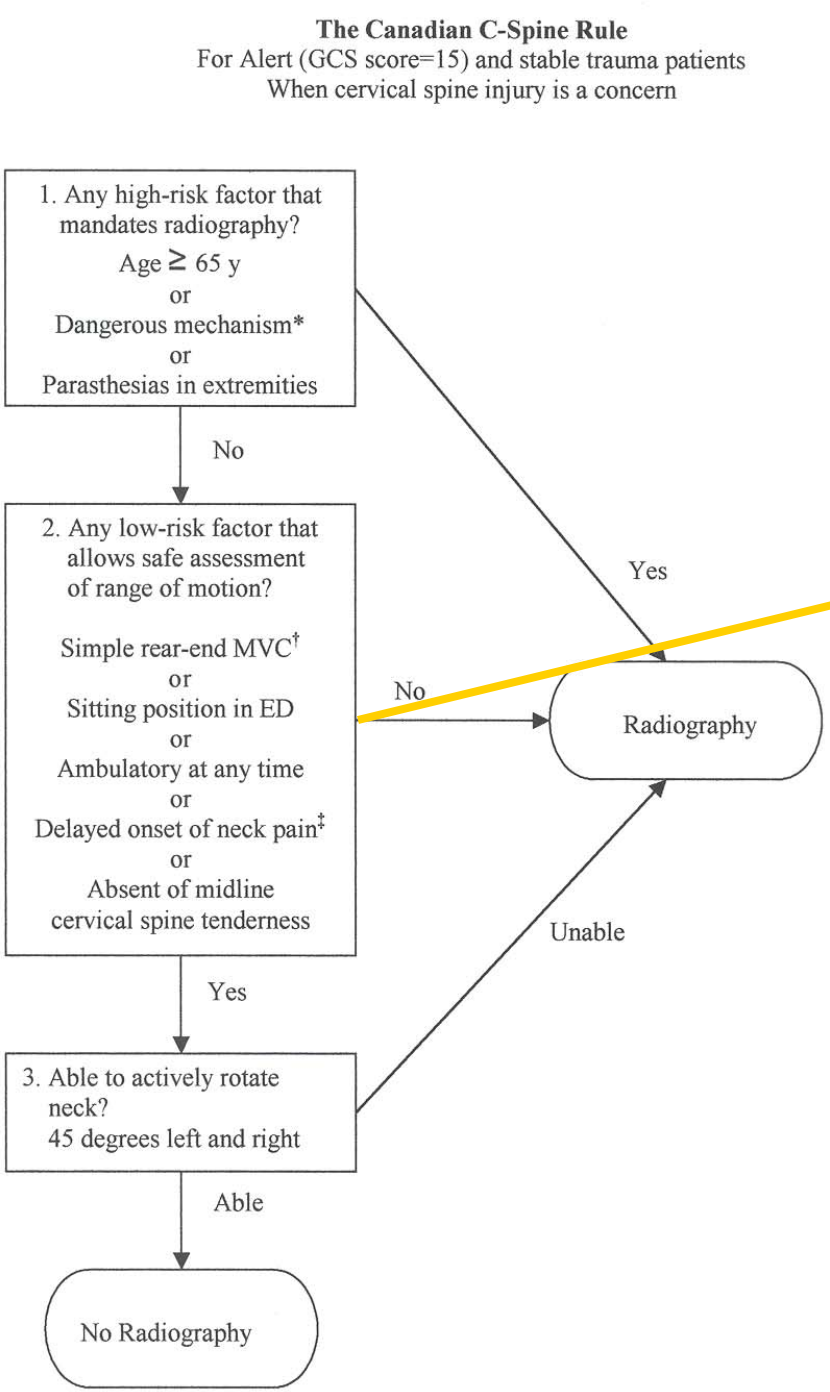
The Canadian C-Spine Rule
For Alert (GCS score=15) and stable trauma patients
When cervical spine injury is a concern



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

Yes

Radiography



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
Absence of midline cervical spine tenderness

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
Absence of midline cervical spine tenderness

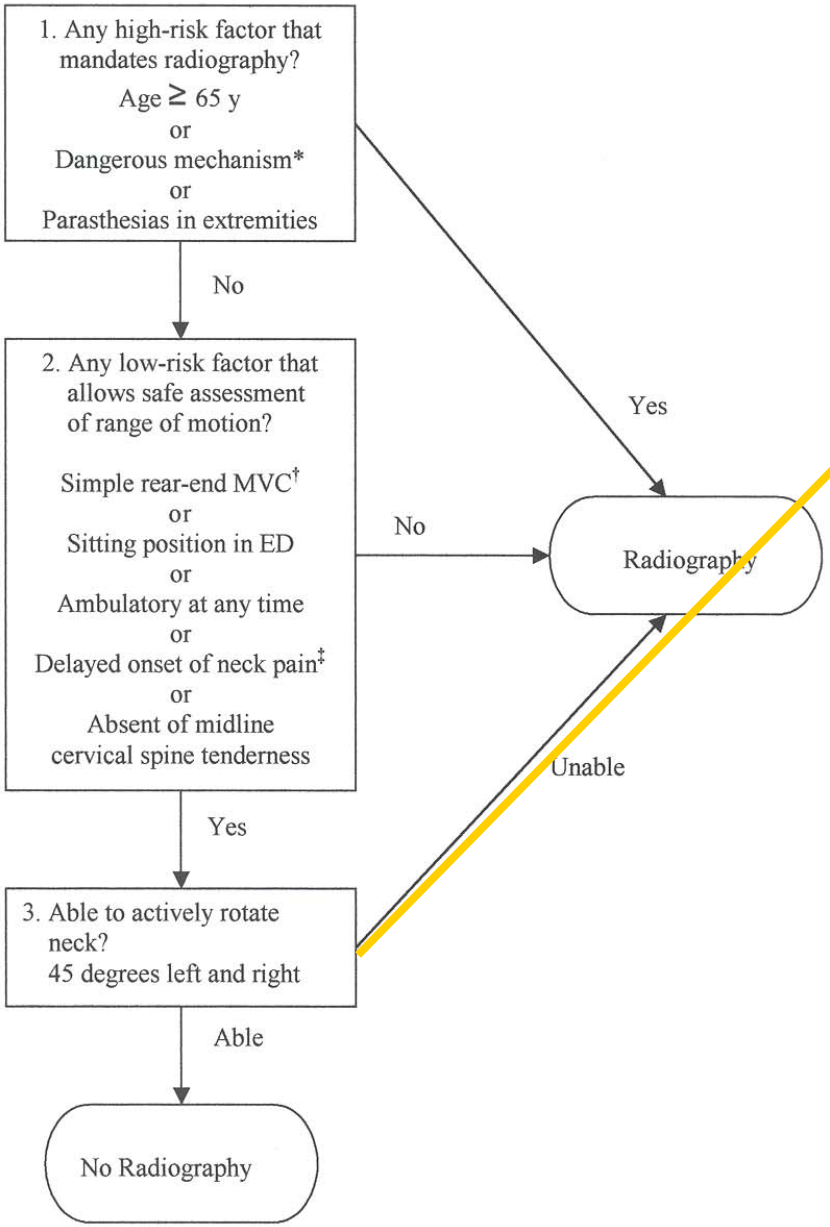
†Simple rear-end MVC excludes

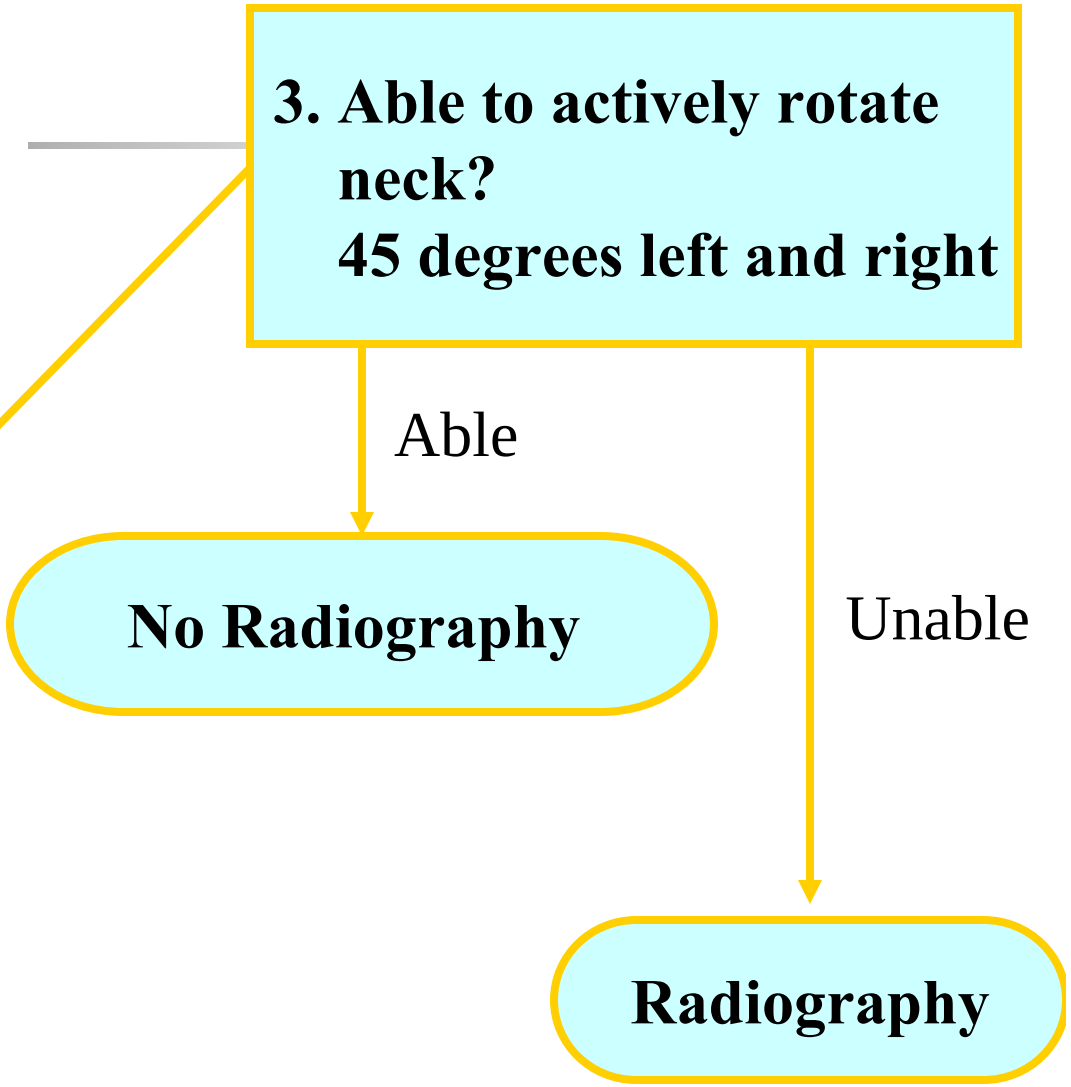
- Pushed into oncoming traffic
- Hit by bus/large truck
- Rollover
- Hit by high-speed vehicle

‡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





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 Mechanism[1]
Age < 65 (NO neck pain)

→

No Immobilization OR Collar only

Emergency imaging optional

[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

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 ≥ 65 WITH neck pain

[1]Dangerous Mechanism:

- **Fall ≥ 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**

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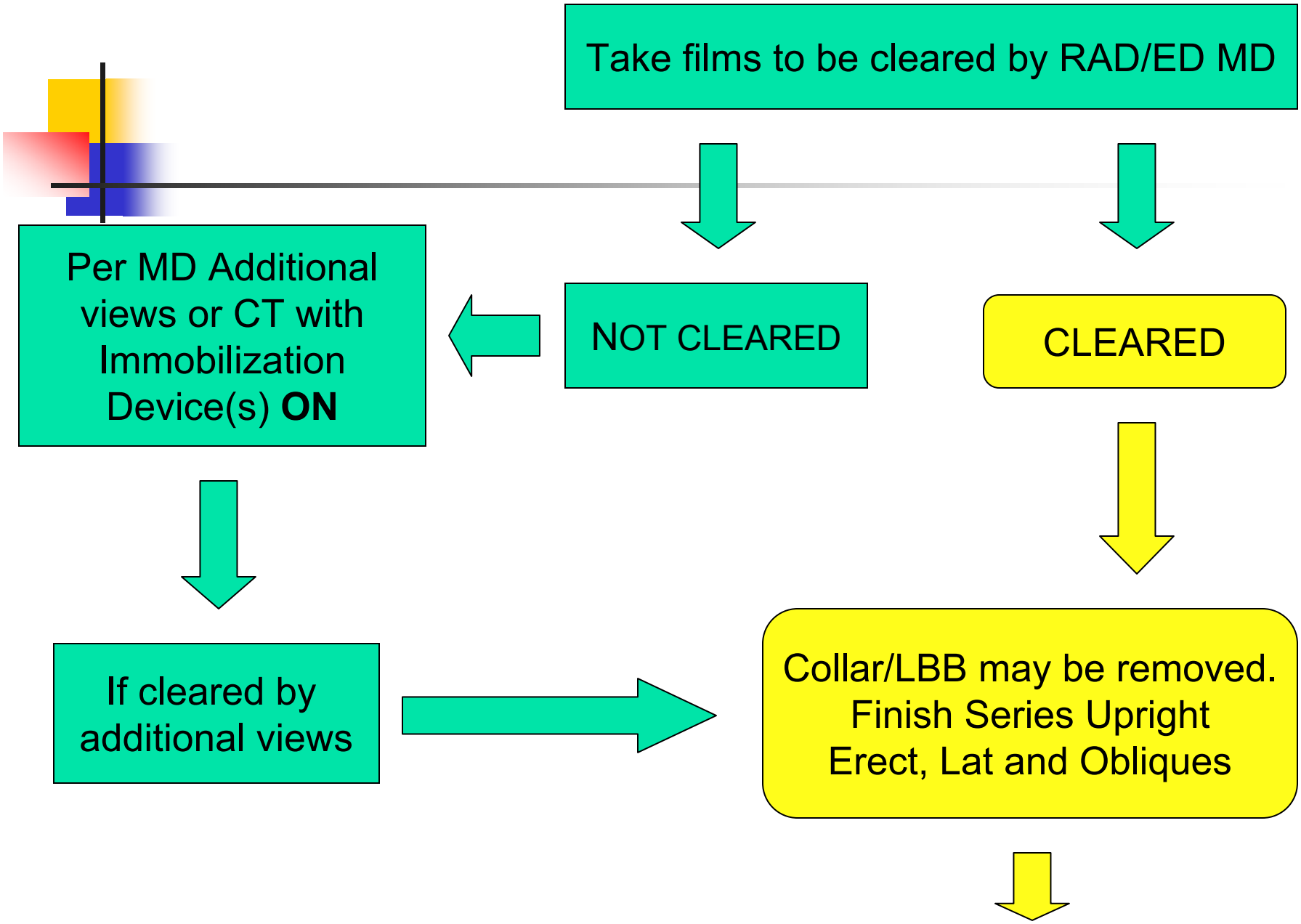
2. ED Orders C-Spine Low-Risk Trauma

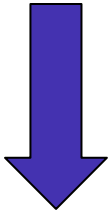
→ Do X-Table Lat, AP, Odontoid ***Supine with Immobilization Device(s) ON*** (if Present)

↓

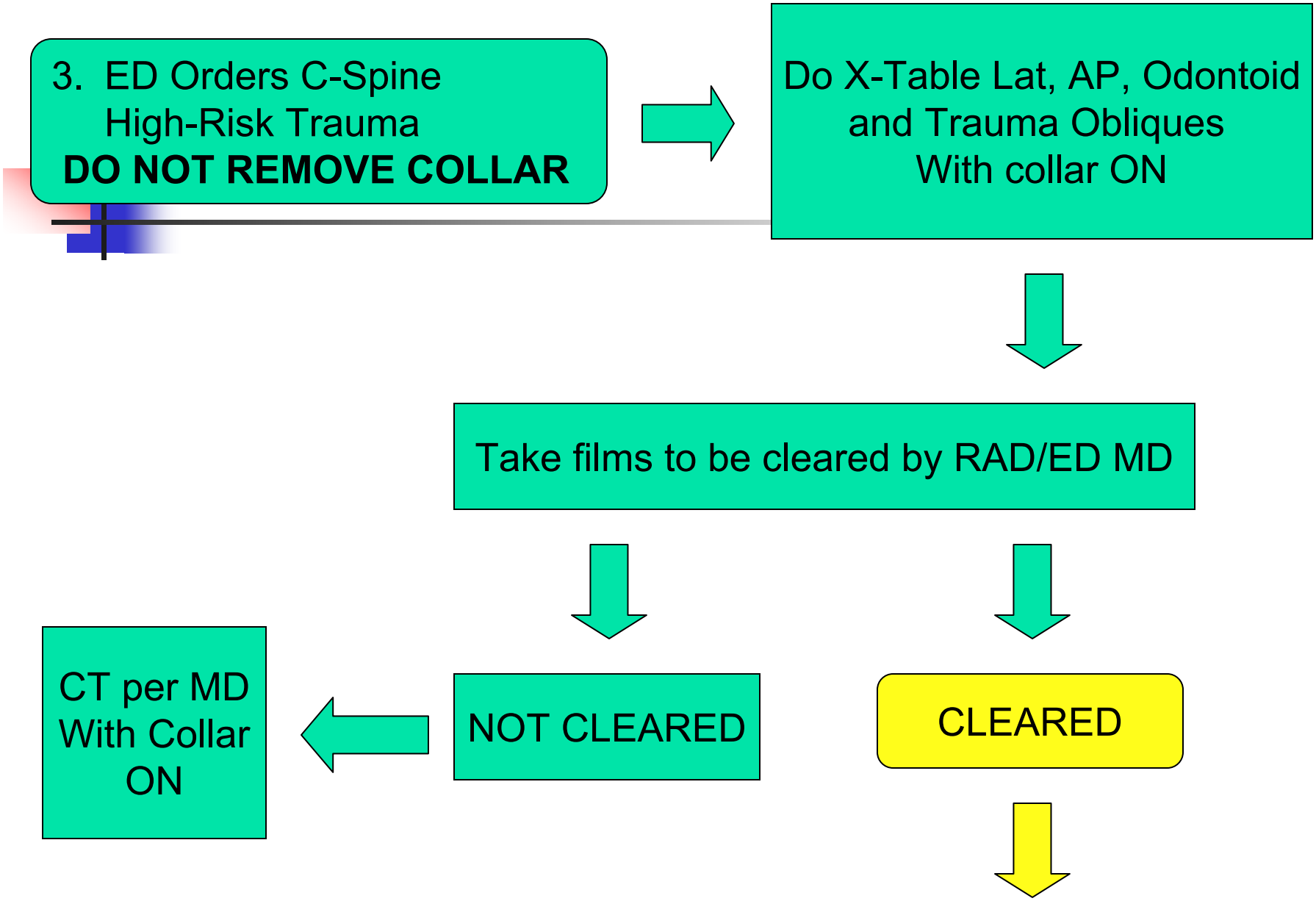
Take films to be cleared by RAD/ED MD

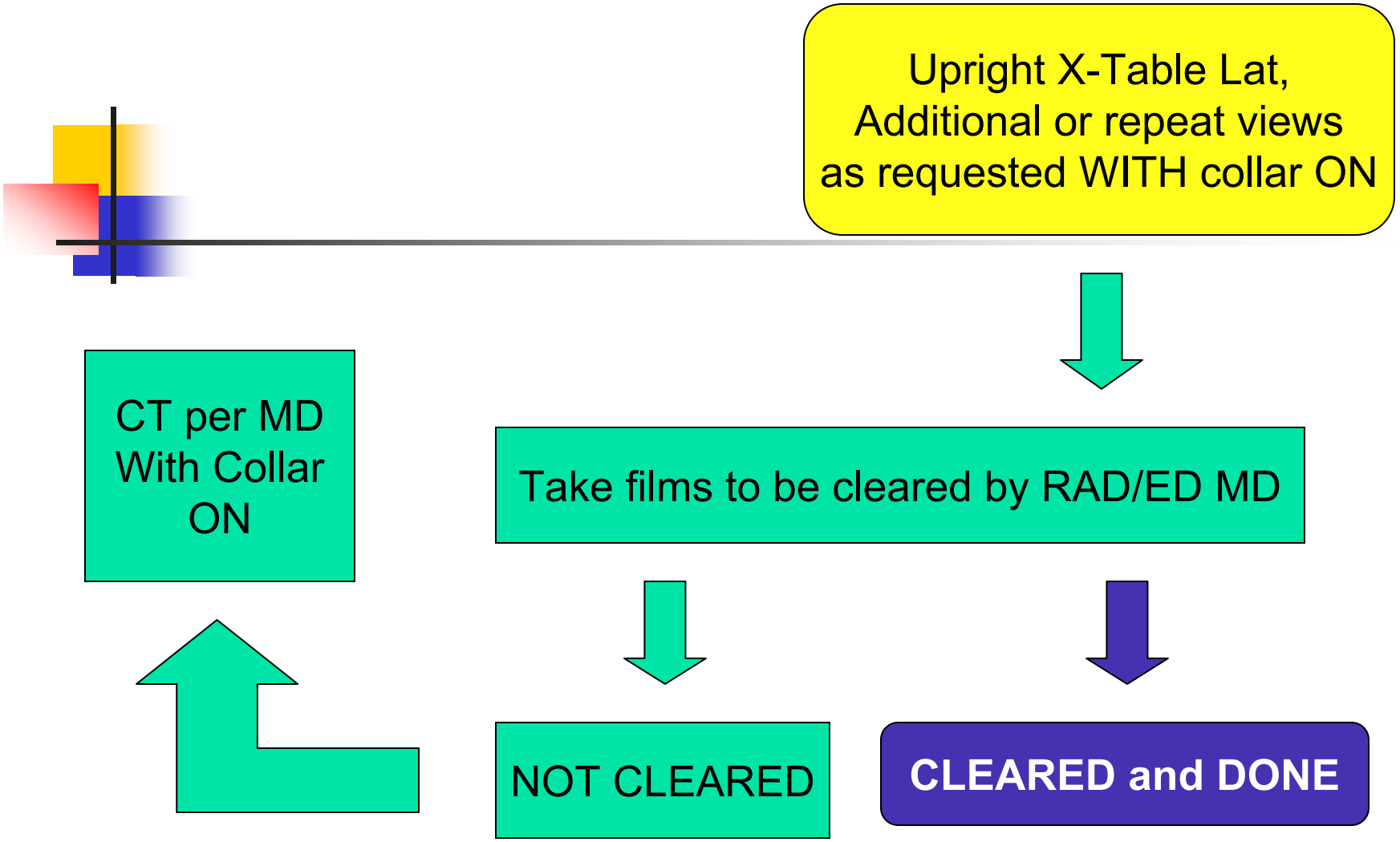

Take films to be cleared by RAD/ED MD
Per MD Additional views or CT with Immobilization Device(s) **ON**
NOT CLEARED
CLEARED
If cleared by additional views
Collar/LBB may be removed. Finish Series Upright Erect, Lat and Obliques

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
CLEARED
NOT CLEARED
CT per MD
With Collar
ON


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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