Duration of disorders

- Acute spine disorder (< 4 weeks duration)
- Subacute spine disorder (4-12 weeks duration)
- Chronic spine disorder (> 12 weeks duration)
Radicular pain

- Neurologic symptoms and signs
  - pain radiating beyond the elbow or below the knee, as intense as neck or the low back pain, often radiating into the hand or foot with numbness or paresthesia in a dermatomal distribution with positive nerve root tension signs, abnormal motor power, sensation or deep tendon reflexes (MSR)

Indications of imaging

- T - Trauma
- R – Range of motion
- A – Alcohol/smoking
- U – Unresponsive to care/unusual natural history/symptoms
- M – Motor/sensory/reflexes
- A - Age
Case 1

- A 63 year-old male with history of recurrent severe headaches over the past 25 years.
- However, lately he has been suffering bouts of dizziness without any neurological signs.
- Done martial arts for years but no known history of other trauma.

Courtesy of Dr. K. Wickens
February 22, 2018
Findings

- C7 transverse processes are elongated.
- Cervical lordosis is flattened inferiorly and accentuated superiorly with a 1mm anterolisthesis at C4-5 and 2mm anterolisthesis at C7-T1.
- A mild right cervicothoracic scoliosis
- Mild disc narrowing with bone spurring from C5 to C7.
- Uncinate hypertrophy with foraminal encroachment at C5-6 and C6-7.
- Ossification of stylohyoid ligaments

Diagnosis

- Ossification of stylohyoid ligaments. This has been associated with Eagle syndrome where compression of the carotid artery may lead to syncope.
- CT angiography with provocation head position that triggers dizziness may corroborate the diagnosis.
Indications of imaging

- T - Trauma
- R – Range of motion
- A – Alcohol/smoking
- U – Unresponsive to care/unusual natural history/symptoms
- M – Motor/sensory/reflexes
- A - Age

Case from internet

- A 49-year-old man had been experiencing transient right-sided weakness during neck rotation and flexion to the left for 1 year.

- Courtesy of JAMA Neurology August 2013
  Volume 70, Number 8
The angiogram demonstrates a filling defect from what appears to be an extrinsic compression (arrow) with the patient’s head turned to the left.

Obtained with the patient’s head turned to the left, the angiograms (anterior view and posterior view) reveal a left cervical internal carotid artery compression due to the elongated styloid process (arrow).
The styloid process normally measures 2.5–3 cm in length; when the length exceeds 3 cm, it is said to be elongated.
Eagle syndrome

- First described by Watt Eagle, American otorhinolaryngologist in 1937.
- Sudden, sharp nerve-like pain in the jaw bone and joint, back of the throat, and base of the tongue, triggered by swallowing, moving the jaw, or turning the neck.
- Caused by abnormal ossification of the stylohyoid ligament with compression of cranial nerves (facial nerve, vagal nerve, glossopharyngeal nerve, and hypoglossal nerve).
Eagle syndrome

- Initially subdivided into two clinical types by Eagle
  1. Classic styloid process type - fibrous tissue causing distortion of the cranial nerve endings in the tonsillar bed after tonsil removal.
  2. Sympathetic type – due to compression of sympathetic chain in the carotid sheath.

Eagle syndrome

- Divided into two types based on clinical presentation

1. Carotid artery syndrome (Stylocarotid syndrome)
   - Cerebrovascular symptoms cause by
     a) Cerebral ischemia (TIA) from vascular compression
     b) Injury to carotid arteries with embolization or dissection
     c) Vasovagal response to compression of carotid body

2. Craniofacial syndrome (Classic)
   - Cranial nerve compression by elongated styloid process.
   - (cranial nerves V, VII, IX and X) Trigeminal, Facial, Glossopharyngeal, & Vagus nerves

---

<table>
<thead>
<tr>
<th>Clinical Type</th>
<th>Carotid Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>F &gt; M</td>
</tr>
<tr>
<td>Age</td>
<td>5th and 6th decades (peak)</td>
</tr>
<tr>
<td>History of tonsillectomy</td>
<td>Increased frequency</td>
</tr>
<tr>
<td>Odynophagia</td>
<td>Frequent</td>
</tr>
<tr>
<td>Dysphagia</td>
<td>Frequent</td>
</tr>
<tr>
<td>Pain (present/absent)</td>
<td>Variable</td>
</tr>
<tr>
<td>Pain (location)</td>
<td>Ipsilateral;parietal region to pectoral region</td>
</tr>
<tr>
<td>Pain (quality)</td>
<td>Dull, constant</td>
</tr>
<tr>
<td>Stridor</td>
<td>Rare (children)</td>
</tr>
<tr>
<td>Dizziness</td>
<td>Not observed</td>
</tr>
<tr>
<td>Syncope/TIA/Stroke</td>
<td>Not observed</td>
</tr>
<tr>
<td>Flexion/extension</td>
<td>Aggravates symptoms</td>
</tr>
<tr>
<td>Contralateral head rotation</td>
<td>Minimal effect</td>
</tr>
<tr>
<td>Tonsillar pillar palpation (exam)</td>
<td>Aggravates symptoms</td>
</tr>
</tbody>
</table>

Eagle syndrome

- Possible symptoms include
  - Sharp shooting pain in the jaw, back of throat, base of tongue, ear, neck and/or face
  - Difficult swallowing
  - Sensation of a foreign object in the throat
  - Pain from chewing, turning neck, or touching the back of the throat
  - Ring or buzzing in the ears
  - Symptoms are usually unilateral

Eagle syndrome

- Diagnostic confirmation of carotid artery syndrome
  - CT angiography with provocation head position that triggers dizziness may corroborate the diagnosis.

- Treatment options
  - Intra-oral or extra-oral resection of elongated styloid process.
Follow-up

- February 22, 2018
  - X-ray reported generated.
- June 6, 2018
  - Dr. Wickens emailed me and stated the following: “The radiologist gave the MD a hard time about doing the CT scan with dye but the MD insisted and we got the results we were looking for. Now we need to find someone who knows what to do about it.”

Indications of imaging

- T - Trauma
- R – Range of motion
- A – Alcohol/smoking
- U – Unresponsive to care/unusual natural history/symptoms
- M – Motor/sensory/reflexes
- A - Age
Case 2

- 8-year-old girl with 8 days of neck pain and wry neck. No history of trauma.
- Started with neck pain and fever (102.7°F) 8 days ago.
  - Told to rule out meningitis in a Walk-in clinic.
  - No improvement for three days and went to emergency room – was told to buy a cervical collar and was sent home.
  - Went to Children’s Hospital on the 5th day – sent home with morphine.
- Saw chiro on the 8th day.
  - Noticeable swelling and tenderness on left submandibular region with neck left laterally flexed.

Courtesy of Dr. Brianna Albright
June 22, 2018

Indications of imaging

- T - Trauma
- R – Range of motion
- A – Alcohol/smoking
- U – Unresponsive to care/unusual natural history/symptoms
- M – Motor/sensory/reflexes
- A - Age
Findings

- Moderate asymmetry of the upper cervical soft tissue is visualized with swelling of the left submandibular region, retropharyngeal soft tissue swelling and an unusual oval soft tissue mass anterior to C2 vertebral body.
- The cervical lordosis is flattened with left lateral tilting of the skull and right lateral listing of the cervical spine. In addition, there is asymmetry of paraodontoid spaces with narrowing on the right and widening on the left.
**Diagnosis**

- Left submandibular soft tissue and retropharyngeal swelling with rotational malposition at C1-2. The findings are highly suggestive of retropharyngeal abscess with extension to upper cervical spine, also known as Grisel’s syndrome.

**RECOMMENDATION:**

- Urgent investigation for septic arthritis of upper cervical spine with CT scan is recommended.

**Follow-up**

- “Parents took her to the emergency room on Friday evening (June 22) with your report, a clinical note from me and the CD with the images. They did blood tests (haven't heard any results yet) and she was started on antibiotics and cortisone. By Saturday evening the torticollis was almost completely resolved. She was back to eating and energetic. I believe they follow up with the Dr on Tuesday.”

- Thanks again for all your help!
Grisel’s syndrome

- A rare cause of torticollis that involves subluxation of atlanto-axial joint from inflammatory ligamentous laxity following an infectious process in the head and neck, usually a retropharyngeal abscess.
- Usually occur in infants or young children.
- Variable presentation, time between inciting event and symptom onset is variable, and laboratory investigations may be normal. So diagnosis is difficult.

However, typically presentation consists of
- torticollis
- cervical pain
- symptoms related to underlying infection

Etiology
- upper respiratory tract infections
- tonsillectomy/adenotonsillectomy
- otitis media
- other ENT infections/surgery

Causative organisms
- Staphylococcus aureus
- Group B. Streptococcus
Grisel’s syndrome

- Imaging
  - X-ray – limited value.
  - CT – Best, demonstrate abnormal lateral placement of C1 on C2, and of occipital facets on C1.
  - MRI – evaluate inflammatory soft tissue change.

- Treatment
  - Mild case and early dx – broad spectrum antibiotics and cervical collar is sufficient.
  - Delay dx – traction brace.
  - Residual subluxation after 8 wks or neurological symptoms requires surgery.

Case 3

- 18 year-old lacrosse play with acute neck pain after another player falling on him causing cervical spine flexion.

Courtesy of Dr. Morin
June 14, 2017
Indications of imaging

- T - Trauma
- R – Range of motion
- A – Alcohol/smoking
- U – Unresponsive to care/unusual natural history/symptoms
- M – Motor/sensory/reflexes
- A - Age
Findings

- Minimal anterior wedged deformity of 6 vertebral body with focal kyphosis
- Asymmetry of the C5 articular pillar orientation.
- The right C4 and C5 pillars more horizontal on the APLC view.
Diagnosis

- Compression fracture of C6 with likely traumatic right C5 articular pillar fracture.
Findings

- Flexion-extension study of the cervical spine dated June 7, 2017 show 2mm anterolisthesis at C5-6 in flexion with persistent kyphosis at C5-6 in extension.
Diagnosis

- Hypermobility at C5-6.

Pedicollaminar Fracture-Separation

- Also known as
  - Fracture-separation of the articular pillar (FSAP)
  - Pedicollaminar fracture-separation (PLF-S)
  - Traumatic isolation of the articular pillar (TIAP)
- Incidence
  - Less than 3%
  - Location
    - C4, 5, 6

2. Harris JH Jr., Mirvis SE. The radiology of acute cervical spine trauma, 3rd ed. Baltimore: Williams & Wilkins
Pedicolaminar Fracture-Separation

- Rare
  - Requires a simultaneous fracture through the LAMINA and ipsilateral PEDICLE
  - May result in rotation of the injured articular pillar to a more horizontal position
    - Rotation of fractured articular pillar > 25° progress to instability without surgery*


Pedicolaminar Fracture-Separation

- Mechanisms
  - Poorly understood (retrospective)
    - Extension – Forsyth + Fuentes
    - Rotation-lateral compression – Argenson
  - Argenson
    - Flexion-rotation unlocks the facets.
    - Ipsilateral compression force acts like a vice resulting in the fracture the pillar.
Pedicolaminar Fracture-Separation

- Mechanisms:
  - 81% hyperflexion + rotation
  - 14% hyperflexion + distraction
  - 5% hyperextension + rotation
- Neurologic deficits
  - 63%
    - Spinal cord (10/21)
    - Radiculopathy (3/21)
  - 37% NO NEUROLOGICAL SYMPTOMS!!!!
- Associated findings:
  - 90% # foramen transversarii – ipsilateral
  - 67% # contralateral articular pillar

Pedicolaminar Fracture-Separation (PLF-S)

image: www.maitrise-orthop.com

Example from MedPix
Pedicolaminar Fracture-Separation

- Complications
  - High association with transverse process fracture.
  - 90%
  - High association of transverse process fractures with vertebral artery injuries.
  
  (J. of Trauma, June 93; vol 34, no 6.)
Pedicolaminar Fracture-Separation

- Radiographic features
  - “Horizontalization of the articular pillar on lateral and AP views.
  - Anterolisthesis of above vertebra.
  - No spinous deviation.

Case 4

- 18 year-old female with acute neck pain and a 10cm laceration on the top of her head after a MVA in a truck.
- Back passenger, no seatbelt.
- Hospital cervical study.

Courtesy of Dr. Kathy Wickens
July 14, 2016
18 year-old female unbuckled back passenger of a truck involved in a MVA. Acute neck pain and a 10cm laceration on the top of her head.
Findings

- Horizontalization of left C5 pillar.
- Anterior wedged deformity of C6
  - Minimal step defect at C7

Diagnosis

- Acute left pedicle-laminar fracture dislocation at left C5
- Acute moderate compression fracture of C6 and minimal at C7.
June 2014

10 cm laceration with subcutaneous emphysema of the right side of skull

Right parasag

Left parasag
Findings

- Anterior wedged deformity of C6.
- Marrow edema in vertebral bodies of C6, C7, T1, T2, T3 and even T4.
- Edema surrounding left anterior scaleneus from C3 to T1 and posterior erector spinae from C3 to C6.
Diagnosis

- Acute compression fractures from C6 to T4.
- Muscle edema of left scaleneus and erector spinae.
Findings

- Oct. 25/14
  - Surgical fixation from C4 to C7 with kyphotic angulation at C6-7.
- Nov. 10/14
  - Extending surgical fixation from C7 to T3.

Case 5

- 46 year-old female with re-aggravation of her chronic neck pain after a fall.
- New onset of right arm pain and numbness.
Indications of imaging

- T - Trauma
- R – Range of motion
- A – Alcohol/smoking
- U – Unresponsive to care/unusual natural history/symptoms
- M – Motor/sensory/reflexes
- A - Age
Findings

- Moderate disc narrowing with bone spurring at C5-6.
- Uncinate blunting with foraminal encroachment at C5-6.
Diagnosis

- Moderate DDD and uncovertebral arthrosis with foraminal stenosis at C5-6.

Question

- Does the plain film explain the neck and right arm pain?
Answer

- That is all depend on the symptoms.
  - Reduced right triceps reflex
  - Pain and paresthesia radiate into the right middle finger.
  - Weakness of elbow extension and wrist flexion on the right.
  - All attribute to right C7 nerve root that exit via right C6-7 intervertebral foramen.
  - X-ray findings do not explain the patient’s symptoms and physical findings.
Findings

- Small central disc protrusion at C4-5.
- Osteochondral bar at C5-6.
- Right posterolateral disc extrusion at C6-7 with narrowing of right C6-7 intervertebral foramen and compression of right C7 nerve root.

Diagnosis

- A large right posterolateral disc extrusion at right C6-7 with compression of right C7 nerve roots.
Findings

- Artificial disc at C6-7.
Findings

- Stable surgical fixation at C6-7.
Case 6

- 44 year-old female with gradual onset of unsteady gait, hyperreflexia and clonus.
- Longstanding rheumatoid arthritis of her hands and feet.

Indications of imaging

- T - Trauma
- R – Range of motion
- A – Alcohol/smoking
- U – Unresponsive to care/unusual natural history/symptoms
- M – Motor/sensory/reflexes
- A - Age
Findings

- Increased atlantodental space with retroversion and cephalad migration of odontoid process.
- Posterior defect in the odontoid process.
- Marked narrowing of central canal at C1 with compression of spinal cord.
- Mild hyperintense T2 signal in the compressed cord.
Diagnosis

- Longstanding atlantoaxial instability with myelomalacia of the spinal cord at C1.

- Follow-up
  - Surgical fixation of C0-1-2.
Case 7

- 53 year-old female with neck pain.
- Previous cervical spine fracture 20 years ago
  - Traction and bedridden for 1 month
  - Cervical brace for 3 additional months

Indications of imaging

- T - Trauma
- R – Range of motion
- A – Alcohol/smoking
- U – Unresponsive to care/unusual natural history/symptoms
- M – Motor/sensory/reflexes
- A - Age
Findings

- Asymmetry of paraodontoid spaces with offset of the lateral masses of atlas.
- Increased atlantodental space.
- Cleft in posterior arch of atlas.
- Moderate disc narrowing with bone spurring at C5-6.
- Right lateral vertebral scalloping at right C5.
**Diagnosis**

- Old Jefferson’s fracture of atlas with persistent laterally displaced lateral masses.
- Right vertebral artery tortuosity with bony erosion of C5 vertebral body.
- DDD at C5-6.

**Vertebral artery tortuosity**

- Cadaveric study
  - 2.7% incidence
  - C4-C5 > C3-4 > C5-6
  - Most asymptomatic
- MRI + MRA imaging study
  - 2.0% of 250 imaging studies, the vertebral artery formed a medial loop either into an unusually large transverse foramen whose internal border was medial to the uncovertebral joint or into the intervertebral foramen.
- Age – 11 year-old to elderly

Case 8

- 13 year-old male with 5 weeks of upper back pain after a fall onto his back from a standing position.
- Originally achy and dull pain and responded well to IFC and soft tissue therapy.
- Re-aggravated 1 week ago playing hockey where he was hit several times head first into the boards.
  - No LOC, numbness, tingling or radiation.
  - Pain with shoulder abduction, adduction and cervical rotation.
  - DTR's normal.
  - Bone irritation with ultrasound at low setting.

Courtesy of Dr. Erika Bell
October 31, 2017

Indications of imaging

- T - Trauma
- R – Range of motion
- A – Alcohol/smoking
- U – Unresponsive to care/unusual natural history/symptoms
- M – Motor/sensory/reflexes
- A - Age
Findings

- Adequate bone density with unfused ring apophyses.
- Subtle cortical disruption at the anterosuperior aspect of T1 vertebral body with no obvious prevertebral soft tissue swelling.
- Mild anterior wedged deformity of T2 with a subtle band of impacted trabeculae on the swimmer view.
Diagnosis

- Strong radiographic findings suggesting recent compression fractures of T1 and T2 vertebral bodies.
- Clinical correlation recommended.
- What imaging modality would able to help us confirm our suspicion?

Case 9

- 72 year-old female with neck pain and occasional left shoulder pain.
- Hysterectomy in 1982
- Cancer 2014 - double mastectomy.
- Chiro concerns about the density in the lung to the right of T5.

Courtesy of Dr. Michelle Antao
June 8, 2016
Indications of imaging

- T - Trauma
- R – Range of motion
- A – Alcohol/smoking
- U – Unresponsive to care/unusual unusual natural history/symptoms
- M – Motor/sensory/reflexes
- A - Age
Minimal disc narrowing with bone spurring from C3 to C6.

Thick ossification of posterior longitudinal ligament with marked narrowing of central canal (at least 50%) from C2 to C4 and from C6 to T2.

The uncinate processes are inadequately visualized.

Mild facet sclerosis with hypertrophy from C2 to T1.

Nuchal ossification is seen from C3 to C6.

Calcified right paratracheal lymph nodes.
Diagnosis

- Ossification of posterior longitudinal ligament from C2 to C4 and from C6 to T1 with severe central stenosis in the cervical spine.
- Neurological consultation is recommended.

OPLL

- Estimated to account for 25% of patients presenting with cervical myelopathy.
- General population
  - Prevalence of OPLL is between 2-4%.
  - Japanese, Korean and Taiwanese rate is near 3%.
  - Caucasian in North America rate is 0.12%
- Familial OPLL in Caucasian and European populations.


Incidence of DISH in patients over 65 years of age is between 15% and 30%.

25% of patients with OPLL has DISH.

Location of OPLL

- Cervical spine 93%
- Thoracic spine 5.5%
- Lumbar spine 4.5%


OLF = ossification of ligamentum flavum
Case 10

- 72 year-old male with chronic neck pain and significant reduced neck motion.

Indications of imaging

- T - Trauma
- R – Range of motion
- A – Alcohol/smoking
- U – Unresponsive to care/unusual natural history/symptoms
- M – Motor/sensory/reflexes
- A - Age
Findings

- Facet fusion from C3 to C6.
- Vertebral squaring from C3 to C5 with thick syndesmophytes from C3 to C7.
- Marked narrowing with sclerosis of atlantodental space.
- Anterior shift of gravitational line.
Diagnosis

- Seronegative spondyloarthropathy such as ankylosing spondylitis.

Case 11

- 56-year-old male with sudden onset of left arm numbness.

Courtesy of Intern Schuell/Dr. C. DeGraauw
January 17, 2019
Findings

- Cervical lordosis flattened with a 3.5mm retrolisthesis at C6-7. This results in the narrowing of the central canal measuring 8.5mm.
- Severe disc narrowing with bone spurring and vacuum phenomenon is noted from C5 to C7.
- Uncinate blunting is evident at C6 and C7 with foraminal encroachment at C5-6 and C6-7, worse on the left.
Diagnosis

- Severe degenerative disc disease from C5 to C7 with central stenosis at C6-7 secondary to degenerative retrolisthesis.
- Moderate uncovertebral arthrosis with foraminal stenosis at C5-6 and C6-7, worse on the left.
- RECOMMENDATION:
  - Neurological examination to confirm cervical spondylotic myelopathy secondary to degenerative disc disease and retrolisthesis at C6-7.
Findings

- Retrolisthesis at C6-7 results in marked narrowing of the central canal measuring 5.5mm in mid-sagittal dimension. This is associated with compression of the spinal cord with no obvious edema.
- Moderate disc narrowing with posterior osteochondral bar is seen at C5-6 with central canal narrowing measuring 8mm. The spinal cord is compressed at this level with no obvious edema.
Diagnosis

- Marked central stenosis at C6-7, mild at C5-6, with compression of spinal cord secondary to degenerative disc disease and retrolisthesis.

Indications of imaging

- T - Trauma
- R – Range of motion
- A – Alcohol/smoking
- U – Unresponsive to care/unusual natural history/symptoms
- M – Motor/sensory/reflexes
- A - Age
Adults with complicated neck pain

- No response to care after 4 wk.
- Significant activity restriction > 4wk.
- Non-mechanical pain (unrelenting pain at rest, constant or progressive S&S)
- Neck rigidity in the sagittal plane in the absence of trauma (discitis, infection, tumor, meningitis, etc)
- Dysphasia
- Sudden onset of acute and unusual neck pain and/or headache
- Hx of severe trauma.