Blunt External Laryngeal Injuries

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I have no conflicts of interest.

Overview

- Review the basic imaging appearances of blunt external laryngeal injuries.
- Discuss some of the limitations of CT when used to evaluate patients for these injuries.
- Stress the need to maintain a high index of suspicion.

Blunt External Laryngeal Injuries

- Blunt trauma
  - Incidence 0.04%-0.06%
  - Mechanism
    - Direct blow
    - Clothesline injury
    - Crush injury
    - Hanging, strangulation
- Excludes
  - Internal injuries
    - Usually iatrogenic
    - e.g., endoscopy, intubation

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Blunt External Laryngeal Injuries

- Treatment
  - Early intervention improves outcome
  - Tailored to patient
    - Surgery
    - Non-operative

Complications

Acute

- Airway compromise
  - Possibly sudden
- Death
  - Prehospital mortality 40%-80%
  - Mortality with airway secured 8%

Chronic

- Breathing difficulties
- Dysphonia
- Aspiration
- Abnormal deglutition

Diagnosis

- Clinical diagnosis may difficult
  - Signs & symptoms may be subtle
  - Unconscious, intubated
  - Cervical collar
  - Co-existing injuries in 80%
    - Mask BELI or distract away from it
- Radiologists may be 1st to suspect injury
  - Maintain high index of suspicion

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Diagnosis

- Two-tiered process
- MDCT
  - Skeletal framework
- Endoscopy
  - Soft tissues
  - Vocal cord function

Anatomy

Imaging:

Skeletal framework

- Cartilage
- Bone
- Synovial joints
  - Cricoarytenoid
  - Cricothyroid

Laryngoscopy:

Soft tissues

- Mucosal lining of airway
- Ligaments
- Muscles
- Nerves (vocal cord)
- Epiglottis

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MDCT: Protocol & Interpretation

- Thin reconstructions
  - 1 mm @ 0.5 mm
  - Axial, sagittal, coronal
- Active manipulation of images is vital
  - 3D/MIP reconstructions
  - Oblique, off-axis MPRs
  - Adjust windows/levels
    - “Non-standard”

MDCT: Accuracy

- Forensic radiology
  - Sensitivity 88.2%
  - Specificity 90.0%
- Clinical practice
  - Limited literature

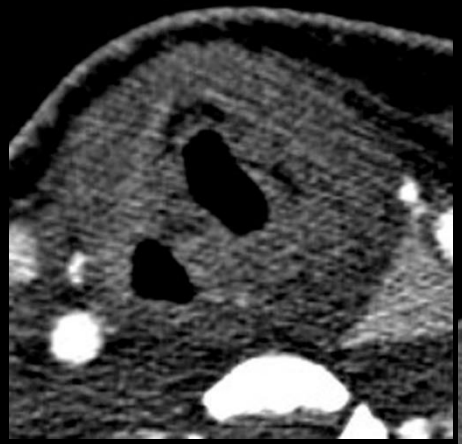
- Frequently missed
  - 58% accuracy prospective diagnosis
  - Improved accuracy
    - Known clinical S&S
    - Cervical spine injury

Treitl et al. European Radiology, 2020

Khan et al. RSNA Annual Meeting, 2016

Diagnostic Challenges

- Fibrocartilage
- Non-calcified
  - Young patients
  - Fractures subtle
- Calcification increases with age
  - Fractures more conspicuous



16 years-old

42 years-old

Diagnostic Challenges

- Anatomy
  - Multiple parts
  - Parts small
  - Complex 3D shapes

- Thyroid cartilage
  - Laminae
  - Superior horns
  - Inferior horns
- Cricoid cartilage
- Hyoid

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  - Superior horns
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- Cricoid cartilage
- Arytenoid cartilage

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- Cricoarytenoid joints
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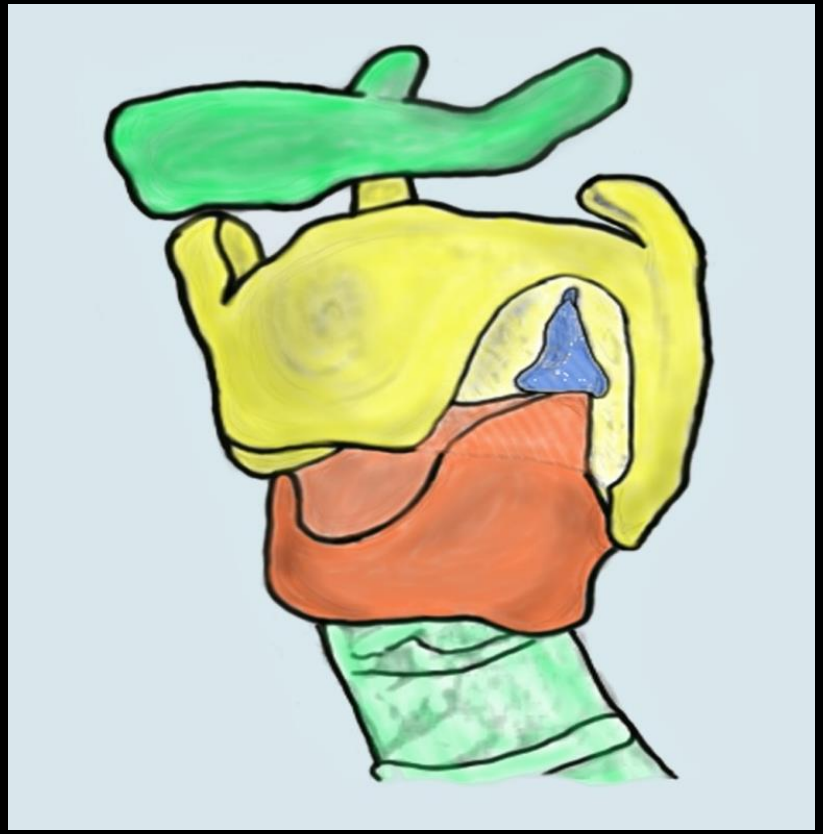
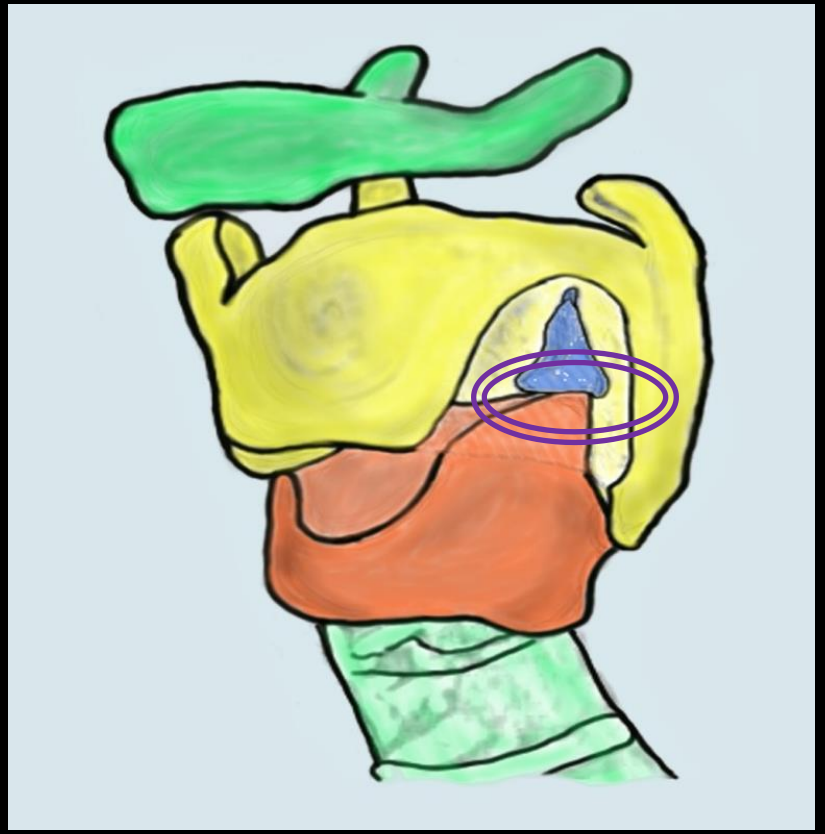


- Arytenoid cartilages
- Cricoarytenoid joints
- Cricothyroid joints



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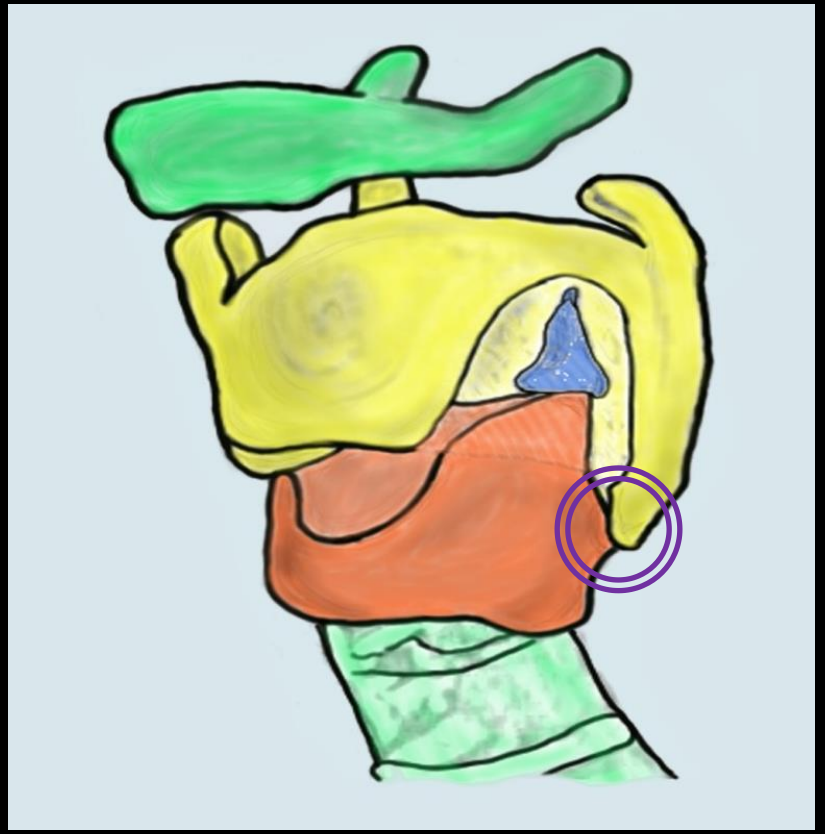
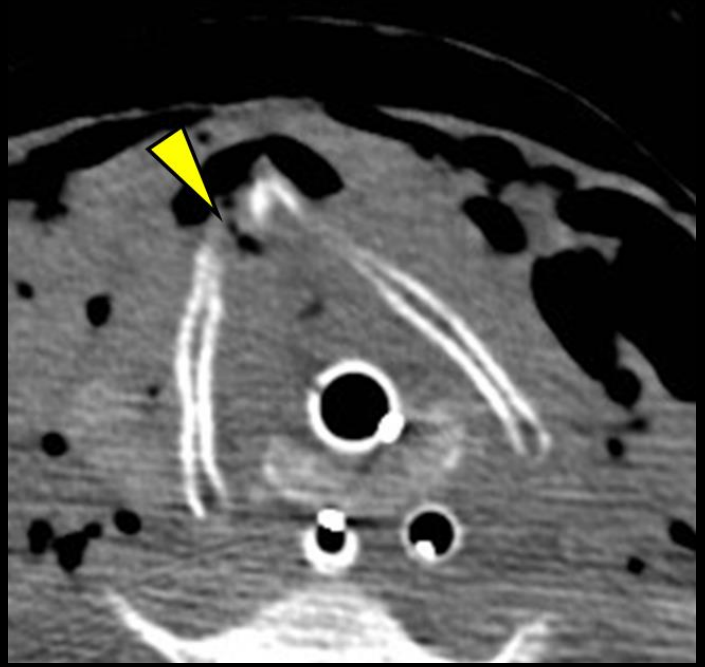


Injuries

- Fractures
- Joint disruption
  - Cricoarytenoid
  - Cricothyroid
- Laryngotracheal separation
- Multiple injuries common
- Secondary signs
  - Soft tissue emphysema
  - Submucosal hematoma

Soft Tissue Emphysema

- Non-specific finding
- May be absent
  - Mucosal disruption
- Other causes
  - Facial fractures
  - Thoracic injuries



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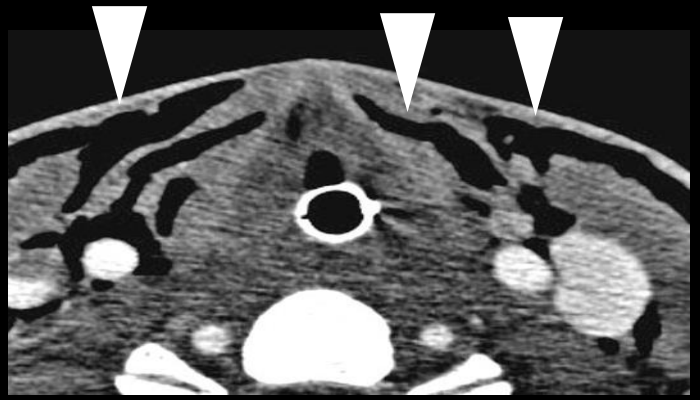
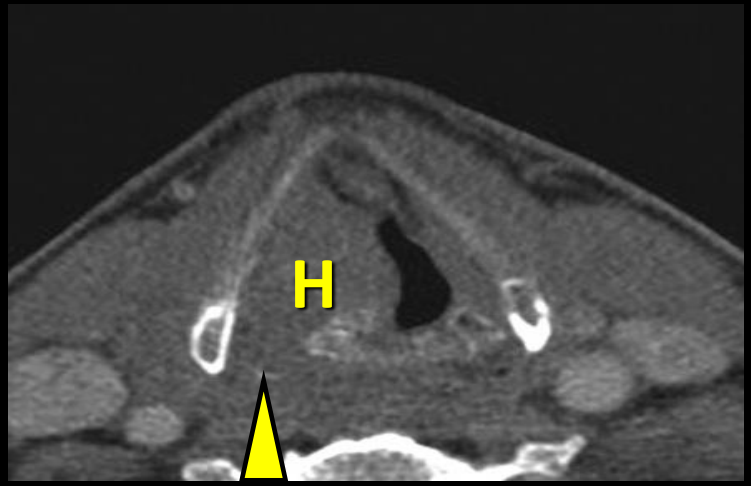


Submucosal Hematoma

- May be isolated
- Usually related to structural injury
  - Useful secondary sign
- Can compromise airway



Submucosal Hematoma

- May be isolated
- Usually related to other injury
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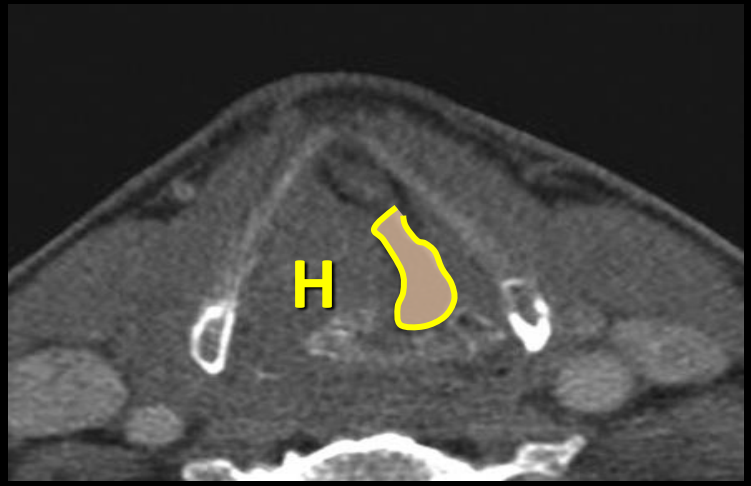


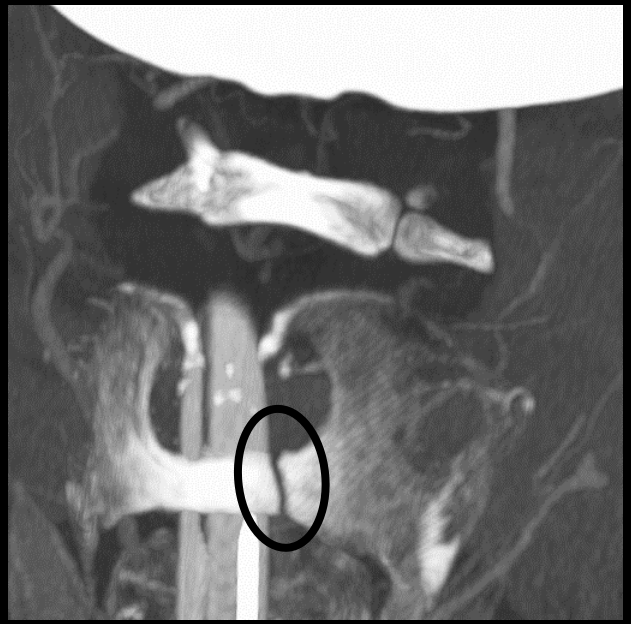
Fractures

- Straightforward
  - Cartilage calcified or ossified
  - Fracture displaced
- May be subtle
  - Minimal displacement
  - Non-calcified cartilage

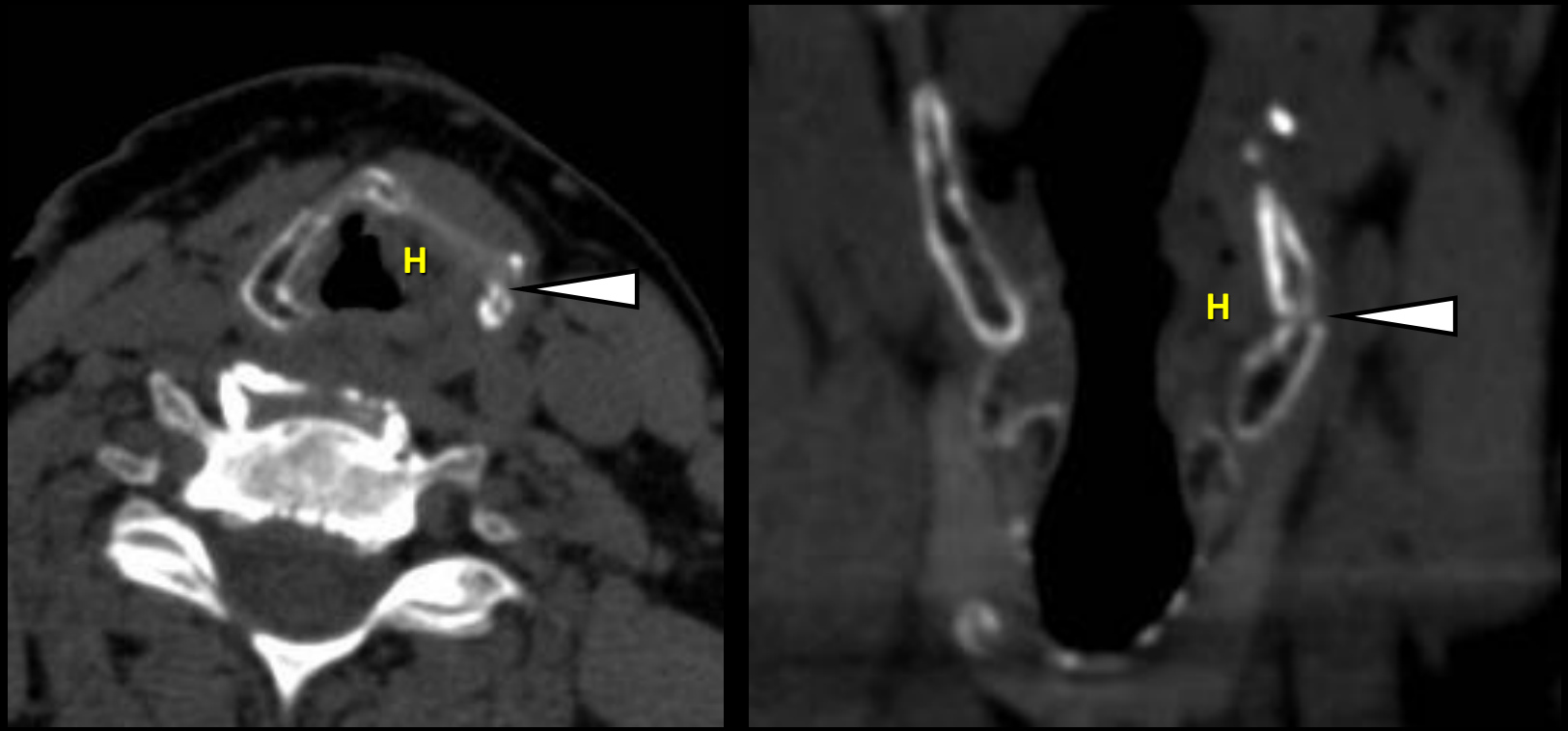
- Calcified/ossified cartilage
  - Patients > 30 years
  - Less pliable
  - Multiple injuries more common

Thyroid Cartilage

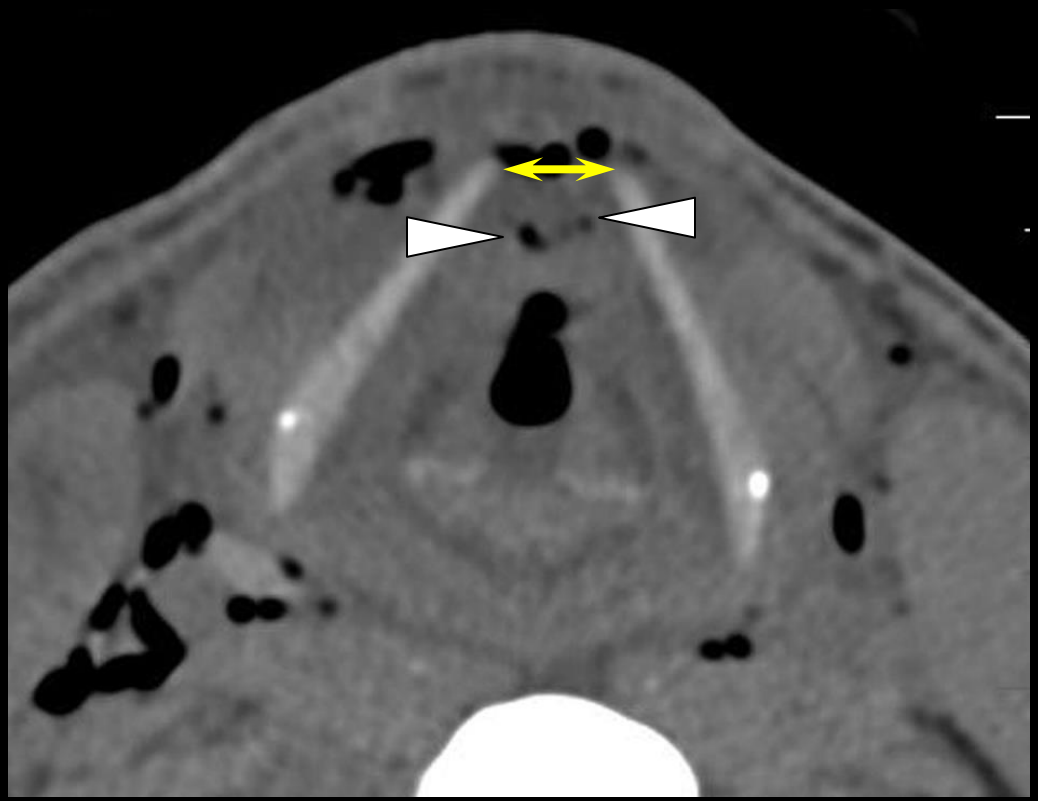
- Lamina fracture
  - Most common laryngeal injury
- May be single fracture
  - Young
  - Non-calcified cartilage



Thyroid Lamina Fracture

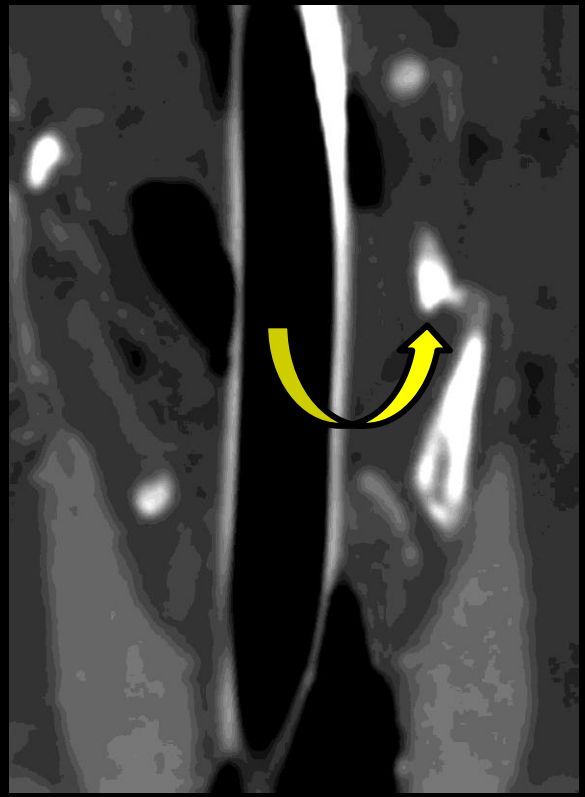


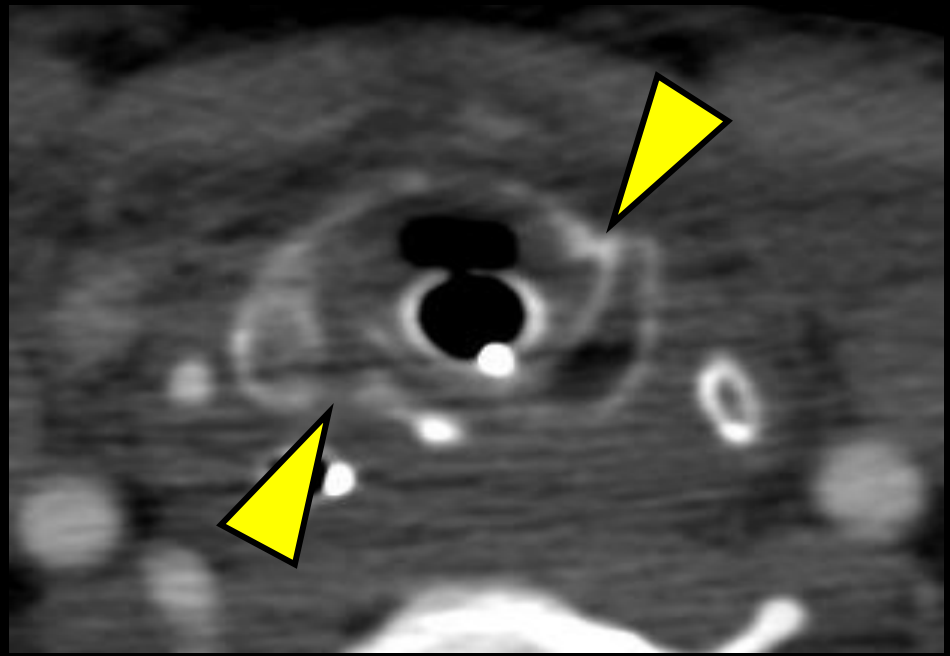
Thyroid Apex Fracture



Superior & Inferior Horn Fractures

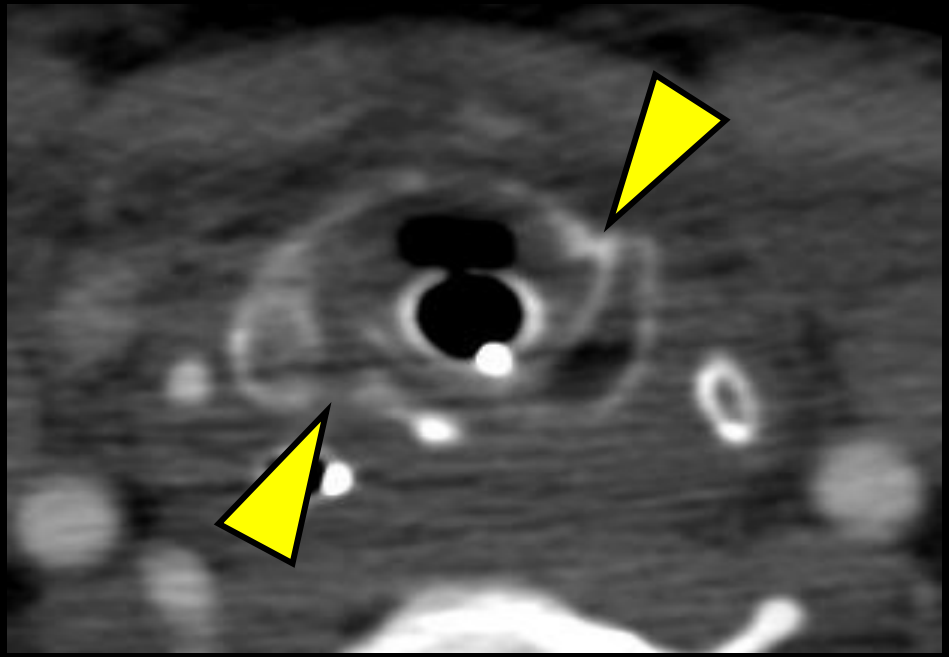
- Superior horn
  - Common with hanging, strangulation
  - Usually insignificant
    - Non-union, chronic globus sensation
  - Mimicked by accessory cartilage in stylohyoid ligament
    - Fracture margins sharp
- Inferior horn
  - Recurrent laryngeal nerve inj.
    - Asymmetric true vocal cords

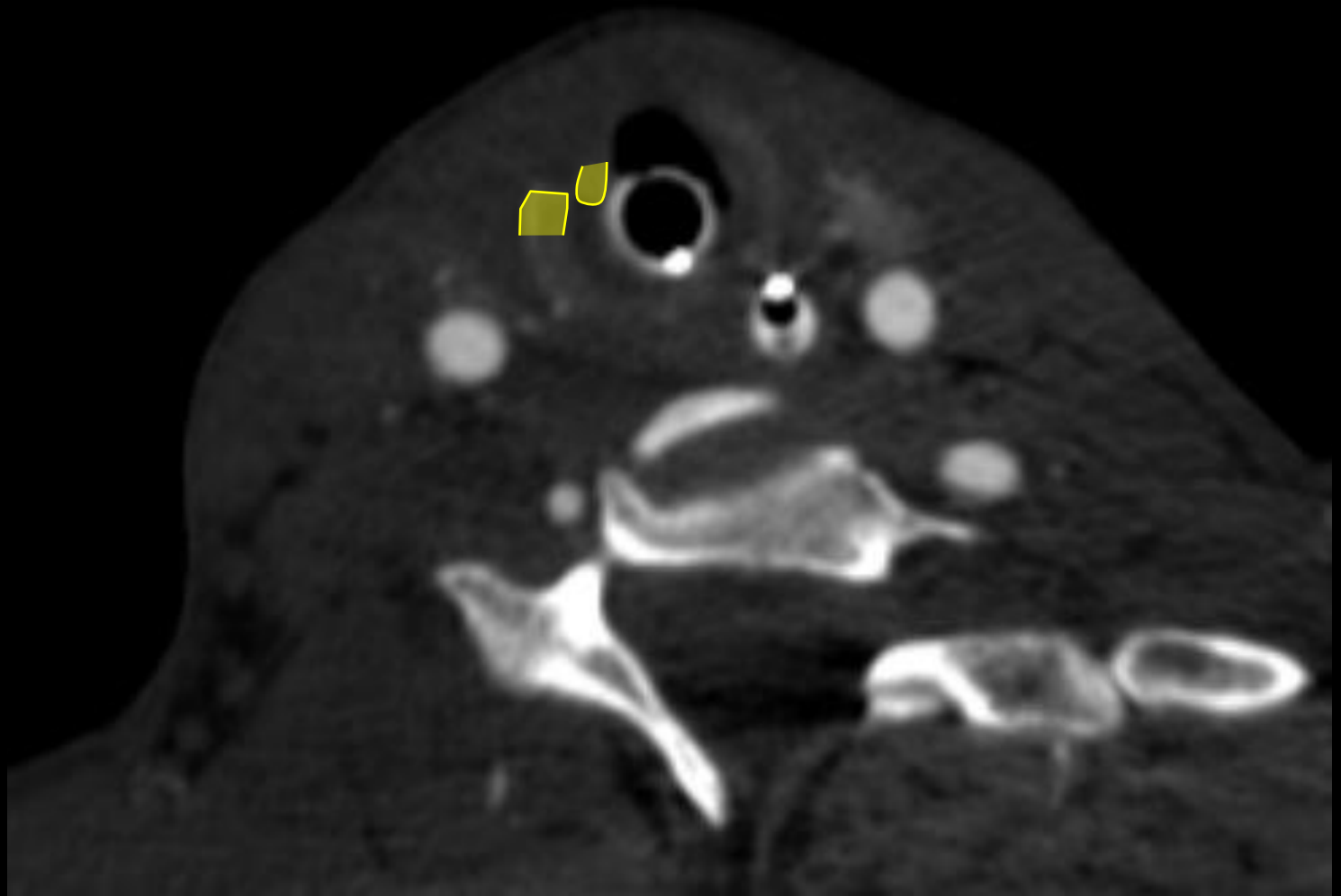


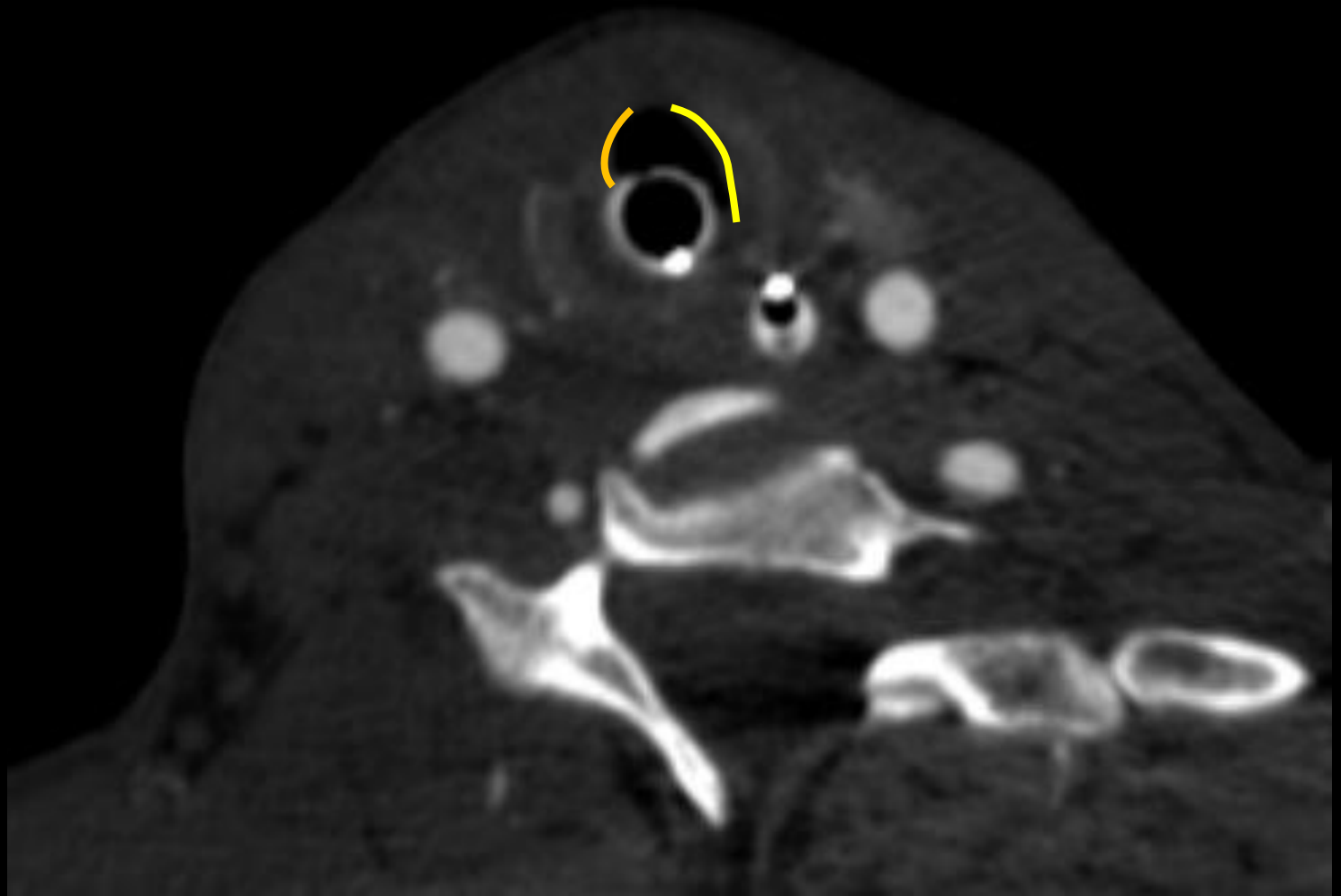


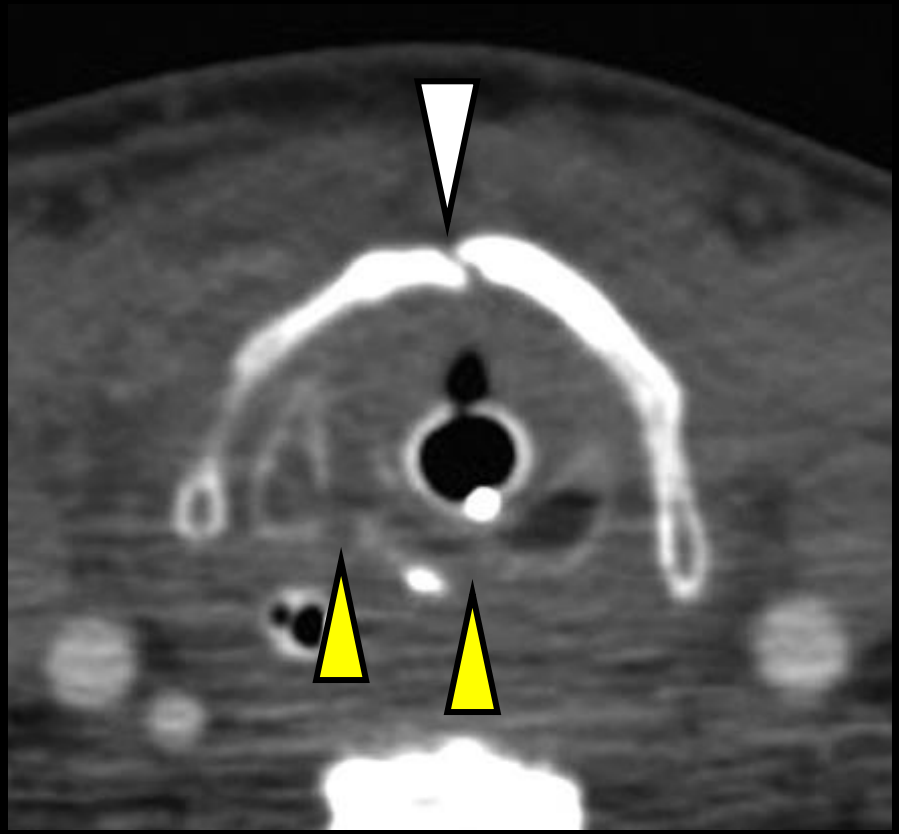
Cricoid Fractures

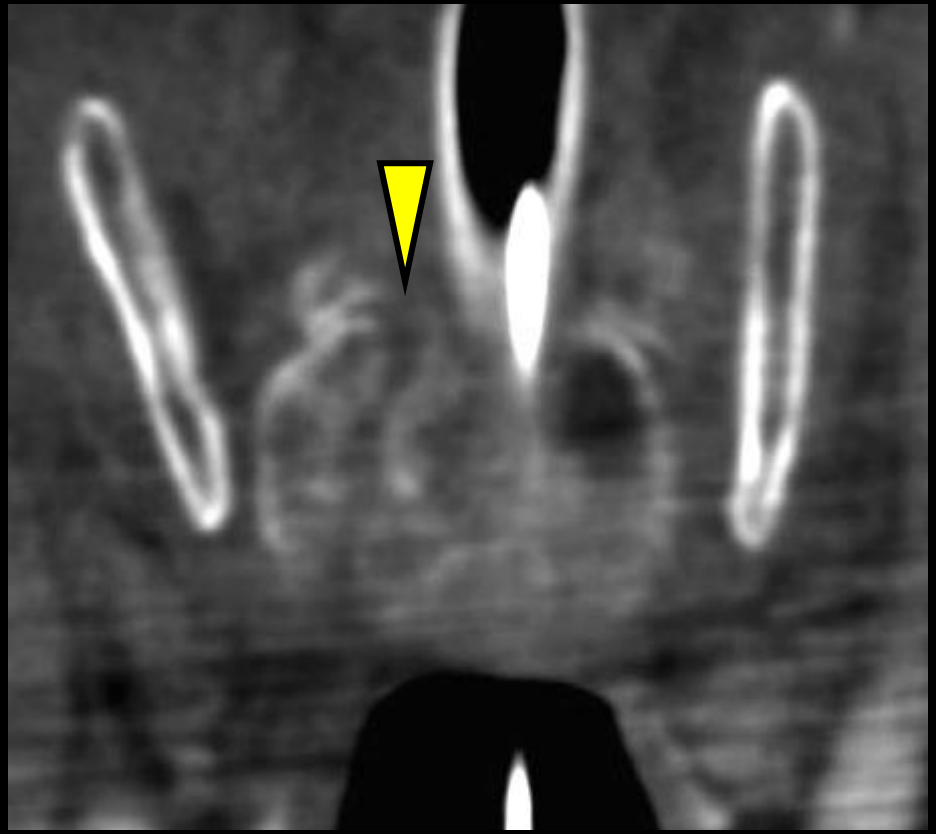
- Usually > 1 fracture
- Cricoid complete ring
  - Only one in laryngo-tracheal airway
  - Scaffold for airway
- High risk of airway loss

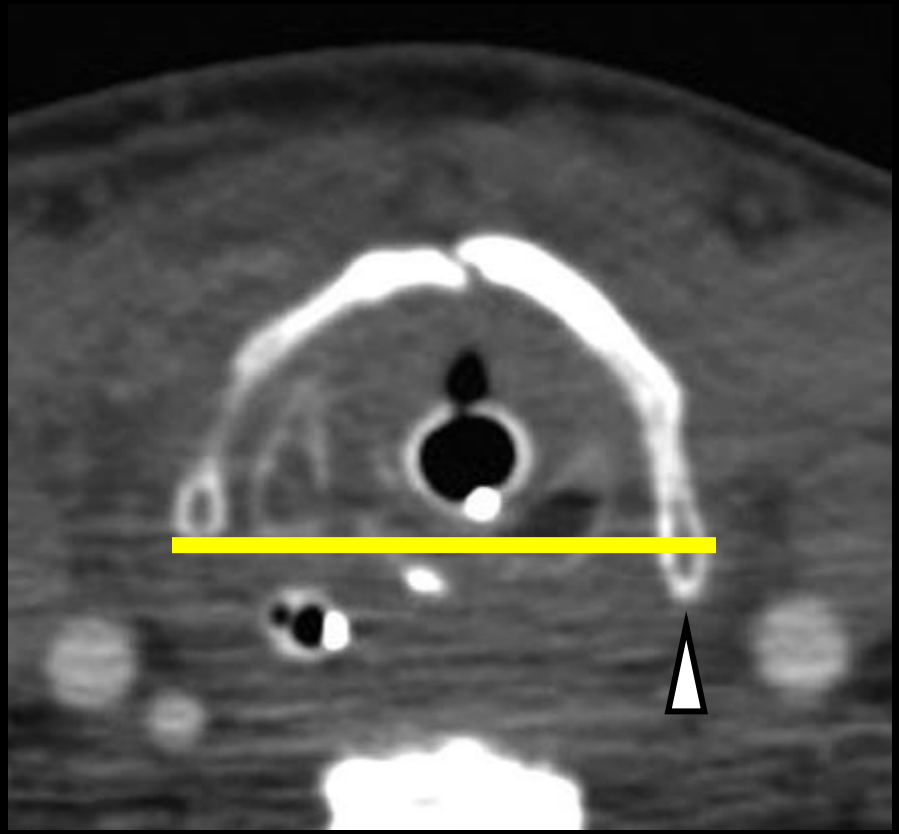






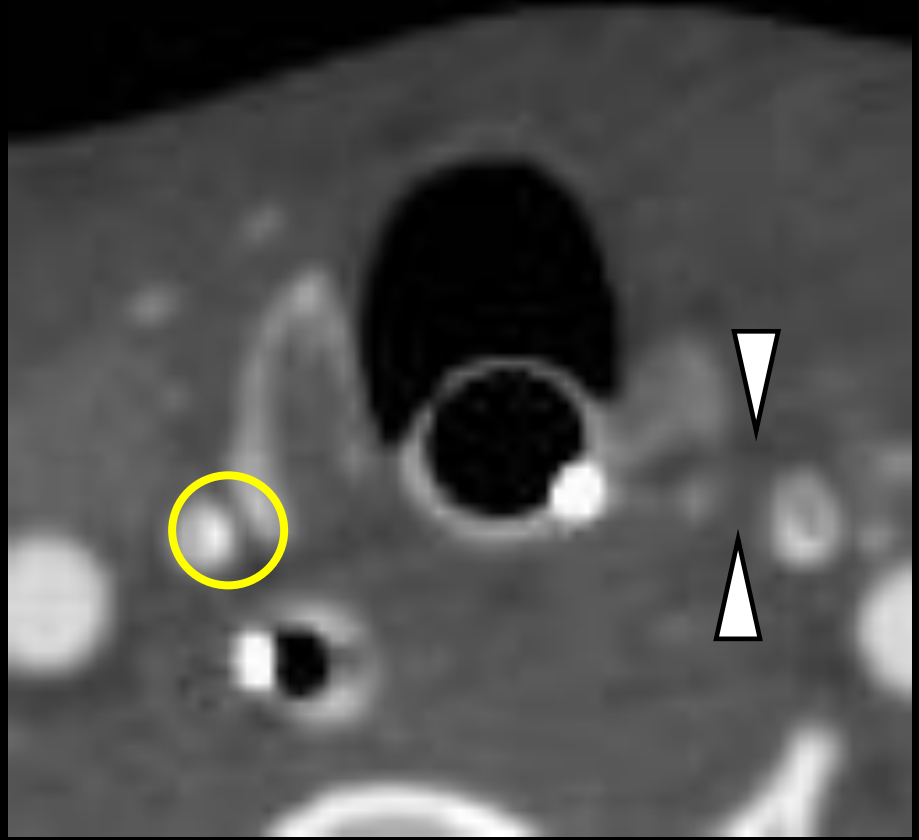


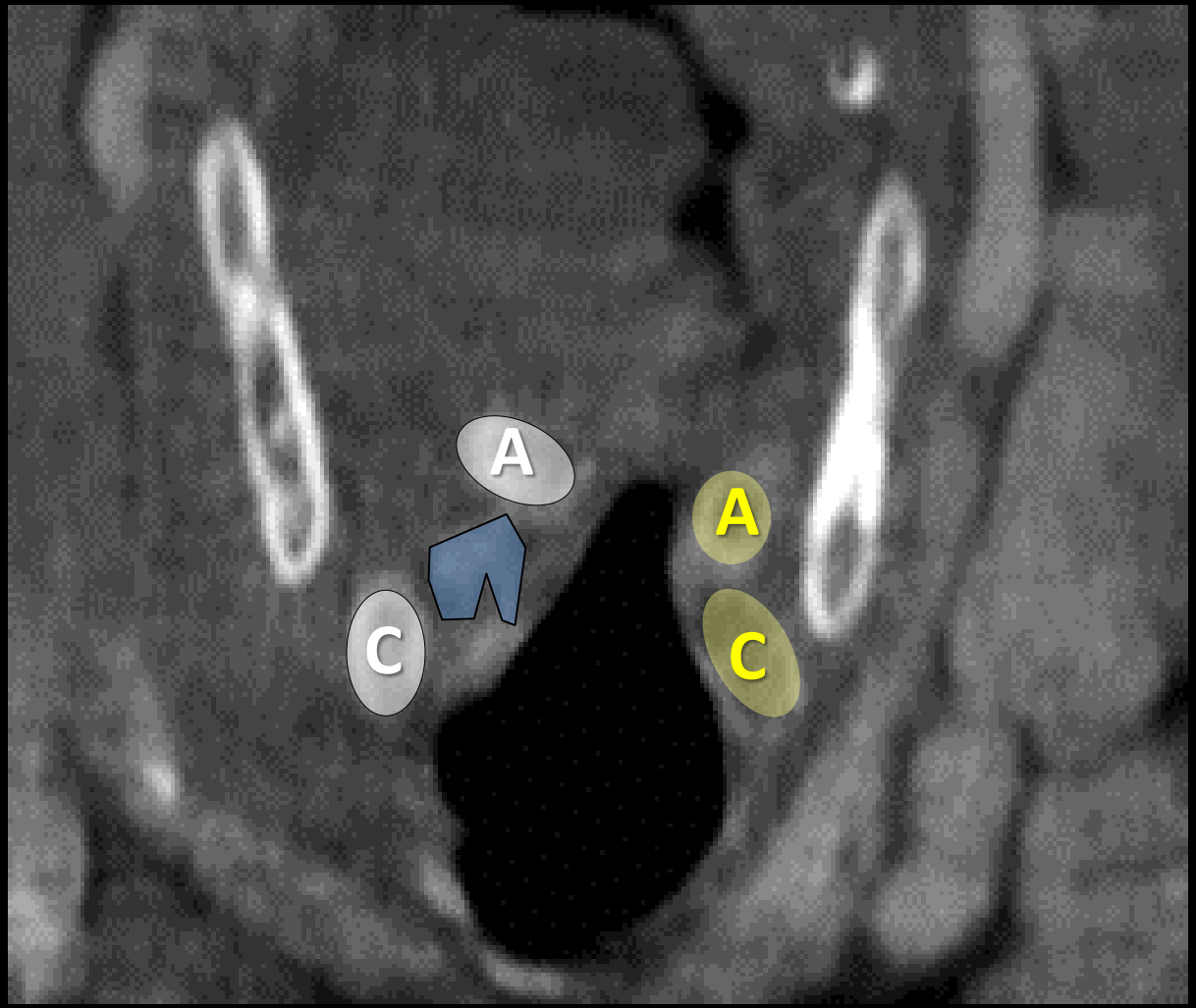




Cricothyroid Joint Separation

- Wide cricothyroid joint
  - Relative to other side
  - True axial or coronal
- Vocal cord paralysis
  - Recurrent laryngeal nerve injury

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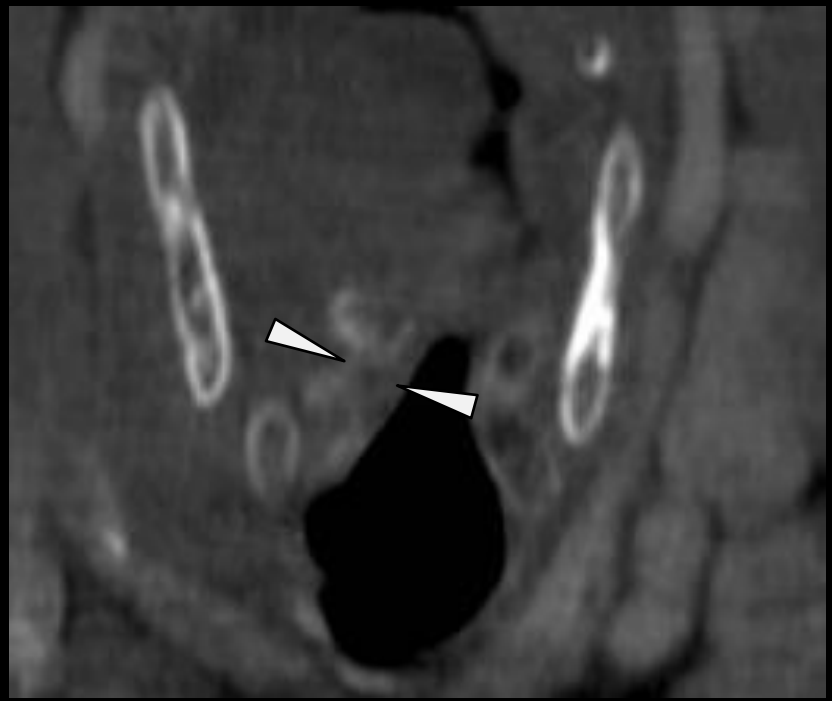
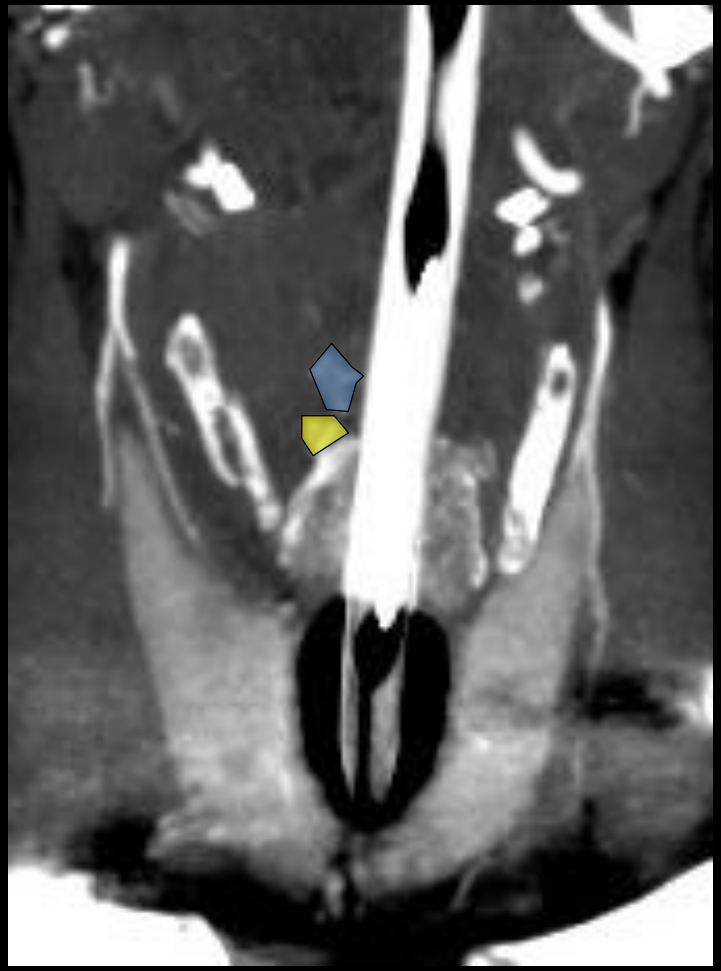
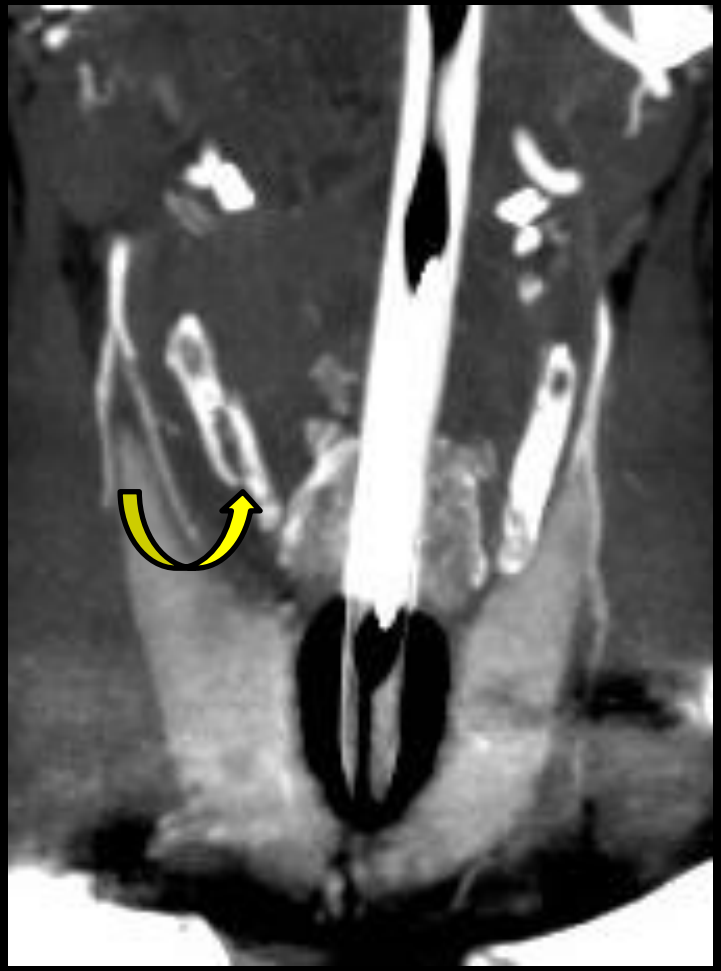
Arytenoid Fracture

- Rare external trauma
  - Usually iatrogenic
- Vocal cord dysfunction





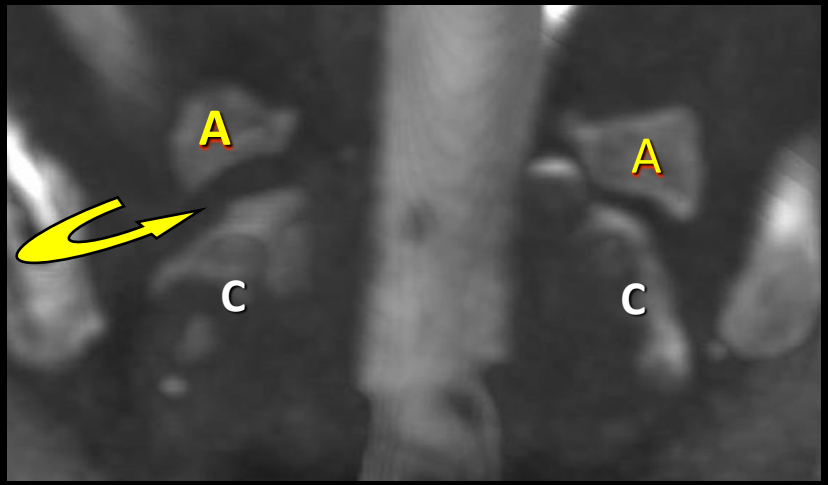


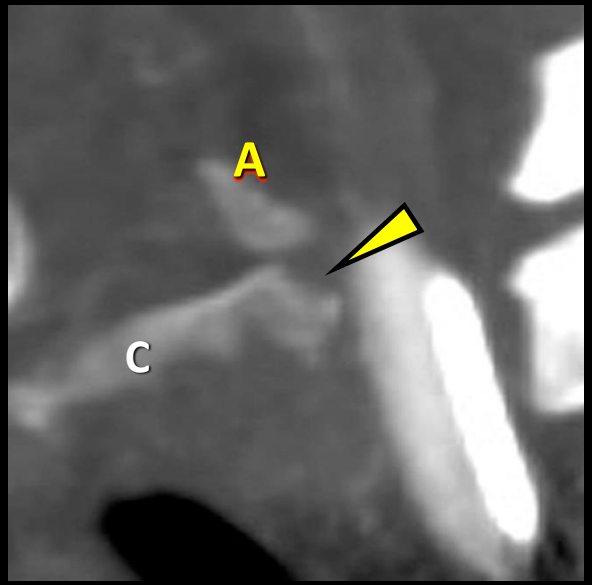
Cricoarytenoid Joint Disruption

- Rarely external cause
  - Usually iatrogenic
- Accurate diagnosis difficult with imaging
  - Mobility arytenoid
  - False positives frequent
- Vocal cord dysfunction

Cricoarytenoid Joint Disruption

- Joint space asymmetrically wide
- Bare articular surfaces



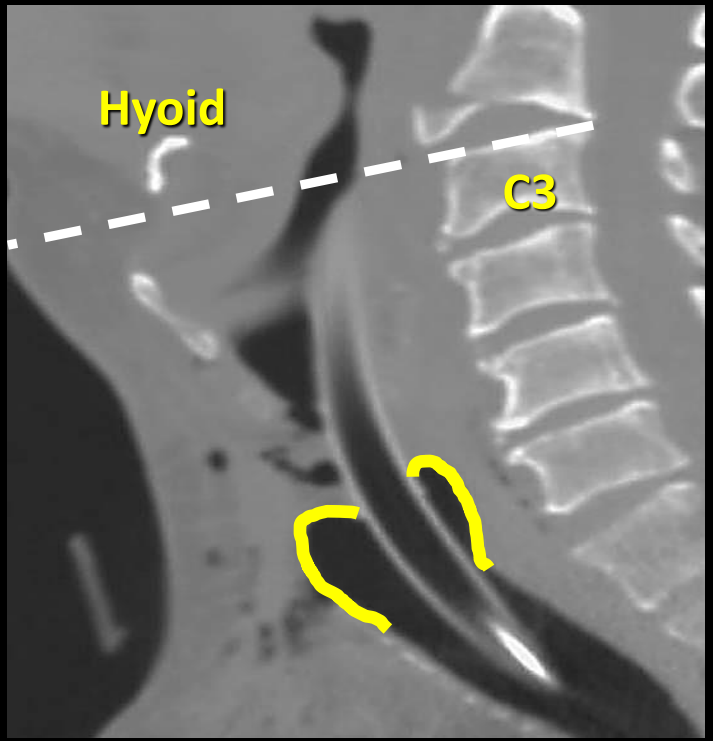


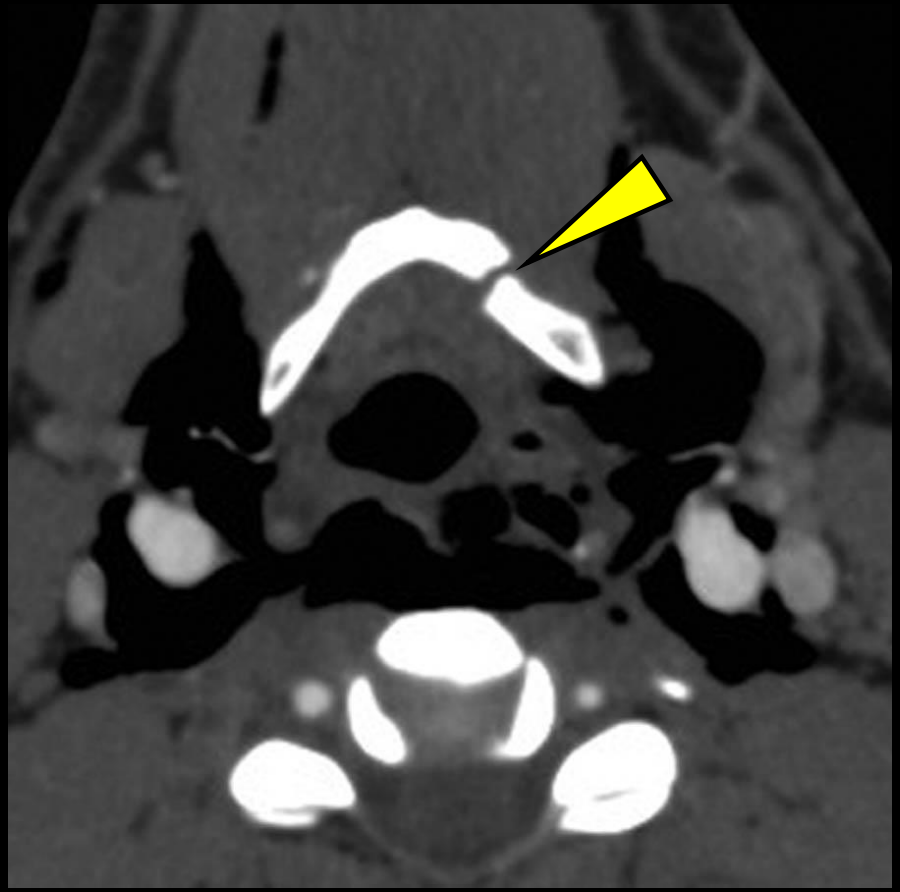
Laryngotracheal Separation

- Disruption of cricotracheal membrane
- Rare in clinical practice
  - Immediate fatal airway compromise
- Caudocranial separation cricoid & tracheal rings
  - Hallmark finding

Imaging

- Caudocranial separation cricoid & tracheal rings
- Hyoid elevated above C3 superior endplate
- ETT balloon through defect





Hyoid Fracture

- May be isolated
- Mechanism
  - Direct blow
  - Hanging, strangulation
- Clinical
  - Dysphonia
  - Odynophagia
  - Pain
- Usu. insignificant long-term
  - Acute airway loss uncommon

Summary

- Blunt laryngeal injuries uncommon but clinically important.
- Injuries may be both clinically and radiographically subtle.
- Maintain high index of suspicion.
- MDCT and endoscopy are complementary.

Have a nice day.

Star Wars: Episode IV – A New Hope (1977). Lucas Film, 20th Century Fox.