

Trauma Patients in the Primary Care Setting

Danielle D. Campagne, MD, FACEP

Chief of Emergency Medicine, UCSF-Fresno
Professor of Clinical Emergency Medicine, UCSF
University of California San Francisco
Fresno, CA

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Disclosure

Consultant: EM:RAP

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Learning Objectives

1. Discuss approach to patients who present with injury due to trauma
2. Share “tricks of the trade” on assessment skills
3. Discuss clinical decision tools to help decide who needs imaging or not

Case

- 45 y.o. male
- Involved in a low speed MVC
- Walks into your office
- CC: Neck Pain
 - No neck pain at scene
 - Complains of mild neck pain now
- Exam: no c-spine TTP, can rotate neck to left & right



- Do you need to image his neck??
- What decision rules can you use to make this decision?



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Decision Rules: You Say....



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Decision Rules: I Say.....



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C-Spine Imaging

- Canadian C-Spine Rules
- NEXUS C-Spine Rules

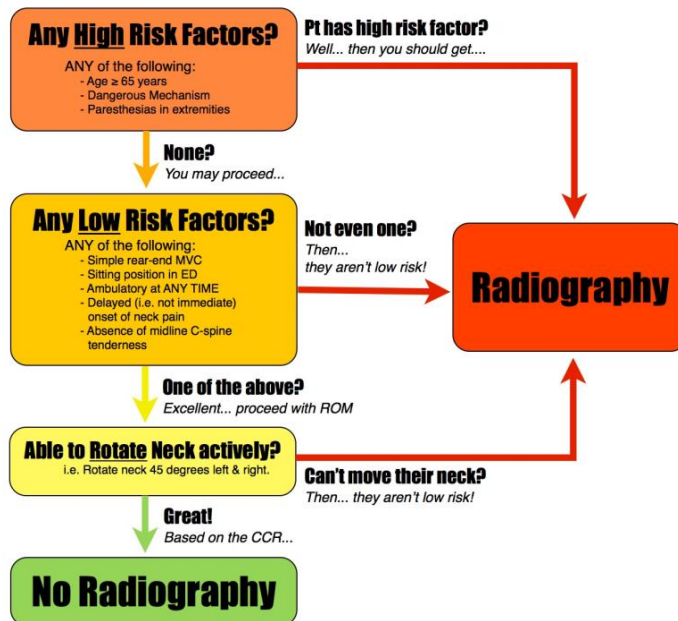


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Canadian C-Spine Rules

- Guidelines used to decide if C-Spine Imaging is **NOT** needed
 - Adults with Blunt Trauma
 - GCS 15 and stable
 - 100% sensitivity for identifying "clinically important C-spine injuries"

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Canadian C-Spine Rules

– ANY High-Risk Factors:  GET CT

- Age >65
- Dangerous mechanism*
- Paresthesia in extremities



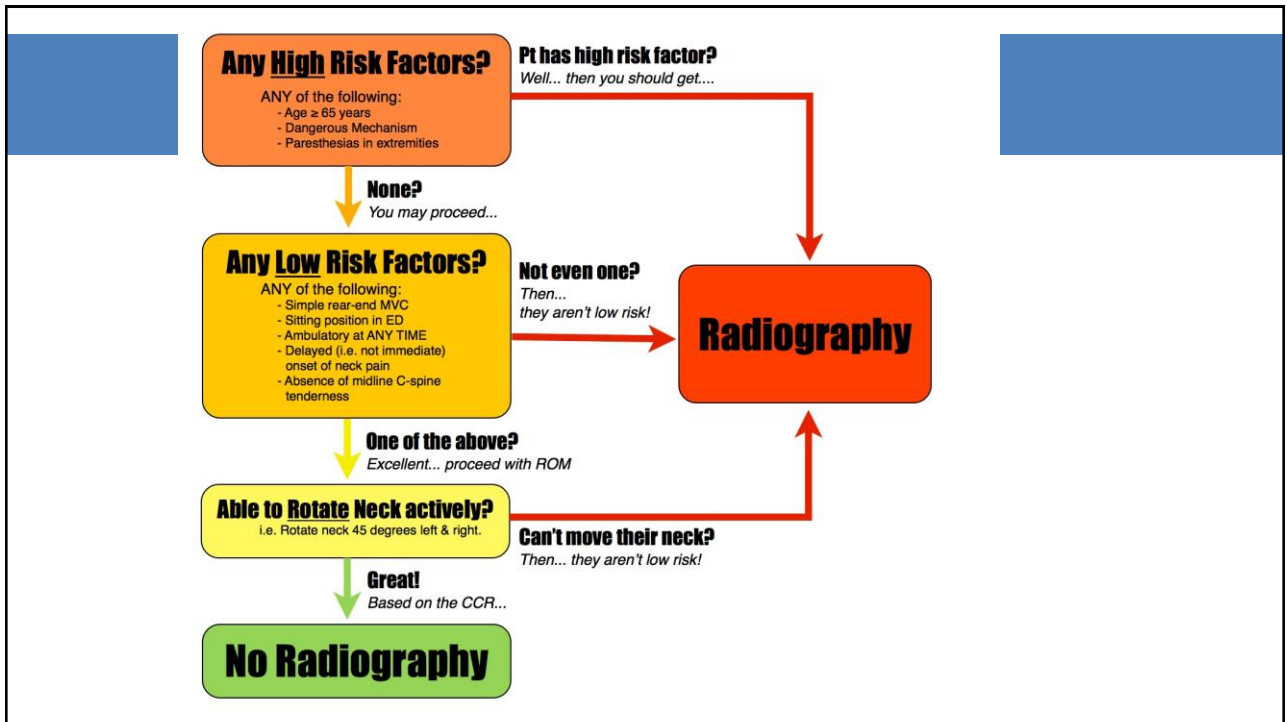
- *Mechanism = fall >3ft, high speed MVC, rollover, ejection, axial load, bike collision

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Canadian C-Spine Rules

- Low Risk Factors
 - Simple rear end MVC
 - Delayed onset of pain
 - Sitting position in ED
 - Ambulatory at any time
 - Absence of midline TTP
- If all Low-Risk, then check ROM
 - Rotates neck 45 degrees to the left and right

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Canadian C-Spine Rules

- 100% sensitivity for identifying "clinically important C-spine injuries"

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NEXUS C-Spine

- Blunt trauma pts
- 99.6% sensitive for clinically important injury
- *not many elderly pts (> age 65) in the study so use caution when applying to elderly population

Paykin G, O'Reilly G, Ackland HM, Mitra B. The NEXUS criteria are insufficient to exclude cervical spine fractures in older blunt trauma patients. *Injury*. 48 (5): 1020-1024.

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NEXUS C-Spine

- Imaging NOT necessary if:
 - No focal neuro deficits
 - No midline cervical TTP
 - Normal alertness
 - No intoxication
 - No painful distracting injury



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Canadian Rules vs NEXUS

- Designed for whether or not a patient requires imaging
- Canadian
 - Reduced imaging rates by 44%
- NEXUS
 - Reduced imaging rates by 36%

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Canadian Rules vs NEXUS

Table 4. Sensitivity, Specificity, and Negative Predictive Value of the Two Rules for 162 Cases of “Clinically Important” Injury among 7438 Patients.*

Result of Assessment	Canadian C-Spine Rule		NEXUS Criteria	
	Injury	No Injury	Injury	No Injury
Positive (no.)	161	3995	147	4599
Negative (no.)	1	3281	15	2677
Sensitivity (%)	99.4 (95% CI, 96–100)†		90.7 (95% CI, 85–94)†	
Specificity (%)	45.1 (95% CI, 44–46)†		36.8 (95% CI, 36–38)†	
Negative predictive value (%)	100		99.4	

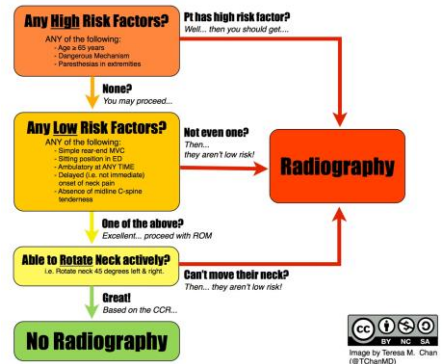
* A total of 845 cases were classified as indeterminate and are therefore omitted from this analysis.

† P<0.001. CI denotes confidence interval.

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Back to the Case

- 45 y.o. low speed MVC
- Not intoxicated and alert
- Ambulatory in ED
- No neck pain at scene, complains of mild neck pain now
- Exam: no c-spine TTP, can rotate neck to left & right
- Do you image??

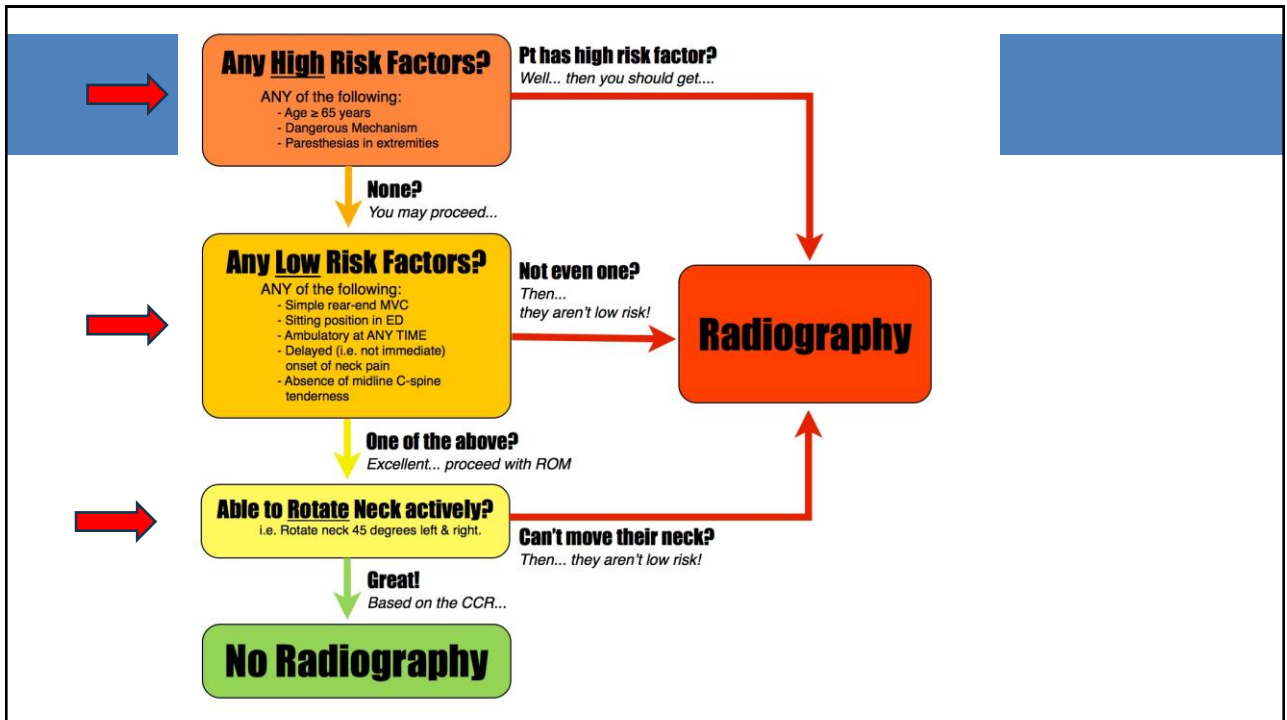


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Do You Image C-Spine?

- A. Yes
- B. No
- C. Unsure

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Case

- 30 y.o. male presents after an MVC
- Hx of + LOC and + vomiting
- Not on blood thinners
- No sz, + HA
- Presents to the ED with vomiting
- DO YOU ORDER A HEAD CT??
- Any Decision Rules to help you make this decision?

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Who Needs a Head CT After Trauma??

- Canadian Head CT Rule
- New Orleans Rule
- PECARN for pediatrics



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Canadian Head CT Rule

- Validated rule to determine the need for head CTs
- Adult ED patients with MINOR head injuries
- Initial study was in 10 Canadian ED's
- 3121 patients
- Five high risk factors and two medium risk factors
 - Predict the need for subsequent NSS intervention

Stiell IG, Wells GA, Vandemheen K, Clement C, Lesiuk H, Laupacis A, McKnight RD, Verbeek R, Brison R, Cass D, Eisenhauer ME, Greenberg G, Worthington J. The Canadian CT Head Rule for patients with minor head injury. *Lancet* (London, England). 357 (9266): 1391-6.

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Canadian CT Head Rule for Minor TBI

CT Head only indicated if any one of the following present:

High Risk (for Neurological Intervention)

1. GCS score < 15 at 2 hrs after injury
2. Suspected open or depressed skull fracture
3. Any sign of basal skull fracture*
4. Vomiting ≥ 2 episodes
5. Age ≥ 65 years

*Signs of Basal Skull Fracture

- hemotympanum, 'raccoon' eyes, CSF otorrhea/rhinorrhea, Battle's sign

** Dangerous Mechanism

- pedestrian struck by vehicle
- occupant ejected from motor vehicle
- fall from elevation ≥ 3 feet or 5 stairs

Medium Risk (for Brain Injury on CT)

6. Amnesia before impact ≥ 30 min
7. Dangerous mechanism ** (*pedestrian, occupant ejected, fall from elevation*)

Rule Not Applicable If:

- Non-trauma cases
- GCS < 13
- Age < 16 years
- Coumadin or bleeding disorder
- Obvious open skull fracture

Stiell IG, et al. The Canadian CT Head Rule for Patients with Minor Head Injury. Lancet 2001;357:1391-96.

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High Risk

High Risk (for Neurological Intervention)

1. GCS score < 15 at 2 hrs after injury
2. Suspected open or depressed skull fracture
3. Any sign of basal skull fracture*
4. Vomiting ≥ 2 episodes
5. Age ≥ 65 years



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Medium Risk

Medium Risk (for Brain Injury on CT)

6. Amnesia before impact \geq 30 min
7. Dangerous mechanism ** (*pedestrian, occupant ejected, fall from elevation*)

Dangerous Mechanism:

- Ped vs auto
- Occupant Ejected from MVC
- Fall from >3 ft or 5 stairs

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Canadian Head CT Rule

- Can Not Apply Rule:
 - Blood thinner
 - Open skull fracture
 - Altered Mental Status (GCS $<$ 13)

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Canadian Head CT

- CT not needed
 - If pt has none of the risk factors!
- If Positive Risk Factors -> Order Head CT
- Rule does NOT apply to Kids

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Canadian Head CT

- High-Risk Factors
 - 100% sensitive (95% CI 92-100%) for predicting need for neurological intervention
 - 32% of patients undergo CT
- Medium-Risk Factors
 - 98.4% sensitive (95% CI 96-99%) and 49.6% specific for predicting clinically important brain injury
 - 54% of patients to undergo CT

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New Orleans Rule

- Patients with
 - Head injury AND
 - Loss of Consciousness AND
 - Neurologically normal
- Sensitivity 97-100% for intracranial injuries needing NSS

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New Orleans Rule

- Questions **(YES TO ANY = Need CT)**
 - Headache
 - Vomiting
 - Age >60
 - Alcohol or drug intoxication
 - Persistent anterograde amnesia (short term memory deficits)
 - Visible trauma above the clavicles
 - Seizure

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Which Rule Is Best?

New Orleans Criteria

- ✓ Sensitivity and Specificity of detecting a clinically significant CT finding
- ✓ Sensitivity = 100%
- ✓ Specificity = 24.5 %
- ✓ Estimated to decrease CT imaging by **23%**

Canadian Head CT Rule

- ✓ Sensitivity and Specificity for need for neurosurgical intervention and clinically significant finding on CT imaging
- ✓ Sensitivity = 100%
- ✓ Specificity = 68%
- ✓ Proposed to reduce CT scanning by **46%**

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Back to the Case

- 30 y.o male presents after an MVC
- Has hx of + LOC and + vomiting
- Not on blood thinners, and no sz
- Presents to the ED with one episode of vomiting

- Do you image?
 - YES according to New Orleans
 - YES by Canadian if 2 episodes of vomiting

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What About Pediatric Head Trauma?



- 6 y.o. in MVC
- Retrained in car seat
- Mom reports a brief LOC
- One episode of vomiting

- Do you order a head CT?
- Any decision rules to help you make this decision?

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PECARN

- Clinical rule aims to find kids at very low risk of clinically important TBI
- Validated pediatric algorithm
 - Predicts likelihood of TBI and who needs a CT

Holmes JF et al; Pediatric Emergency Care Applied Research Network (PECARN). Identification of children at very low risk of clinically-important brain injuries after head trauma: a prospective cohort study. Lancet. 2009 Oct

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PECARN

<div style="display: flex; justify-content: space-between; align-items: center;"> ✕ PECARN Pediatric Head CT Rule </div>	<div style="display: flex; justify-content: space-between; align-items: center;"> PECARN ➤ </div>
younger than 2 years	2 years or older
AMS or GCS < 15 or Palpable skull fx	AMS or GCS < 15 or Signs of basilar skull fx
NONE	NONE
LOC > 5 sec or Non-frontal hematoma or Not acting normally or Severe mechanism*	History of LOC or History of vomiting or Severe headache or Severe mechanism*
NONE	NONE
No CT Required!	No CT Required!
*SEVERE MECHANISMS 	*SEVERE MECHANISMS 
	

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PECARN

- **Clinically important TBI** was defined as:
 - death from traumatic brain injury
 - neurosurgery
 - intubation for >24 hours for traumatic brain injury
 - hospital admission of ≥2 nights associated with traumatic brain injury on CT

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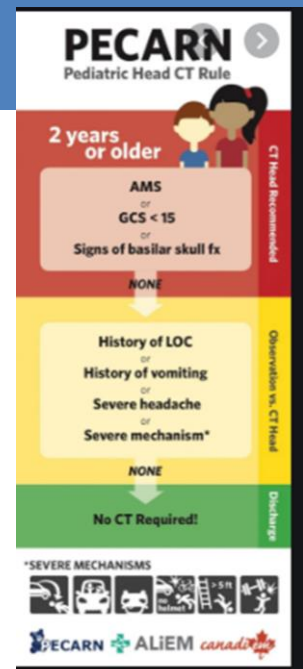
PECARN (Pediatric Emergency Care Applied Research Network)

- Largest trial of its kind!
- Low rates of TBI on head CT (5.2%)
- Even lower rates of clinically significant TBI (0.9%)
- Overall TBI in children is rare
- Head CTs decrease to 35% of pts (Avg 50%) if use PECARN Rule

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Back to the Case...

- 6 y.o. in MVC, retrained in car seat
- Mom reports a brief LOC and 1 episode of vomiting
- Do you order the CT?
- Observation vs Head CT



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Do You Order the CT?

- A. Yes – order CT
- B. No – discharge home
- C. Yes, order CT or observation period

Observation vs Head CT



Observation Period

- 2-4 hours from time of injury



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Case

- 30 y.o. presents to the ED s/p Fall
- Has right foot and ankle pain
- On exam full ROM and + TTP at base of 5th MT
- Do you get an X-Ray?
- Any Decision Rules to help you make this decision?



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Ottawa Rules

- Ottawa Ankle Rules
- Ottawa Foot Rules



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Ottawa Ankle and Foot Rules

- Rules published in 1992
- Reported 100% sensitivity
- Reduced the number of ankle x-rays by 36%
- A second trial in 1994 in JAMA
 - Much larger study
 - Replicated these findings

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How Accurate Is the Ottawa Foot/Ankle Rules?

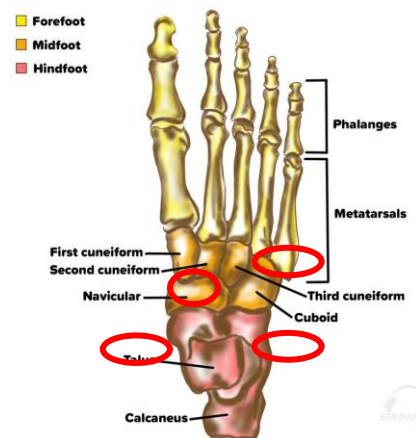
- Meta-analysis of 27 studies
- 15,581 patients
- Negative likelihood ratios 0.08 (95% CI 0.03 to 0.18)
- Sensitivity almost 100%
- Accurate to rule out fracture and decrease x-ray use

[Bachmann LM¹](#), [Kolb E](#), [Koller MT](#), [Steurer J](#), [ter Riet G](#). Accuracy of Ottawa ankle rules to exclude fractures of the ankle and mid-foot: systematic review. [BMJ](#). 2003 Feb 22;326(7386):417.

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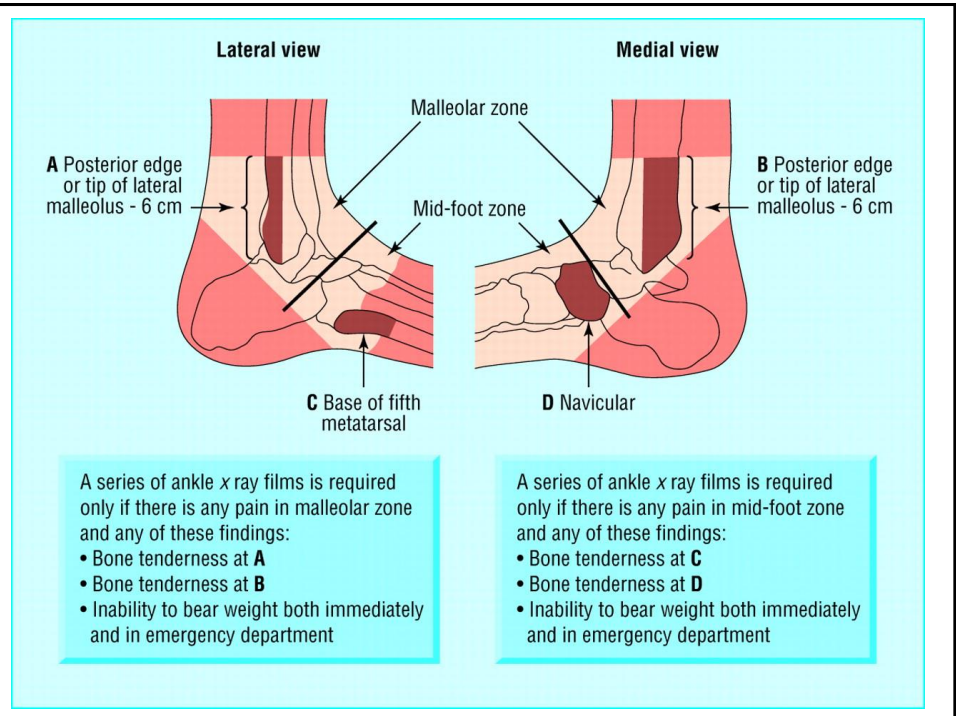
When to Get An X-Ray?

- Ottawa Foot Rules
 - Bony Tenderness of Navicular
 - Bony Tenderness of Base of 5th
 - Unable to bear weight immediately & in ED
- Ottawa Ankle Rules
 - Tenderness of LATERAL malleolus
 - Tenderness of MEDIAL malleolus
 - Unable to bear weight immediately & in ED



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Ottawa Foot & Ankle Rules



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Can Ottawa Apply to Kids??

- The Ottawa ankle rules are validated in children
- Children need to be normally ambulating to apply the rule
- Be cautious in those <6 years old

Runyon MS. Can we safely apply the Ottawa Ankle Rules to children?.
Acad Emerg Med. 2009;16 (4): 352-4. [doi:10.1111/j.1553-2712.2009.00370.x](https://doi.org/10.1111/j.1553-2712.2009.00370.x)

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Back to the Case

- 30 y.o. presents to the ED s/p Fall with ankle/foot pain
- Exam: TTP at base of 5th MT
- Do you get the x-ray?



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Do You Get an X-ray?

- A. Yes
- B. No
- C. Unsure

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YES → X-Ray




- TTP at base of 5th MT
- What if patient 75 years old?
- Does age matter??

NO!

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What If It Was Knee Pain?

- Same case but complains of knee pain
 - 30 y.o. presents to the ED s/p Fall
- 
- Do you image?
 - Any decision rules to help you make this decision?

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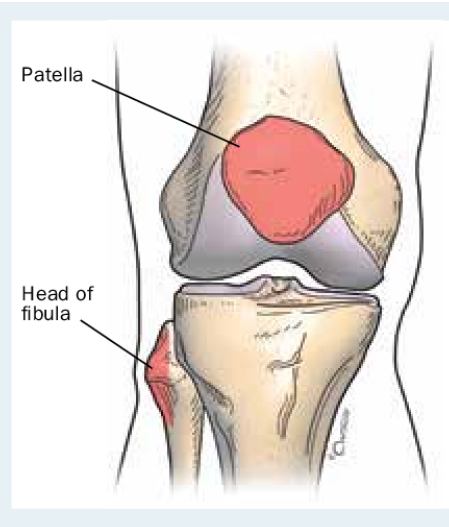
Ottawa Knee Rules

In patients with acute knee injury, a knee x-ray is necessary if any of the following criteria are met:

- Patient is aged 55 years or older
- Isolated tenderness of the patella (Figure 2)
- Tenderness at the head of the fibula (Figure 2)
- Inability to flex the knee to 90°
- Inability to bear weight both immediately and in the emergency department

Figure 2. Ottawa knee rules – regions of bone tenderness.

Adapted from Stiell et al., *Ann Emerg Med* 1995; 26: 405-413.⁹



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Ottawa Knee Validation

- *Annals of Int Med*, 2004
- Systematic review
- 6 studies, 4249 adult pts in the meta-analysis
- Pooled Sen 98.5%
- Pooled Spec 48.6%

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How Accurate Is the Ottawa Knee Rules?

- Meta-analysis of 6 studies
- 4249 adult patients
- Sensitivity was 98.5% (CI, 93.2% to 100%)
- Specificity was 48.6% (CI, 43.4% to 51.0%)

- A negative Ottawa knee rule test accurately excludes knee fractures after acute knee injury

• [Bachmann LM¹, Habermeth S, Steurer J, ter Riet G. The accuracy of the Ottawa knee rule to rule out knee fractures: a systematic review. *Ann Intern Med.* 2004 Jan 20;140\(2\):121-4.](#)

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Case

- 40 y.o. female presents with left knee pain
- Stepped into a hole and twisted her knee yesterday
- Exam: Effusion to left knee, pain with passive & active ROM
- Does she need an x-ray? MRI?

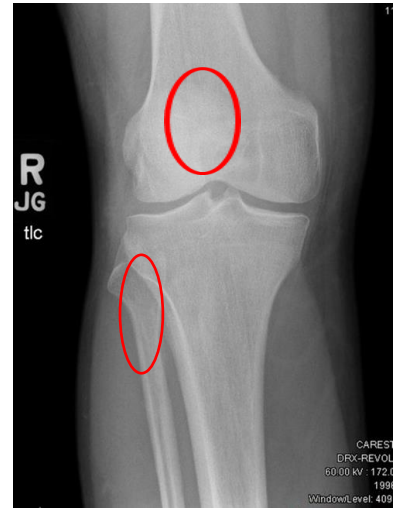


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Ottawa Knee Rules

X-ray needed with 1 or more:

- Age 55 years or older
- Tenderness at head of fibula
- Isolated tenderness of patella
- Inability to flex knee $> 90^\circ$
- Inability to bear weight both immediately and in ED (4 steps)



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Pittsburg Decision Rule

- Fall or blunt trauma mechanism
- Age less than 12 or greater than 50
- Inability to ambulate (unable to take 4 full weight bearing steps)

- If NONE are present: Fracture ruled out 100%

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Ottawa Knee vs. Pittsburg Rule

- *Am J Emerg Med*, 2013
 - 90 pts with knee injury, all got x-rays
 - Assessed by ER & surgical resident prior to x-rays
 - All pts had 2 week follow up
- Sensitivity for fracture
 - 90% Ottawa vs 97% Pittsburg

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Does Ottawa Knee Rules Apply to Kids?

- *Ann Emerg Med*, 2003 **YES! (for age >5)**
- Prospective, multi-center study of 750 kids (age 2-16)
- Ottawa screen, physician discretion for x-rays
- Follow-up phone calls at 14 days by RN's
- Sen 100% & Spec 42.8%
- 31% less x-rays if Ottawa rules used

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Knee: Key Physical Exam

- Effusion
- Bony Tenderness
- Extensor Mechanism
- Stability
 - ACL/PCL
 - Collateral ligaments

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Effusion

- Fracture
- Dislocation
- Septic arthritis
- ACL/PCL injury



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Effusion



Fluid Displacement or Sweep Test



Ballottement or Patellar Tap Test

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Extensor Mechanism

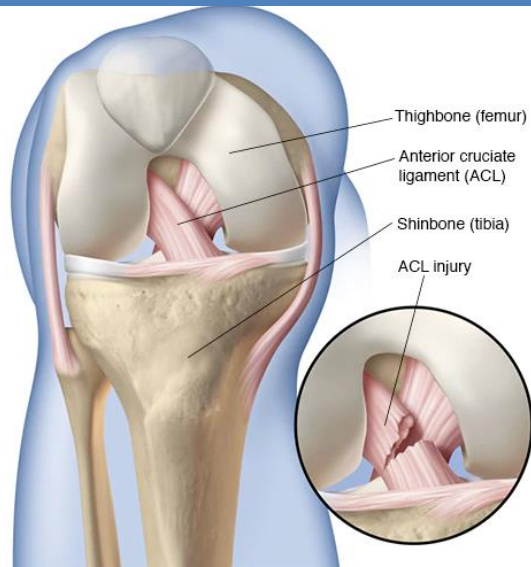
- Patella fracture
- Patella/quadriceps tendon rupture



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ACL/PCL

- Isolated vs Combined
 - Don't miss knee dislocation!
- Acute vs chronic
- Instability symptoms



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Tests for ACL Integrity



Anterior Drawer: Sens 0.73, Spec 0.93



Lachman: Sens 0.85, Spec 0.94

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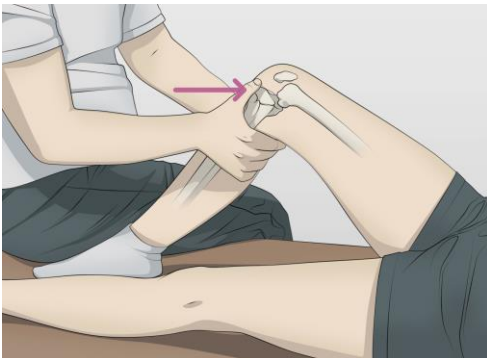
Tests for ACL Integrity

Drop Leg Lachman



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Tests for PCL Integrity



Posterior Drawer



Posterior Sag Sign

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A New PCL Test: Lever Sign / Lelli Test

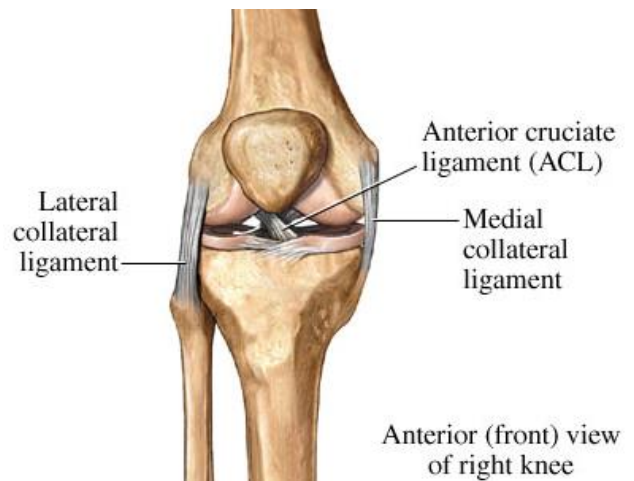


Sens & Spec ~ 1.00

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Collateral Ligaments

- Usually not emergent
- Conservative management



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Medial Collateral Ligament



Valgus stress at 0 degrees



Valgus stress at 30 degrees

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Lateral Collateral Ligament



Varus stress at 0 degrees



Varus stress at 30 degrees

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Meniscal Injury Physical Exam

- Joint Line Palpation
 - Supine
 - Knee flexed
- Palpation of medial & lateral joint lines



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Back to the Case

- 40 y.o. female with ACUTE left knee pain
- Exam: Effusion to left knee, Patella tenderness,
- Pain with passive & active ROM
- X-ray normal
- Still has pain
- Treatment options?



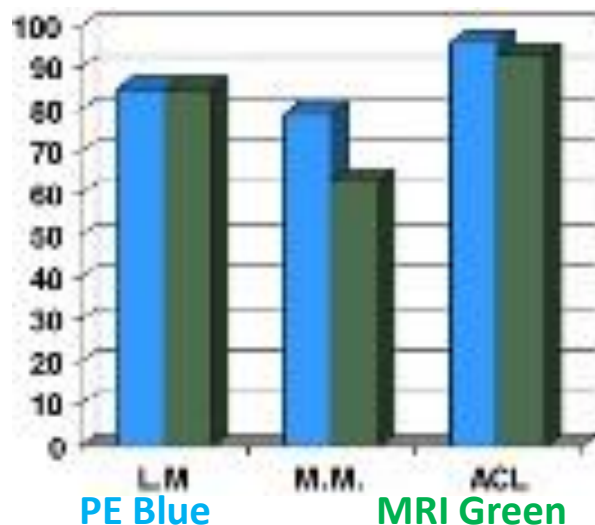
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Do You Order an MRI??

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Delayed PE of the Knee Better Than MRI!

- *Int Ortho*, 2009
- Prospective
- 131 pts
- PE, MRI & arthroscopy
- **PE superior** to MRI for meniscus and ACL injury!



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When to Use a Knee Immobilizer?



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When to Use a Knee Immobilizer?



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If Patients
Insists on
Brace..



Hinged knee immobilizer

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Treatment for Acute Knee Pain

- Ice/Compression/Elevation
- Crutches (partial weight bearing as tolerated)
- Early ROM to prevent loss of mobility
- Trial of conservative measures first
- Follow up in 2 weeks for repeat exam
 - Still pain and laxity -> order MRI



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Case

- 67 y.o presents 3 days after a fall
- Was in the ED and told had left sided rib fractures
- CC: Increase pain and SOB



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Rib Fractures & Mortality

- Study in Injury, 2012
- Rib fractures double risk of death if:
 - Advanced age (age >64)
 - Three or more rib fractures
 - Pre-existing cardiopulmonary dz-> CHF
- 5x increased risk of death if develop PNA after chest trauma/rib fractures



Battle CE, Hutchings H, Evans PA. Risk factors that predict mortality in patients with blunt chest wall trauma: *Injury*. 2012;43(1):8-17.

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Physical Exam for Rib Fracture

- Check for Pulm complications:
 - Splinting
 - short/shallow breath
 - Tachypnea
 - hypoxia
- If Pulm complications present:
 - Refer to ED for admission

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Case

- 60 y.o ground level fall
- Comes in with point tenderness and bruising over one rib
- Clear lungs
- Vitals normal
- O2 sat 100%
- Do you need an x-ray?

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Rib Fracture

- Clinical DX
 - PE and history
- Single isolated/low mechanism single rib fracture usually has benign clinical course
- No x-ray needed!

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Simple Isolated Rib Fracture Treatment



- Conservative therapy
 - Analgesia
 - Rest
 - Ice
 - Incentive spirometer

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NO RIB TAPING!



- Impedes respiratory effort
- Increases PNA risk

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Case

- 30 y.o. with back pain x 2 wks
- No fall, was playing pickle ball and noticed pain
- No midline TTP
- No bowel or bladder complaints



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What Imaging Do You Order?

- A. MRI L Spine
- B. CT L-Spine
- C. X-ray L Spine
- D. None, conservative management

No Imaging Needed

- Study in Spine, 2000
- Withhold imaging for low back pain within the first 6 weeks of symptom onset
- Trial of conservative management
- UNLESS: Red Flags
 - Cancer, wt loss, immunosuppression, trauma, IVDU
 - Motor weakness, GU complaints, age>50

Red Flags Mnemonic: TUNA FISH

PEARLS

- Historical "red flag" symptoms of back pain include:
 - T = Trauma
 - U = Unexplained weight loss
 - N = Neurologic symptoms
 - A = Age >50 years
 - F = Fever
 - I = Intravenous drug use or immunocompromised
 - S = Steroid use/Syncope
 - H = History of cancer
 - Mnemonic: **TUNA FISH** ❄️

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Pop Quiz

- 10 y.o. brought in for vomiting by family
 - Yesterday was jumping on trampoline and fell off striking head
 - No LOC
 - Witnessed by family
 - Multiple episodes of vomiting
 - No personality change
- What do you do?



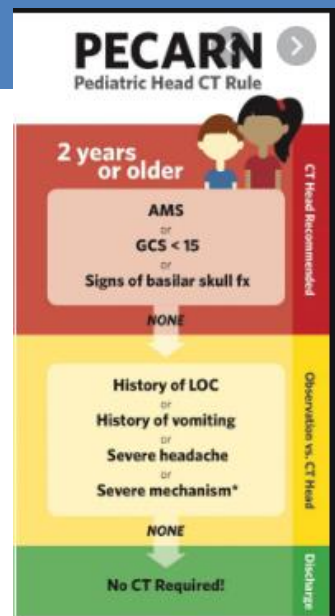
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10 y.o Vomiting What Do You Do?

- A. Send to ED via ambulance for head CT
- B. Period of observation vs CT
- C. Reassure family no CT needed
- D. Unsure

Observation vs CT

- Kid has been observed since yesterday and still vomiting
- My opinion: Head CT!



Pop Quiz

- 50 y.o was gardening and fell yesterday with brief episode of LOC
- Has small bruise to cheek
- No HA
- No vomiting
- Alert and orientated
- Wants to get checked out

Do you order a CT HEAD???



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Do You Order CT Head?

- A. Yes, order Head CT
- B. No, no CT needed
- C. Send straight to ER
- D. Unsure

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Canadian and New Orleans Say NO CT Needed!!

Canadian Head Rule

Canadian CT Head Rule for Minor TE

CT Head only indicated if any one of the following present:

<p>High Risk (for Neurological Intervention)</p> <ol style="list-style-type: none"> 1. GCS score < 15 at 2 hrs after injury 2. Suspected open or depressed skull fracture 3. Any sign of basal skull fracture* 4. Vomiting ≥ 2 episodes 5. Age ≥ 65 years 	<p>*Signs of Basal Skull Fracture</p> <ul style="list-style-type: none"> - hemotympanum, 'racoon' eyes, CSF otorrhea, Battle's sign <p>** Dangerous Mechanism</p> <ul style="list-style-type: none"> - pedestrian struck by vehicle - occupant ejected from motor vehicle - fall from elevation ≥ 3 feet or 5 stairs
<p>Medium Risk (for Brain Injury on CT)</p> <ol style="list-style-type: none"> 6. Amnesia before impact ≥ 30 min 7. Dangerous mechanism ** (<i>pedestrian, occupant ejected, fall from elevation</i>) 	<p>Rule Not Applicable If:</p> <ul style="list-style-type: none"> - Non-trauma cases - GCS < 13 - Age < 16 years - Coumadin or bleeding disorder - Obvious open skull fracture

Stiell IG, et al. The Canadian CT Head Rule for Patients with Minor Head Injury. Lancet 2001;357:1391-96.

New Orleans

- Questions **(YES TO ANY = Need CT)**
 - Headache
 - Vomiting
 - Age >60
 - Alcohol or drug intoxication
 - Persistent anterograde amnesia (short term memory deficits)
 - Visible trauma above the clavicles
 - Seizure

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Summary

- Hard to follow clinical imaging rules when patients want imaging, but these are validated!
- Think Canadian C-Spine Rule for neck pain post trauma
- Think Canadian Head CT on your next minor head injury
- Use PECARN in kids
- Be very cautious with elderly rib fractures

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