
The main resources used today include Tintinalli's Emergency medicine comprehensive study guide, the EM:RAP CorePendium online textbook, and the Royal Children's Hospital Melbourne clinical practice guidelines for pediatric fractures, and we'll mention any other sources as we go.

This is a fun one. We'll be providing a high yield overview of fracture recognition and management, including some of those immediate immobilization, reduction, operative indications, and those can't miss red flag complications (do I smell compartment syndrome and unstable C-spines?).

We'll also touch on everyone's favourite clinical decision tools (shout out to our nation's capital, Ottawa), a little bit about acute and ongoing pain management, age specific considerations (thinking about those salter-harris kiddos and osteoporotic grandmas). We won't be talking specifically about the technical skills like fracture reduction and casting techniques, since they don't fall into the official CCFP learning objectives and are next to impossible to describe over audio anyways.

CASE 1 – This case covers every learning objective except for the last one, which covers our clinical decision tools.

Your first patient of the day, Gladys Von-Chop, an 82-year-old lady with a 30-pack-year smoking history and COPD, who presents to the ER with her daughter after a fall from standing height onto her left side after tripping on the loose corner of a rug. She was able to get up onto her feet with assistance immediately after the fall, but couldn't take more than 1 or 2 steps on account of left groin pain. She did not lose consciousness, nor did she strike her head or sustain any other known injuries. Her home medications include an inhaled LAMA-LABA inhaler combo and a statin. She has no allergies. She quit smoking 7 years ago. She has a history of a distal radius fracture 9 years ago that was managed conservatively. The remainder of her past history is unremarkable.

Triage vitals show a temperature of 37.2, blood pressure of 155/100, heart rate of 91, RR of 18, and O2 of 94% on RA. When speaking with her at the bedside, she endorses 8/10 left groin pain that radiates into the left hip, buttock, and upper thigh area. There are no paraesthesias and no pain below the knee. She has no headache or neck pain and no pain other than that which was previously described. She hasn't taken anything for the pain yet.

Physical examination reveals a somewhat frail looking elderly woman who is moderately thin. She is fully alert and oriented. There are no signs of head or neck injury, including full c-spine ROM. Cardiovascular, respiratory, and abdominal examinations are unremarkable. Lying in the stretcher, her left and right legs do not appear to be visibly shortened or rotated. There is some ecchymoses over the left greater trochanteric region and left groin, with moderate tenderness over that same area. There is no midline bony tenderness or step-off

deformities to the lumbar or sacral region. There are palpable dorsal pedis and posterior tibial pulses that are equal in strength bilaterally.

Active range of motion is normal on the right hip but significantly limited on the left due to pain, with Gladys lifting her left leg a few inches off the table before stopping due to pain. Passive ROM, including left straight leg raise, is also significantly limited due to pain. There is full active and passive range of motion of the knees bilaterally and, when sit upright, Gladys is able to rotate her torso left and right without pain. DRE reveals normal rectal tone and perianal sensation.

To finish things off, you perform a patellar-pubic percussion test that you just learned about earlier that week on your favourite CCFP exam prep podcast. To perform this test, you place the diaphragm of your stethoscope on the pubis symphysis and percuss the patella on each leg. This revealed a diminished sound upon percussion of the left patella (which is above 90% sensitive and 85% specific for femoral neck fractures).

Ok, so there's lots to talk about there. We've got some focal tenderness, reduced ROM, bruising over the left, and reduced patellar-pubic percussion to the left. Kinda suspicious for something going on in that left hip, if you ask me.

But, importantly, lets talk about what we DON'T see. We *DON'T* see any problems with ABCs or any immediate or obvious life-threatening injuries. Ms. Von-Chop also doesn't display any *limb*-threatening injuries. Caleb, any helpful mnemonics for remembering common limb-threatening injuries?

We like to use the mnemonic VON-CHOP.

Wow, what are the chances that our patients last name is actually Von-Chop? That's insanely coincidental. Von-chop is as follows:

- V-vascular injury,
- O-open fracture,
- N-neuro compromise (eg, cauda-equina),
- C-compartment syndrome,
- H-hip dislocation,
- O-osteomyelitis/septic arthritis,
- P-unstable Pelvic fracture.

Thankfully, a thorough and focused physical exam reveals none of the above findings, meaning we don't need to get ortho on the phone – at least for the interim. Regarding the cause of the fall, we also have a nice clear history of a mechanical trip on a rug – meaning we don't need to work-up those scary secondary causes of fall (think of things like vertigo, weakness, syncope, or gait disorders).

So, what are you thinking, and what are you going to do next?

Right away, we have an elderly woman with fragility fracture risk factors like systemic disease with COPD, low BMI, and a smoking history, who has inner left groin pain and limited ambulation after a mechanical fall from standing height. I'm smelling a hip fracture. Thankfully, as mentioned, we don't see any of those VON-CHOP red flags on exam, so this isn't emergent, but we're going to need some imaging.

The question of the day – what imaging should we order? Well, particularly as we're not seeing any visible displacement of the leg (shortening or external rotation), its possible that, even if there *is* a fracture, it could be missed on x-ray. The sensitivity of X-rays for hip fracture ranges from 90% to 98% in the literature, so reasonably good – but not perfect. Radiographically occult fractures account for approximately 2% to 9% of hip fractures, and osteoporosis can make it more difficult to detect any cortical disruption.

Thinking ahead, if x-ray is positive, great – you've diagnosed a fracture. If it's negative, you'll probably want to go digging a bit deeper if your clinical suspicion is high enough. Typically that involves CT scan. Keep in mind CT can also miss some occult fractures and MRI is the gold standard with near 100% sensitivity and specificity! It's also longer to wait for, more costly, and would involve shipping Gladys out of our small ED, so its totally reasonable to start with CT for a negative XR. But we're jumping ahead.

Back to Gladys, we grab some plain film x-rays, including an AP pelvis and lateral hip view. Also, keep in mind the "screen the joint above and below" and consider imaging of L-spine and ipsilateral knee if you have any suspicion for related injuries, or if your history can't safely rule them out (for example, an elderly patient with dementia who is unable to reliably localize pain). In this case, our L-spine and knee exams were reassuring, but we'll make sure the entire left femur is included in the imaging for good measure.

We're probably thinking of starting with something a bit stronger right off the bat then, AKA opioids. We'll include our standard Tylenol Advil in the mix, but these should not be considered the main or only form of analgesic for fracture-related pain. Depending how fancy you are with ultrasound and procedural care, you can also consider something like ultrasound-guided femoral nerve blocks, or fascia iliaca blocks of the affected limb. These are typically done in the context of pre-operative pain control, so we'll wait for imaging and our orthopod assessment before jumping the gun with that.

There's also procedural sedation or hematoma blocks for fractures that need to be reduced in the ED, but those don't apply here so we'll table that discussion until a bit later.

We've established an IV and start with a little dose of IV hydromorphone (morphine is preferred at some shops, though can tend to be more deliriogenic in elderly patients. Follow your local practice pattern). It is prudent to be mindful of the old adage "start low and go slow", especially for opioid naïve patients – so give small doses and frequently reassess and titrate as needed. There's also some solid evidence for use of Ketamine as analgesic as well, particularly in our paediatric population - which we'll discuss in a bit.

We've thrown in the orders, just sat down to grab our first sip of coffee, you hit the refresh button on your EMR, and BOOM – the x-rays are up.

There's simply too much to cover with respect to interpreting x-rays, so we won't dig into any real detail. In any case, you take a peek at the AP x-ray and it looks normal. The lateral hip x-ray, however, demonstrates a very small disruption to the bony cortex of the femoral neck – without any displacement or angulation.

Looks like a non-displaced left femoral neck fracture. This is our most common type of hip fracture, particularly in elderly patients, commonly seen as with Gladys – in those low-impact falls from standing height. As a brief refresher, remember that hip fractures can be broken into 2 main subtypes:

- Above the trochanteric line is called Intracapsular (femoral head and neck); and below the trochanteric line is called

- Extracapsular (trochanteric, intertrochanteric, and subtrochanteric)

Treatment varies widely, but generally speaking, will almost always involve operative fixation and, at the very least, ortho consult. Special consideration for these femoral neck fractures is that they come with a risk of avascular necrosis of the femoral head – since they have a tendency to disrupt those capsular femoral circumflex vessels that wrap around the femoral neck and supply the head. Less of a risk with nondisplaced fractures, but still there.

So what next? Well, we pick up the phone and call our ortho friends across the Howe Sound in North Van. They agree to accept her under their service. It's likely she'll need to go to the OR for either internal fixation or partial hip arthroplasty or total hip arthroplasty. The decision really requires more than just a fracture on x-ray and depends heavily on patient factors and practice patterns – and it's not your call, so don't sweat it. They've requested a CT of the hip in the meantime.

You put in some holding orders, including the ever-so-important DVT prophylaxis – don't forget that – and wander off to see the next patient. Before you head off however, you are already planning follow-up with her in your office, as the astute rural doc that you are. Remember those special considerations for your elderly patients. These are things like:

- Fall risk assessment: I don't need to emphasize how dangerous and life-altering these can be for our older patients. Often they can be seen as "the beginning of the end" – so its critical that we address some other important contributing factors.

- Specifically, we'll need to consider things like OT for walker assessment and home safety assessment, PT for ongoing rehab to prevent deconditioning and that dreaded spiral into frailty that often accompanies hip fractures, and osteoporosis screening and treatment. We can assume

her bones are probably pretty fragile, given the low-impact mechanism of injury.

So that was a doozy of a case, but covered nearly all the objectives, except for the final objective, which is all about those clinical decision rules that we love in primary care. Keep in mind that a lot of these rules have age cut-offs, which tend to be around 65 years of age, for example the Canadian C-spine and CT head rules. Still no history in this case of head or neck injury and Gladys was a reliable historian, but have a low threshold to jump on head and neck imaging in elderly patients with suspicious or unclear histories.

CRPS – Chronic Regional Pain Syndrome

It's also worth briefly mentioning complex regional pain syndrome, or CRPS, as an important complication of fractures, particularly as it's something you could see in your clinic several weeks or even months out from an injury. We really don't know what causes it. It tends to affect people in their 40s to 50s, women more often than men. It's essentially characterised by pain, typically in a previously injured limb, that is more prolonged and/or more severe than you would expect. Diagnosis is clinical, with a set of criteria that we won't get into. In brief, you may see sensory changes, temperature or colour changes, and even loss of motor function. You'll obviously want to rule out things like cellulitis or peripheral vascular disease as well, which can look very similar in some cases.

Management for CRPS is, as you would expect, aimed at symptom control, and multimodal. Patient education, psychological interventions for pain management, medical therapies with our usual analgesics and the neuropathic pain ones like TCAs or gabapentin, and sometimes interventional procedures like trigger point injections or nerve blocks, are a part of care. Get a pain management service involved early, if you have access to one in your community.

With that, we move into our next cases. We took our sweet time with case 1 and covered a lot of ground, these next cases are going to be a bit more rapid-fire, aimed at providing a high-yield overview of some common stuff that you'll see in your local ER or urgent care clinic.

CASE 2 Paediatric Patient covering all Objectives except decision rules

With our last case, we covered some demographic-specific considerations for elderly patients. Let's shift gears and talk about pediatric fractures, which also have some unique features that need to be considered. Shout out to Trekk "translating emergency knowledge for kids" bottom line recommendation on pediatric fractures and the pediatric fracture guidelines from the Royal Children's hospital Melbourne, which were the main sources used for this section.

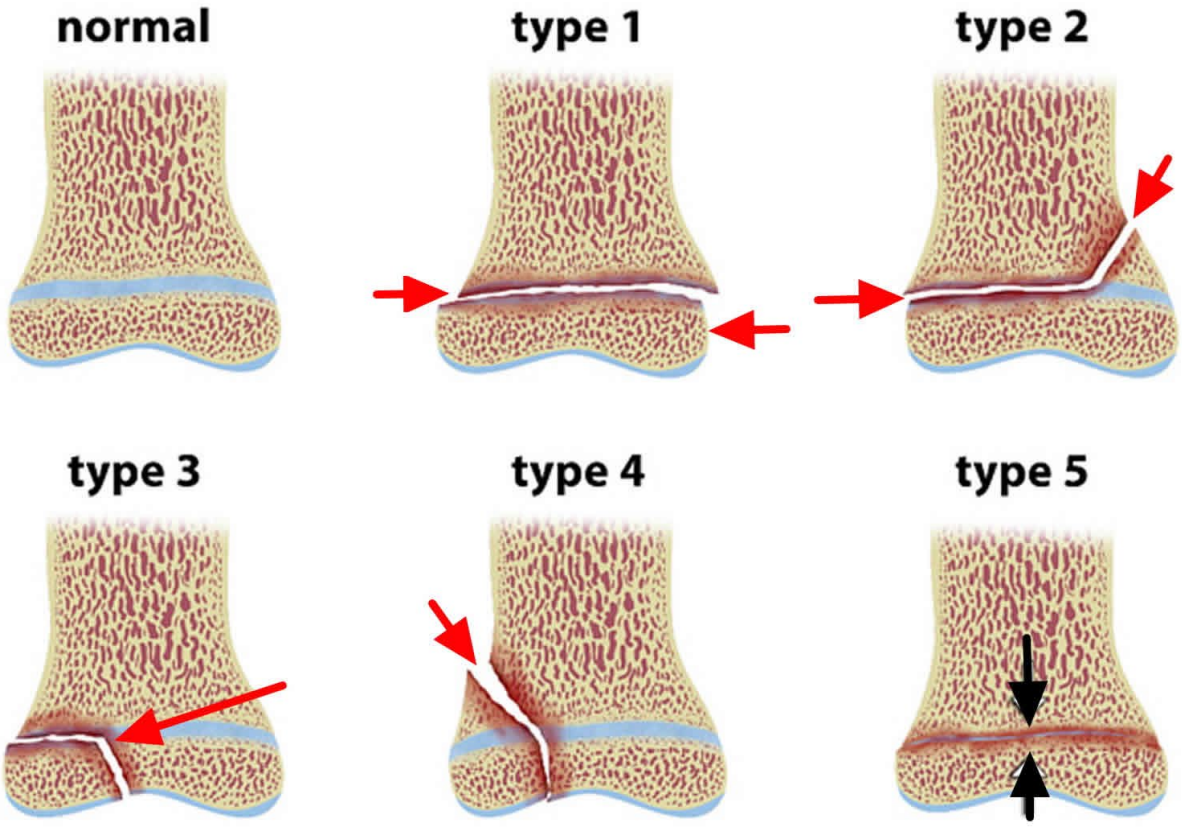
What's important to know about kids is that they love to break their bones. Between birth and age 16, there's an estimated 42% risk of fracture for boys and 27% for females. That's a lot

of fractures! Common things being common, we're talking about distal radius, hand, elbow, clavicle, radial shaft, tibial shaft, foot, ankle, femur, and humerus.

Without digging into too much physiology, we also know that pediatric bones are unique in that they still have growth plates, also known as the physis, which are those areas of active new bone growth made of hyaline cartilage that separate the metaphysis and epiphysis (meta is middle, epi is end). They tend to close around 14-15 years for girls and 15-17 years for boys and are responsible for long bone growth.

So, it goes to follow, you damage the growth plate, you risk impairing the bone's ability to properly grow in length – which can obviously have serious downstream consequences. Thankfully, not all growth plate fractures are created equal, and we've devised a system that allows us to characterize these fractures based on their growth plate involvement and, thus, their need for an intervention like surgery.

I'm sure you all know what we're talking about, it's the infamous Salter-Harris classification system, which ranges from grade I to grade V. The common mnemonic used is SALTER, which makes sense. Let's quickly go through these, with a laser jet focus on the most pertinent facts only. You can quickly search for salter harris for a picture if you want to visualize them as we mention them.



- Type 1 – S, separate, these are transverse fractures directly through the growth plate: these make up ~6% of all growth plate injuries. They often have negative x-rays and are missed, but not a big deal because they heal rapidly – typically within 2-3 weeks, and complications are rare. If you spot it, you can immobilise for comfort, and have them follow up with ortho or PCP as an outpatient – based on local practice patterns.

- Type 2 – A, above, these start off like type 1 but then exit above the growth plate into the metaphysis (aka shaft, M for middle of the bone), making a little triangle shaped fragment: they comprise 75% of all growth plate injuries, by far the most common. They typically require closed reduction, then a cast, and as with above, they can follow up with PCP ortho as an outpatient – based on local practice patterns.

- Type 3 – L, lower, so these also start like type 1 but then take a hard turn south and cut vertically into the epiphysis (E for End of the bone): they comprise 8% of all growth plate injuries. These have a tendency to cause growth and joint problems and will possibly need surgery. So call ortho while they're sitting in the ER.

- Type 4 – T, through, these cut through the metaphysis, into the growth plate, then continue down into the epiphysis. They comprise 10% of all growth plate injuries. This is serious business, they'll almost certainly need surgical fixation – so you'll need an ortho consult in the ED.

- Type 5 – ER, erased, this is essentially a crush injury of the entire growth plate. As you might expect, they're often confused for type 1 or just missed entirely. Thankfully they are Rare, less than one percent of all growth plate injuries. They are often picked up retrospectively, after a child has experienced growth arrest. Obviously call ortho if you see this, but unfortunately treatment options can be limited.

In short, if it's type 1 or 2, its conservative care and outpatient follow up. If its type 3 or greater – it's probably surgical and needs ortho involvement from day 1.

Aside from growth plates, pediatric bones are immature, and literally softer than adult bones, so they tend to bend instead of breaking. As a result, we see different types of fractures in peds than in adults. The three main types are buckle or torus fractures, plastic deformities, and greenstick fractures. Let's highlight this with a case.

A 10-year-old boy wipes out on his skateboard, falling onto his outstretched right hand. There are no other injuries and he was wearing a helmet. There's no broken skin. He's neurovascularly intact on exam. You note focal tenderness to the dorsal forearm without any associated snuffbox tenderness. The joints above and below the wrist examine normally,

and there's no elbow or hand pain on exam. You grab AP and lateral x-rays of the distal forearm and wrist, which reveals a buckle fracture of the distal radius with no other findings.

With buckle fractures, compressive forces cause a bulging or buckling of that outer periosteum rather than a more complete fracture line. The cortex itself is untouched, so there's no displacement or angulation. It essentially looks squished on XR. You throw on a

removable splint and advise the patient that these injuries are expected to heal over 2-4 weeks. You print off a buckle injury fact sheet to give to dad and send them home with follow-up to be arranged with their family doctor in the next 2-3 weeks. For pain management, you counsel on ice, elevation, compression, and ibuprofen every 6-8 hours as needed, which is actually shown to be as effective as morphine in children in that non-acute setting. Acetaminophen can be added or used alternately if needed for additional pain management.

For acute severe pain management in the ED, parenteral opioids, whether IV morphine, hydromorphone, or fentanyl, are often used. Intranasal fentanyl is also a popular option. There's also a growing body of evidence that supports intranasal ketamine as a non-inferior analgesic alternative to intranasal fentanyl for acute pain, particularly for fractures, so keep your eyes out for that. [ref: Influence of ketamine versus fentanyl on pain relief for pediatric orthopedic emergencies (nih.gov)]

Now let's imagine that our case is identical, except you see a visible dinner fork deformity to his wrist on exam. You go ahead and grab those same x-rays and instead discover a displaced and dorsally angulated metaphyseal fracture of the distal radius with and an associated greenstick fracture of the distal ulna. There's no physeal, aka joint, involvement so we can ignore our friend Mr Salter-Harris for now.

The big concern here is the complete fracture of the radius, but what about that associated greenstick fracture of the ulna? If you recall from med school, greenstick fractures refer to incomplete long bone fractures when a bone bends but doesn't completely break… almost like… wait for it… a green stick. Essentially, Imagine a bone being bent like a bow. Now imagine a little incomplete break on the convex surface of the bone, almost like its chipped. But, when you look on the opposite side (ie, the concave surface) of the bone, the cortex remains intact.

Contrast this with a buckle fracture, where the entire cortex remains intact on both sides. Greensticks are more common in kids under 10, and unlike the removable splint that we use for buckle fractures, they require casting. Often we'll start with a slab or half-cast and then move up to a full cast, so that we minimise the risk of compartment syndrome.

Kind of a moot point in this case, since we also have a dorsally displaced and angulated distal radius fracture (aka the Colles fracture) – which definitely needs closed reduction and casting regardless.

Regarding treatment: As a rule of thumb, if the deformity is clinically visible, reduction is typically indicated, which it definitely will be in this case. None of those Von-Chops red flags today thankfully, so no need to get ortho on the phone emergently, and a closed reduction will suffice. In terms of analgesia for the reduction itself, common techniques would include a hematoma block – whereby local anesthetic is injected directly into the hematoma surrounding the fracture, which effectively numbs the entire local area, or procedural sedation, which – for children – with common agents including propofol, ketamine, midazolam, and fentanyl, among others. It's very similar for adults.

Scaphoid Fracture

Now let's modify the case one final time, and say there's no visible deformity – but we elicit snuffbox tenderness on exam, leading to clinical suspicion of a scaphoid fracture. X-ray is negative but, as you recall, scaphoid fractures often won't show up on initial plain film, and can take upwards of a week to appear on plain film. Your options are immediate CT/MRI of the hand & wrist to rule out fracture, or treat presumptively for scaphoid fracture with repeat plain film imaging and fracture clinic follow up in the next 1-2 weeks.

The most important change in management is immobilisation at the wrist to prevent movement at the radio-carpal joint. There is no difference in the rates of non-union between a short-arm cast or a thumb spica; either is perfectly acceptable treatment, but the short-arm cast has less impact on function and is better tolerated. Removable splint is still acceptable, and probably preferred if you're referring to a family doctor for follow-up, since they may not have the tools to remove a circumferential cast.

Another caveat to be aware of is that scaphoid or wrist injuries can also be associated with tears of the scapholunate ligament - which is the ligament that connects the scaphoid and lunate bones, as you probably guessed. Clinically, this can also present with snuffbox tenderness, but the tenderness can also travel more medially along the dorsal wrist as well. There's also a specific exam maneuver, called the Watson test, where you have the patient deviate their wrist in the radial and ulnar directions while palpating over the scaphoid bone on the volar wrist. A positive test would be a palpable and often painful clunk as the scaphoid and lunate bones essentially slide past each other since they're no longer tightly attached.

If you're at all concerned, you can make a note of it on the x-ray req and they'll add a scapholunate view, AKA a clenched fist view, to look for it. If missed, we're looking at possible arthritis, wrist instability, and weakness down the line, so keep it in the back of your mind.

Just before we tie this case up and move to our third and final section, are there any complications that we should be warning patients about?

So the main early complication is actually just loss of reduction, which you might expect in around 10% of cases. Contributing factors are poor cast technique and residual angulation/displacement after the initial reduction. This stresses the importance of early follow-up so these things can be picked up in a timely manner and avoid long term complications.

The big dangerous one we warn people about is compartment syndrome – caused by restriction from a cast. This is the C in Von Chop, and is an orthopedic emergency. Be on the lookout for the 5 Ps: pain, pulselessness, pallor, paresthesia, paralysis, in a swollen, firm, tender limb. In reality, these patients are re-presenting to hospital with pain. Severe, unremitting, out of proportion pain, to be specific, and you can expect that it will be provoked by passive stretch of the finger or toe. Get the cast off, keep the arm at heart level, and call ortho. Definitive treatment requires fasciotomy.

Non-Accidental Trauma

So that ties up our peds case. One more thing that I wanted to mention before we tie things up is to always have an index of suspicion for non-accidental injuries. It's not on the official CCFP objectives list but it's a critical thing to mention nonetheless. Elements that should raise your spidey sense include when the severity of the injury is incompatible with the history, the history keeps changing, or the injury pattern itself is inconsistent with the developmental age of the child. There are also a number of fracture patterns that are highly associated with non accidental injuries, which include things like transverse fracture in long bones, metaphyseal corner fractures (aka Bucket handle fractures), rib fractures, or skull fractures, but that list is by no means complete. Radiopaedia.org has a great article called "suspected physical abuse" that highlights this topic in good detail - so check it out if you're interested, we'll drop a link in the show notes.

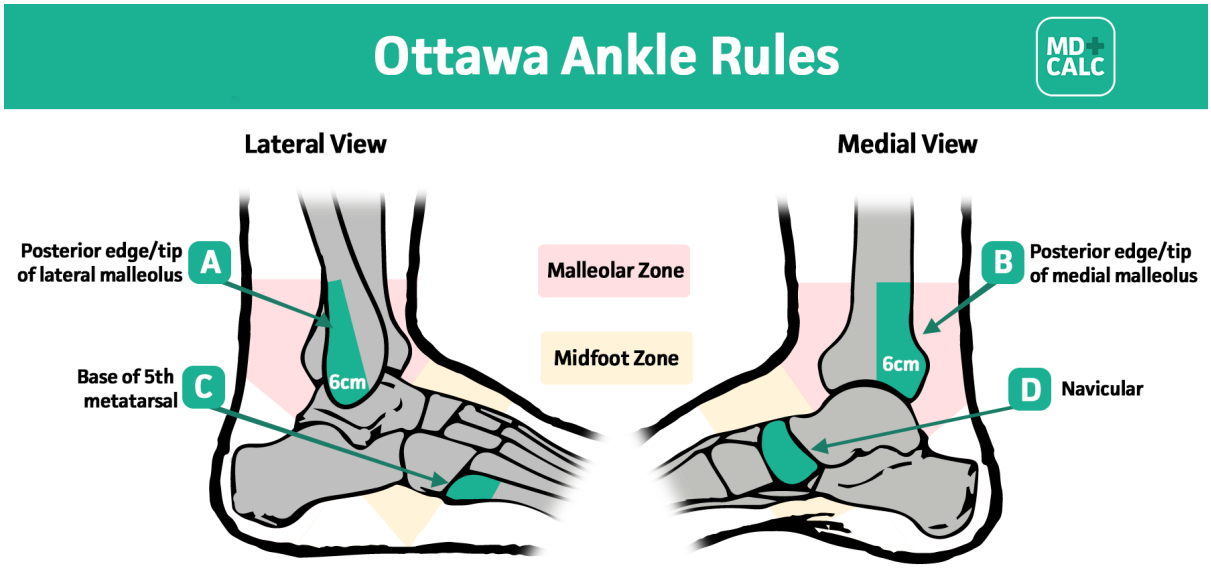
Clinical Fracture Decision Rules

We're in the home stretch, but still have a bit more to cover. We're going to finish off chatting about clinical decision rules. Now, all of what we've touched on so far has been fairly high acuity stuff. In no case did we ever really have to question whether or not imaging was indicated. Old lady falls on her hip and has persistent groin pain? Get an x-ray. Kid falls off a skateboard and his wrist looks like a dinner fork? Get an x-ray. Here's the thing, though, it's not always going to be so obvious. In many cases, you'll be left wondering whether or not it's worth getting imaging at all.

This especially holds true in the clinic setting, whether that's urgent primary care or simply your standard longitudinal family practice. Patients may be presenting a few days out from their injury, and the benefit of imaging becomes less clear in these cases. Luckily, we have some handy rules for that. Let's chat about the three highest yield .

First up is everyone's favourite, the Ottawa ankle rule. It answers the question: does this patient with ankle and/or midfoot tenderness after a trauma need an x-ray? It's incredibly sensitive, ranging from the high 98- 100% range for "clinically significant" ankle and midfoot fractures. Specificities range from 40-80%, but that's less important. This is a rule out test, first and foremost. It is validated for patients aged 2 and up, which is actually pretty impressive when you think about it, given how large of a group this represents.

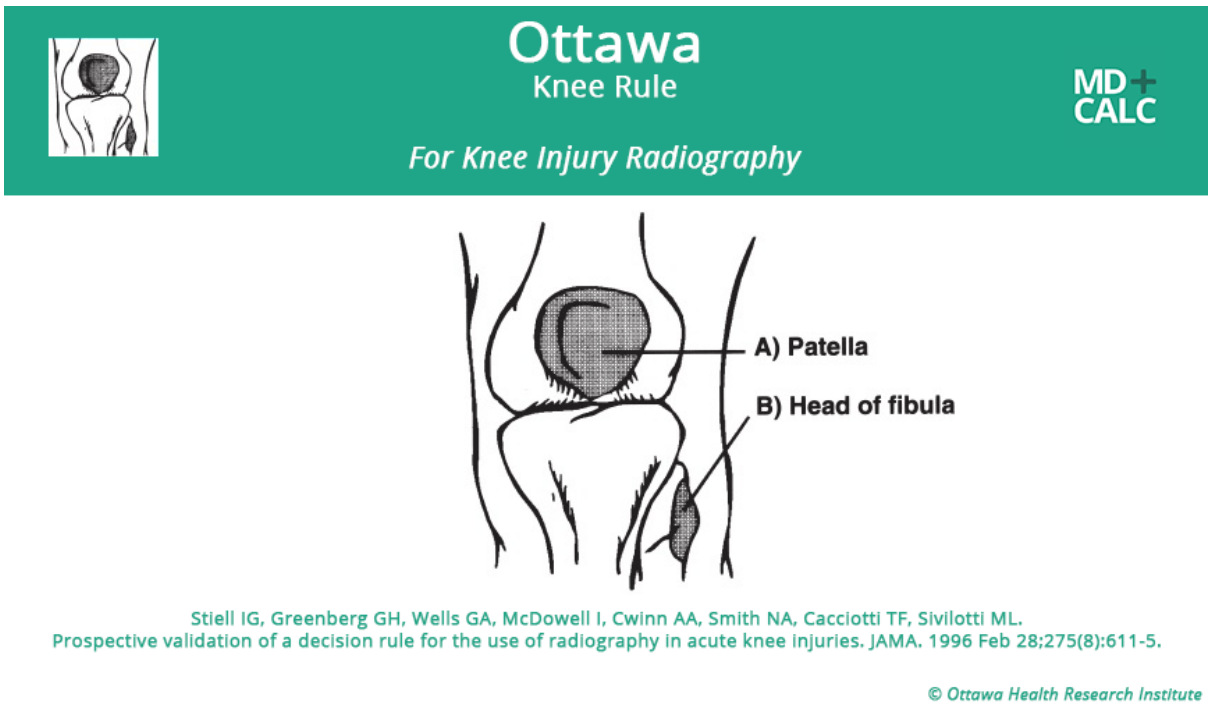
To apply the rule, It has you, as the test performer, palpate over four anatomical landmarks, A,B,C,D, on the ankle and foot. Tenderness over any one of these means you get an x-ray. Landmarks A and B include the tip and posterior edge of the medial and lateral malleoli, ensuring you palpate superiorly for 6 cm from that distal tip. Landmarks C and D include the navicular bone along the medial midfoot (the bony prominence just inferior and distal to the medial malleolus), and the 5th metatarsal base along the lateral midfoot. The Ottawa ankle rule also asks if the patient was unable to weightbear for at least 4 steps both immediately after their injury AND while you examine them. If yes, you also get an x-ray.



Stiell IG, McKnight RD, Greenberg GH, McDowell I, Nair RC, Wells GA, Johns C, Worthington JR. Implementation of the Ottawa ankle rules. JAMA. 1994 Mar 16;271(11):827-32.

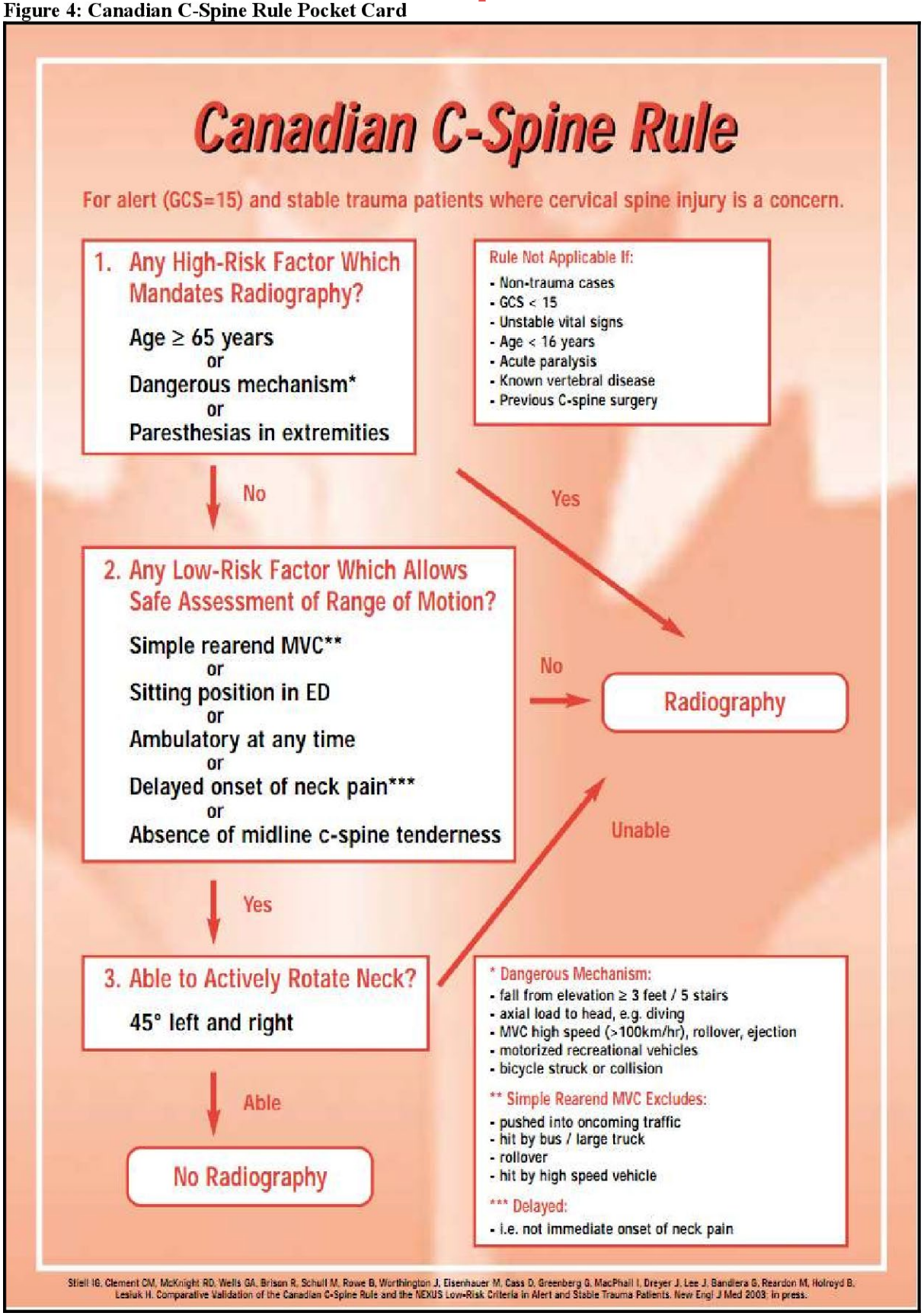
In a similar vein is the Ottawa knee rule. Like its cousin from down south, the Ottawa knee rule boasts a sensitivity ranging from 98-100%. Again, specificity is poorer in the range of 19-50%, though as with the above rule, this is primarily designed as a rule out tool, to stop

us from ordering an x-ray on every Joe Blow who walks into the clinic or ER. Its also only validated for patients aged 55 and up. It's incredibly simple, however, and asks 4 main questions. 1) is there isolated tenderness of the patella (which is to say, JUST the patella and no other bony tenderness) 2) is there tenderness at the fibular head? 3) is the patient unable to flex their knee to 90 degrees and 4) is the patient was unable to weightbear for at least 4 steps both immediately after their injury AND while you examine them, just like the ankle rule. Yes to any one of these buys you an x-ray, since we can't confidently rule out fracture.



The next rule is also out of Ottawa, and in fact the same creator from the first two rules, Dr. Ian Stiell, shout out to this legend. We're talking about the Candian C-spine rule. This is a well-validated decision rule that can be used to safely rule out cervical spine injury in alert, stable trauma patients without the need to obtain any imaging. Once again, it boasts a sensitivity around 99-100%, and has allowed us to safely decrease our imaging among these patients by over 40%. It's a bit more involved than the knee and ankle rules, with a few exclusion criteria, including age below 16 or above 65, so no shame in cracking out MDCalc for this one.

Figure 4: Canadian C-Spine Rule Pocket Card



Right off the bat, if they're over 65, have extremity paresthesias, or had a dangerous mechanism (which includes a list of things like high speed MVC or fall from > 3 feet height), they're high risk and warrant further imaging. If no, we go on to ask if there are any low risk factors present, which includes things like the patient sitting in the ED, if they were ambulatory at any time, had delayed pain onset, or had a simple rear-end MVC. If no, they're again classified as high risk. If yes, we go on to our third and final question, are they able to actively rotate neck 45° left and right. If they can, we're done, and they don't need any imaging. Things like GCS < 15, unstable vitals, paralysis, vertebral disease, or previous c-spine surgery will exclude you from the rule.

Also keep in mind, most times when you're thinking about using the c-spine rule after trauma, you'll also probably be thinking about head injuries. For adults over 16, check out the Canadian CT head rule – also developed by Dr. Stiell out of Ottawa, believe it or not. If they're under 16, check out the PECARN paediatric head injury algorithm instead. Those are outside today's scope but important nonetheless.

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