

- Pre-reading:
 - Kim D, Viswanathan VK, Menger RP. C1 Fractures. [Updated 2020 May 27]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2020 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK534091/#>
 - Walsh GS, Cusimano MD. Vertebral artery injury associated with a Jefferson fracture. *Can J Neurol Sci.* 1995 Nov;22(4):308-11. doi: 10.1017/s0317167100039548. PMID: 8599777.
 - Kontautas E et al. Management of acute traumatic atlas fractures. *J Spinal Disord Tech* 2005;18:402-5.
 - Moore, D., 2021. *Odontoid Fracture - Spine - Orthobullets.* [online] Orthobullets.com. Available at: <<https://www.orthobullets.com/spine/2016/odontoid-fracture>> [Accessed 16 January 2021].
 - Agrawal, R., 2021. *Jefferson Fracture | Radiology Reference Article | Radiopaedia.Org.* [online] Radiopaedia.org. Available at: <<https://radiopaedia.org/articles/jefferson-fracture?lang=us>> [Accessed 16 January 2021].
 - Yao, L. Et al 2013. *Imaging Evaluation Of The Cervical Spine.* [online] Available at: <<https://www.med-ed.virginia.edu/courses/rad/cspine/index.html>> [Accessed 16 January 2021].

- Pre-Questions:
 - List the unstable C-spine fractures.

 - In addition to your usual AP and Lateral views, what other XR view can be most useful when evaluating for Jefferson's Fracture?
 - Odontoid View
 - Flexion View
 - PA oblique view
 - Extension View

 - A patient comes in with after a car accident and is found to have C3 vertebral body fracture without any neurologic deficits, what study is indicated?
 - CTA neck
 - CT head/brain
 - Carotid Ultrasound
 - Lumbar Puncture

- Chief Complaint:
 - 18-year-old male presents with neck pain

- Vitals:

- BP: 142/87 HR: 98 RR: 20 T: 36.8. Sat: 98% on RA Glucose: 80
- What does the patient look like?
 - Patient is in moderate pain, lying in the bed wearing a team swim jacket
- Primary Survey:
 - Airway: speaking in full sentences
 - Breathing: Bilateral breath sounds, non-labored respirations
 - Circulation: Skin is warm and dry with good capillary refill
- Action:
 - Place on monitor
 - Place 2 large bore IVs
 - Labs: Draw rainbow, ultimately will need pre-op labs
 - CBC, CMP, PTT/PT/INR, Type and Screen
- History:
 - Patient
 - HPI: This is an 18-year-old male presenting to the ED from college water polo practice with neck pain. He tells you that he and some of his teammates were goofing off after practice. He dove into the pool, not realizing he was in the shallow end. When he dove into the water, he hit the crown of his head on the bottom of the pool. He was able to get out of the pool without difficulty. He has some mild pain at the site where he hit his head. There was no LOC. ROS: No vision changes. No numbness/tingling to arms or legs.
 - PMH: None
 - PSH: Right Labrum Tear Repair
 - Allergies: Penicillin
 - Meds: Ibuprofen PRN
 - Social Hx: Does not smoke, Drinks multiple times per week with his frat, smokes marijuana
 - Family Hx: No Relevant hx
- Physical Exam:
 - General: Alert and oriented, complaining of neck pain, no acute distress
 - HEET: Small area of tenderness to the top of his head, no boggy, no crepitus, no depression. EOMI, PERRL
 - Neck: Midline proximal C spine tenderness. (patient should not be asked to range neck at least until after imaging)
 - Heart: normal
 - Lungs: normal
 - Abdomen: normal
 - Rectal (must ask): normal rectal tone, brown stool, no saddle anesthesia
 - GU: Normal

- Extremities: No gross deformity, sensation and motor per neuro section. 2+ radial and DP pulses. No loss of ROM
- Back: No T or L spine TTP. No step offs or deformity
- Neuro:
 - Mentals status: A/O x4 and appropriate
 - CN 2-12 intact
 - Reflexes: 2+ throughout
 - Strength: 5/5 in lower extremities, 5/5 in upper extremities
 - Sensation: Intact and symmetric throughout
 - Normal finger to nose, heel to shin, and gait
- Actions:
 - Critical: place patient in c-collar
 - Pain Control:
 - Consider morphine or fentanyl
 - Imaging:
 - XR C-spine with Dens/Odontoid (open mouth) view can be considered
 - CT C-Spine
 - CT angiogram
- Prompt if CTA not ordered: nurse will note the patient is dizzy and starting to have diplopia, dysarthria, and ataxia.
- Results:
 - Labs: Unremarkable
 - XR Figure 1: In open mouth view, C1 lateral masses are noted to be overhanging C2 body concerning for fracture.
 - CT C-spine Figure 2: Anterior and posterior arch fractures present (Jefferson Fracture)
 - CT Angio: No image. Shows L vertebral artery occlusion
- Action:
 - Consult neurosurgery for admission and treatment with external immobilization vs surgery
 - Consult Vascular vs IR for vertebral artery injury
- Diagnosis:
 - Jefferson fracture- Unstable C1 burst fracture
- Critical Actions:
 - Place in c-collar, no neck range of motion while awaiting imaging results
 - Complete neuro exam

- CT c-spine/CTA
- Neurosurgical consult and admission
- Vascular/IR consult

Instructor Guide:

This is a case of a Jefferson (C1 Burst) Fracture. High incidence of suspicion is key in this case as diving into shallow water is a major cause of this type of fracture in isolation. It is also seen in MVCs and traumas and can be missed, as there are usually other distracting injuries that overshadow mild neck pain. Even in patients with no neurologic findings, traumatic midline neck pain should prompt c-collar placement until further workup can be done.

While a rainbow of labs can initially be drawn, the patient will ultimately need pre-op labs for possible neurosurgical intervention.

Pain control should be appropriate.

Additionally, with C1/C2 spine injuries, perform CT angiogram to evaluate for vertebral artery injury since the vertebral arteries pass through the transverse foramina of the atlas and are subject to blunt injury. Development of signs/symptoms of vertebrobasilar injury should help prompt a CTA order if this was not done initially (though often no symptoms are present and can be overlooked). MRI should be considered if there are any focal neurologic findings.

Stat neurosurgical consult for admission and treatment.

Stat vascular vs IR consult for vertebral artery injury, will likely need to start anticoagulation, which should be coordinated based on operative plans.

Teaching Points:

- Jefferson Fractures are unstable c-spine fractures that need emergent neurosurgical consultation
 - Most common mechanisms are due to axial loading of the head in MVCs with impact of the head against the roof of the vehicle and diving into a shallow pool
 - Compression fracture caused by axial load of the occipital condyles of the skull onto C1, splitting the lateral masses and tearing the transverse ligament
 - Often there may be no neurologic deficits noted on exam since the spinal canal at this level tends to be very wide and the fragments are usually pushed radially instead of medially
- About 1/3 of Jefferson fractures are associated with C2 fracture as well
- Anyone with a C1/C2 injury needs a CT angio to evaluate for vertebral artery injury
 - 33-39% of all traumatic cervical spine fractures have associated vertebral artery injury

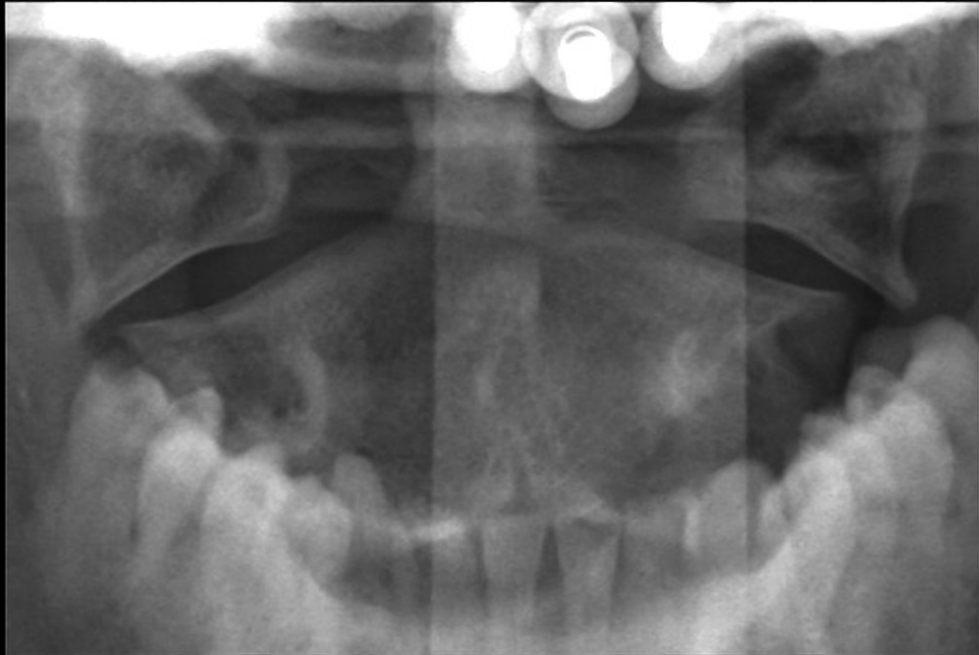
- Remind learners that traumatic neck pain should always be taken seriously even if there are no neurologic findings on exam. If there are any neurologic findings, patient will need an emergent MRI to evaluate for soft tissue and spinal cord injuries.
- Definitive treatment depends on level of instability, fracture pattern, and other co-existing injuries. This may include non-operative management with external immobilization or surgical intervention. This is something that neurosurgery should decide.
- There are 6 unstable C-spine fractures that emergency medicine physicians should be aware of: “Jefferson Bit Off A Hangman’s Thumb”
 - Jefferson Fracture (C1 Burst)
 - Bilateral Facet dislocation
 - Odontoid (Type II and III)
 - Atlantooccipital dislocation (internal decapitation)
 - Hangman’s Fracture (bilateral C2 pedicle fracture)
 - Teardrop Fracture (vertebral body avulsion fracture)

References:

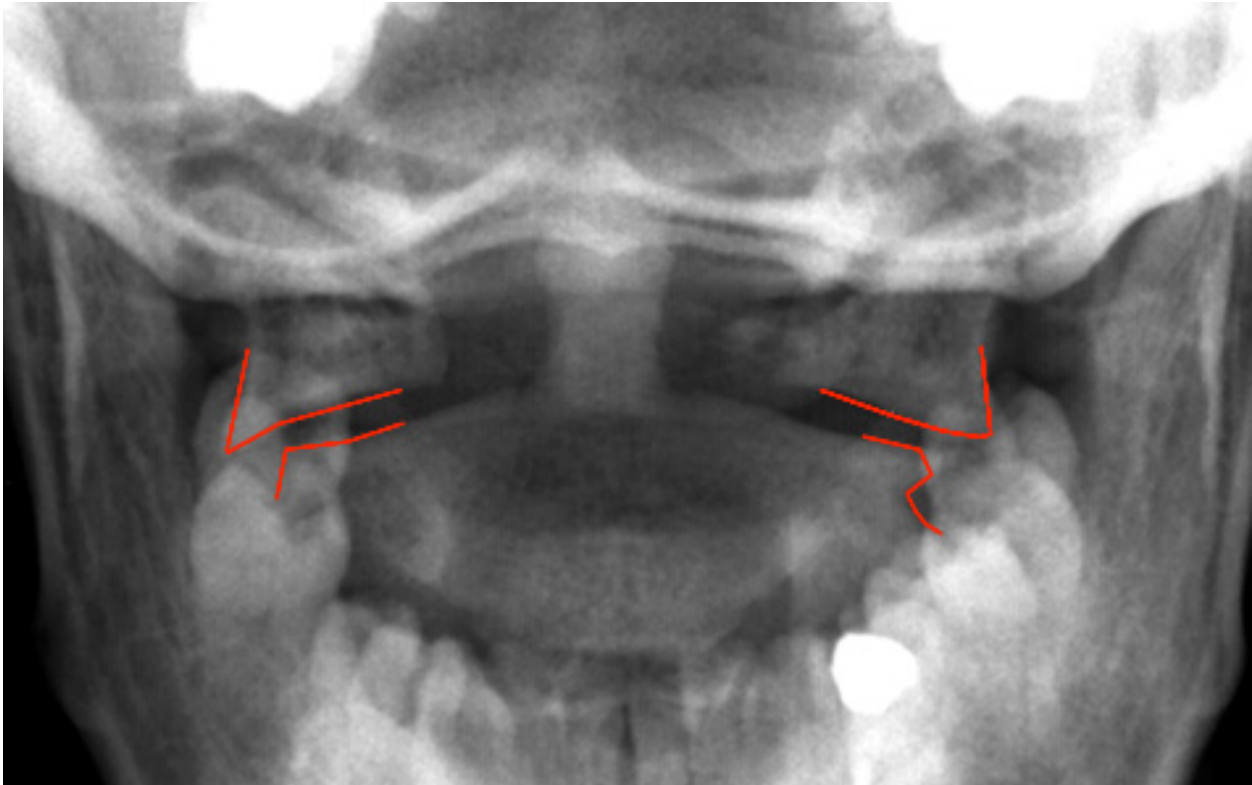
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Images: Per Radiopedia and <https://www.med-ed.virginia.edu/courses/rad/cspine/fracture2.html>

Figure 1:



Teaching Image:



As you can see, the lateral masses of C1 are overhanging C2 making it likely that there is a fracture.

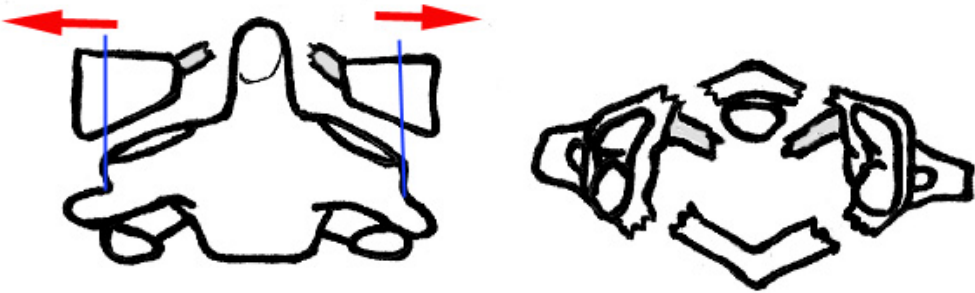


Figure 2:



Labs:

Complete blood count:

WBC 9.8×10^3 /uL

Hb 15.2 g/dL

Hct 45.6%

Plt 281×10^3 /uL

Basic metabolic panel:

Na 141 mEq/L

K 3.9 mEq/L

Cl 101 mEq/L

CO₂ 22 mEq/L

BUN 14 mEq/dL

Cr 0.6 mg/dL%

Gluc 125 mg/dL

Coagulation panel:

PT 13.1 sec

PTT 26 sec

INR 1.0

Type and Screen:

AB +

Post- Questions:

- List the unstable C-spine fractures.
 - Jefferson's Fracture (C1 Burst)
 - Bilateral Cervical Facet Dislocation
 - Odontoid Fracture, Type II or III
 - Atlanto-occipital Dissociation
 - Hangman's Fracture (C2 Pedicular Fracture)
 - Teardrop Fracture

* An easy mnemonic to remember this a "**Jefferson Bit Off A Hangman's Thumb**"

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