

**79 YEAR OLD WOMAN
PRESENTS WITH BILATERAL
HAND AND ARM NUMBNESS /
DECREASED COORDINATION**

Emily Arciero, MS4
Michael Baldwin, MD

Clinical History

- 79 year old female with history significant for L1-L5 spinal fusion years prior, recently diagnosed with L5-S1 spondylolisthesis
 - Other PMHx- HTN, HLD, T2DM, PAD, depression
- Patient had been admitted to hospital for syncopal episode (May 2020)
 - Head CT without contrast showed severe central spinal stenosis/cord compression at atlantoaxial joint due to possible soft tissue mass
 - CT of cervical spine without contrast performed, corroborated initial head CT findings
- Subsequently referred to outpatient orthopaedic spine clinic, had first visit in June 2020

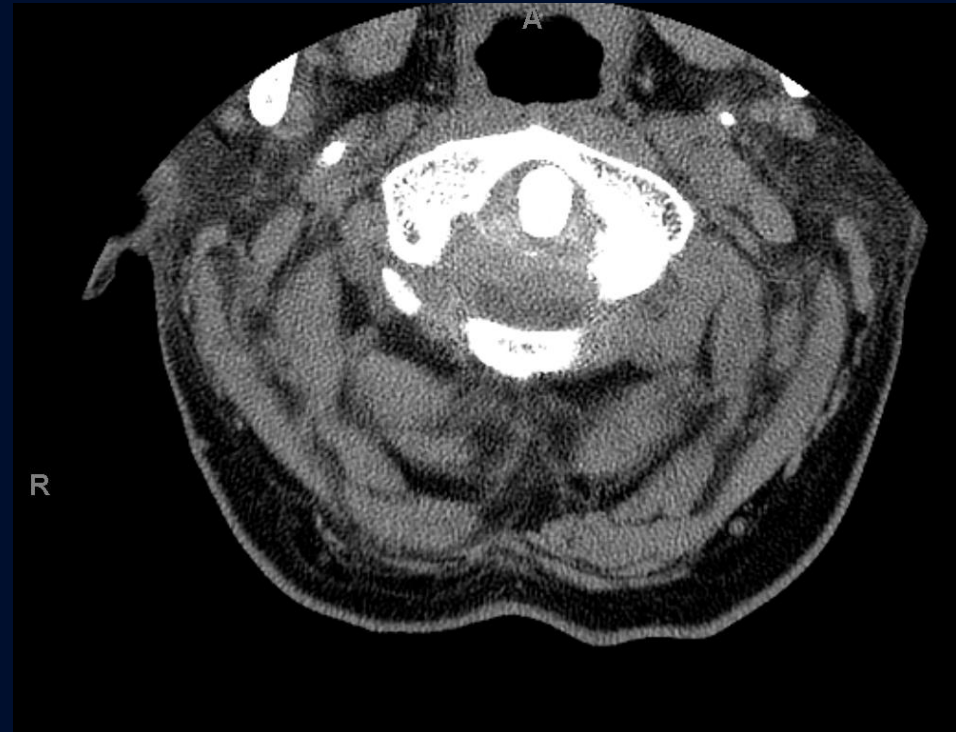
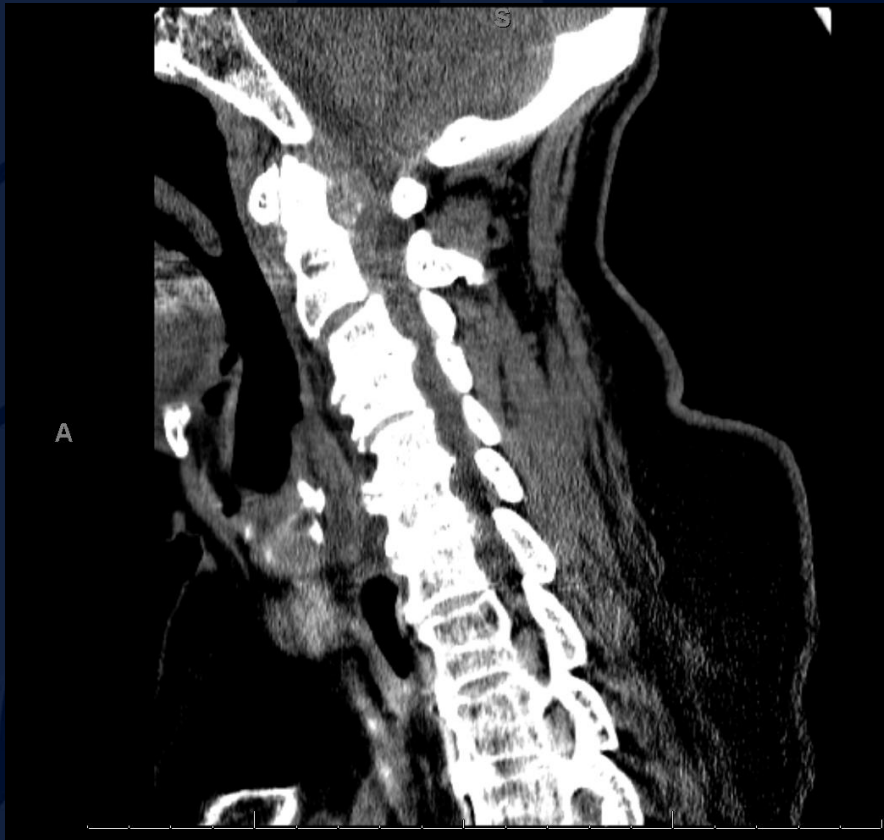
Presenting Symptoms

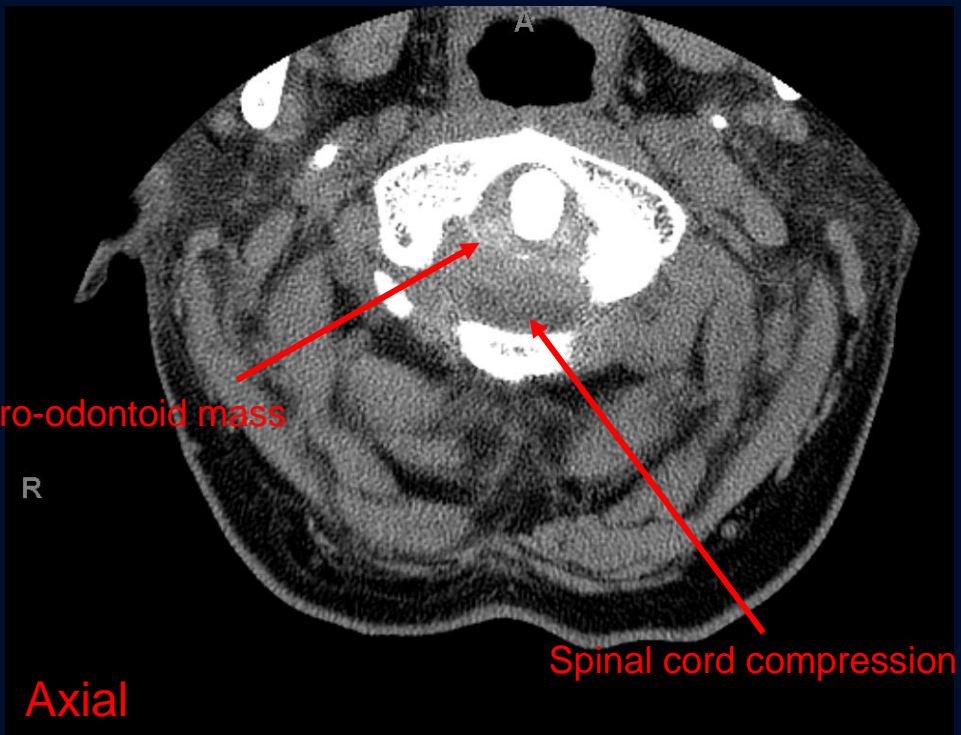
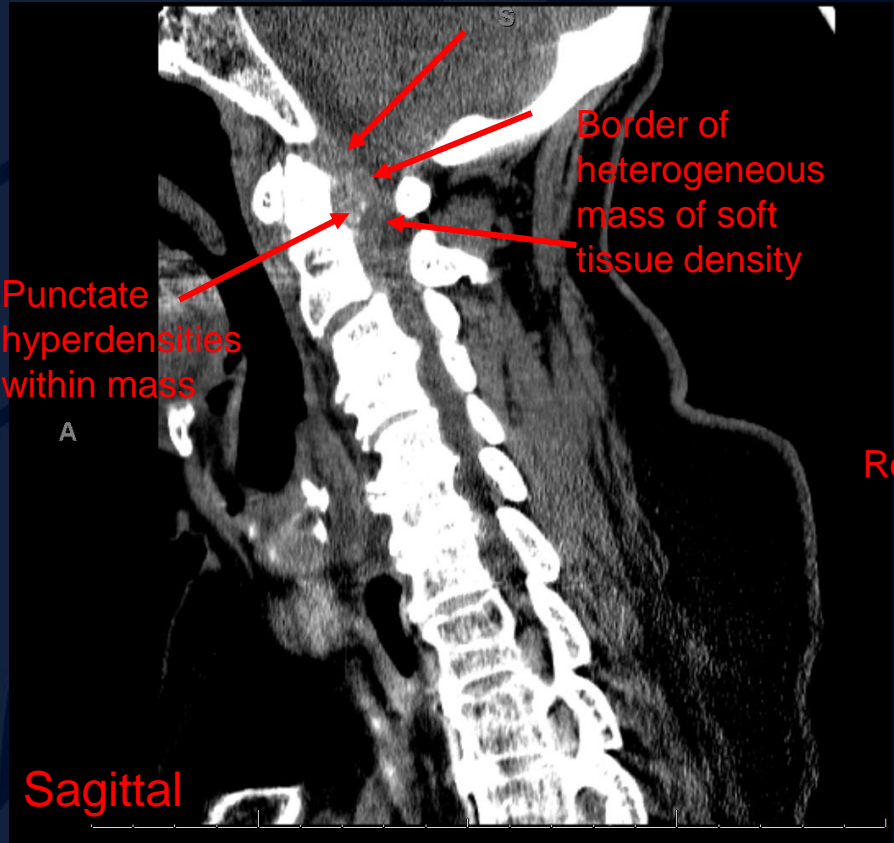
- Initial visit to orthopaedic spine clinic:
 - Patient endorsed a 2 month history of bilateral hand numbness with loss of coordination
 - Numbness in hands radiating to mid-forearm
 - Loss of balance, felt as though she was “drunk” when trying to walk
 - No change in bowel/bladder function
 - Symptoms progressively worsening
 - Patient reported being in car accident about 2 months ago, started noticing symptoms after the event

Extra Information

- Physical exam
 - First visit (June 2020)
 - Significant ataxic gait
 - 3 beats of clonus bilaterally
 - Hoffmann negative bilaterally
 - Strength 5/5, reflexes 2+ bilaterally in upper and lower extremities
 - Second visit (July 2020)
 - Hyperreflexia of bilateral upper extremities
 - Inversion of brachioradialis reflex
- Labs
 - Rheumatoid factor negative in 2018

CT Scan C Spine w/o Contrast







Moderate degenerative atlantodental arthropathy

3mm anterolisthesis C2 on C3

Mild to moderate atlantoaxial arthrosis

Osteophytes

Endplate changes

Uncovertebral arthropathy

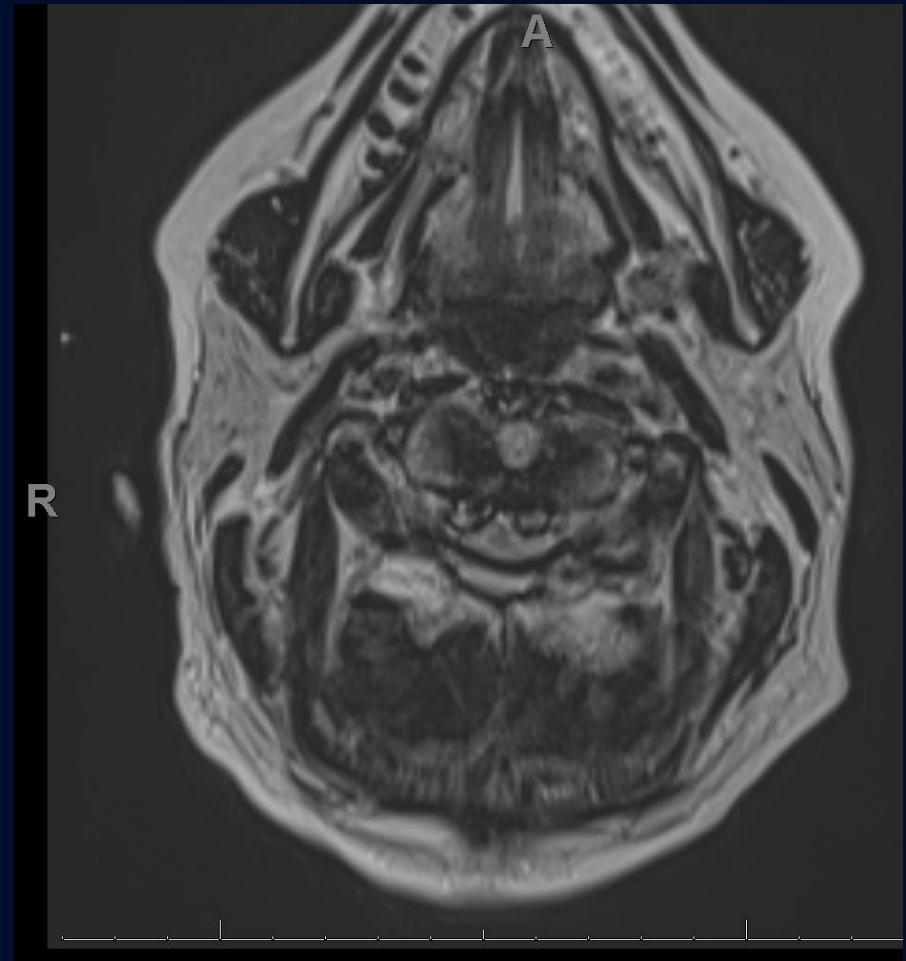
Loss of cervical lordosis

Disc space narrowing

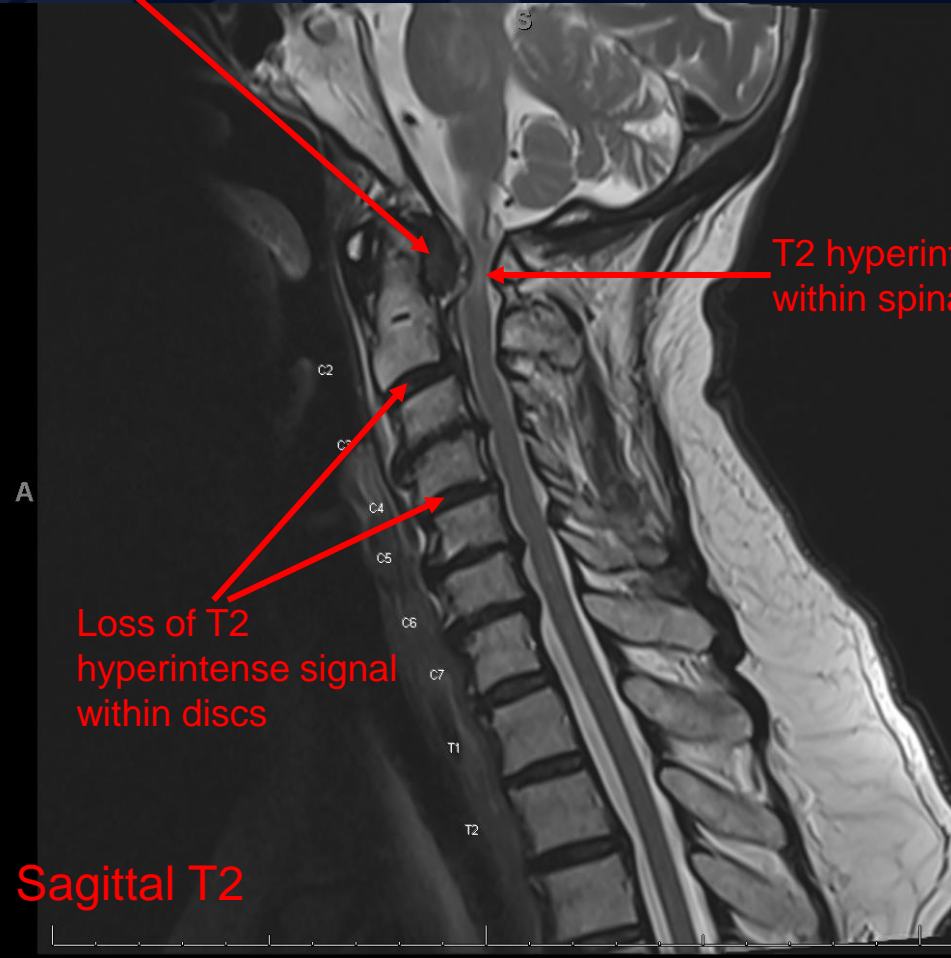
Sagittal

Coronal

MRI C Spine w/o Contrast

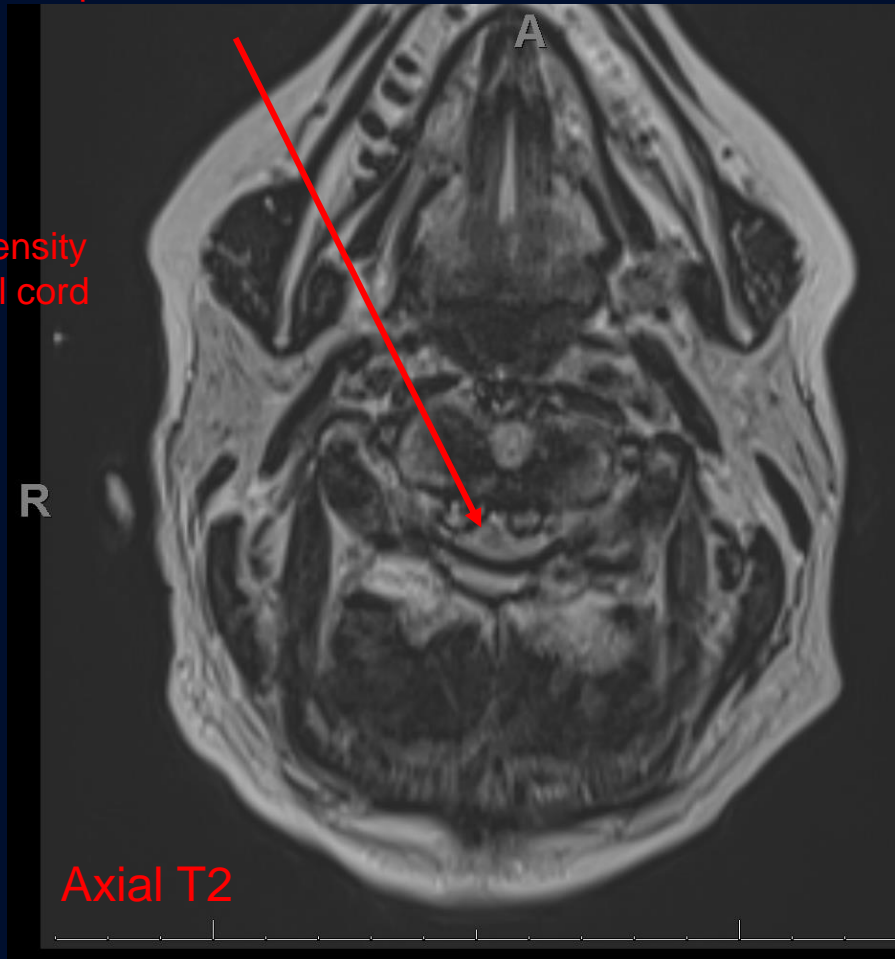


Heterogeneous, overall hypointense, well-demarcated retro-odontoid mass compressing spinal cord



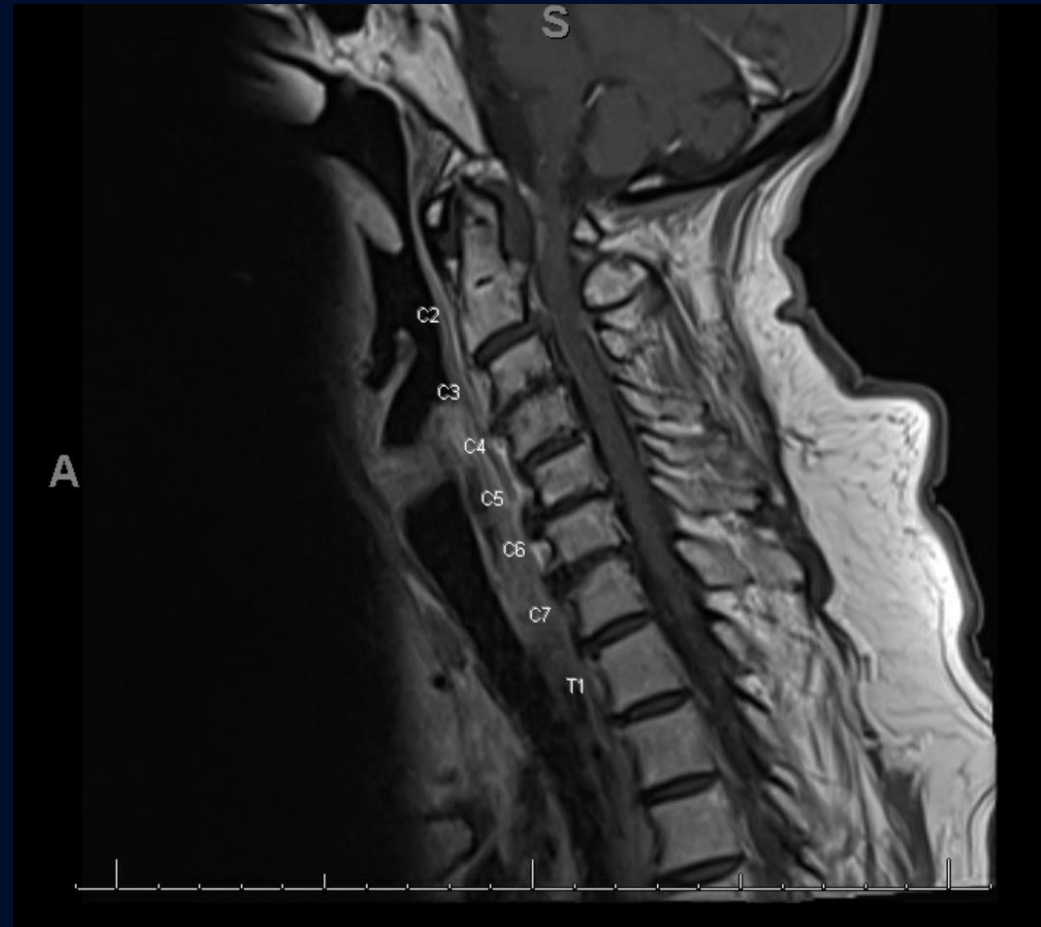
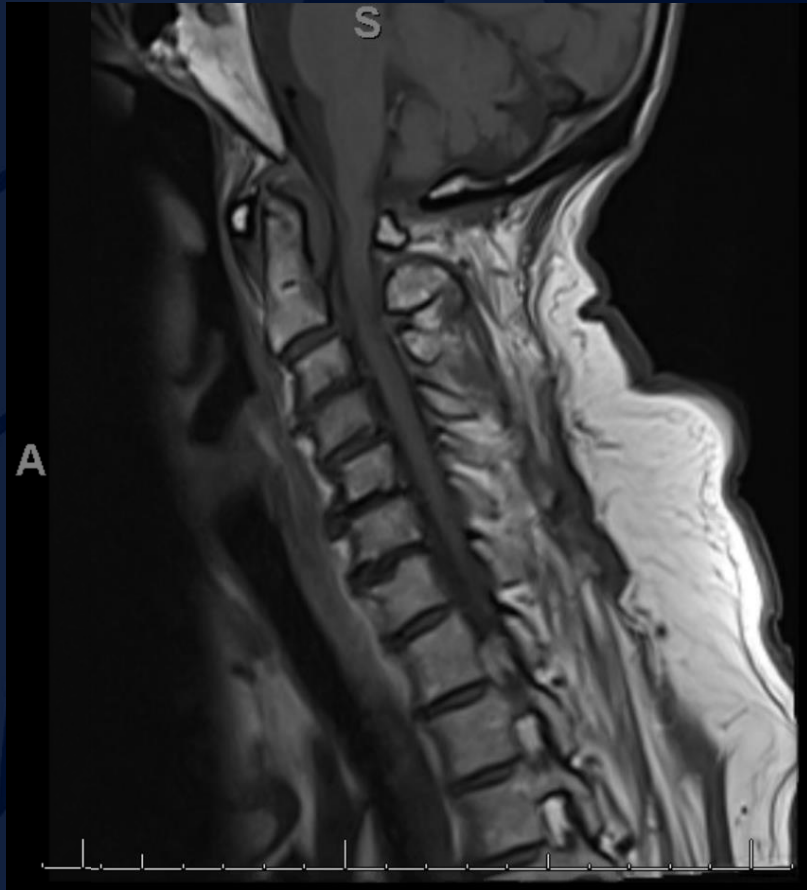
Sagittal T2

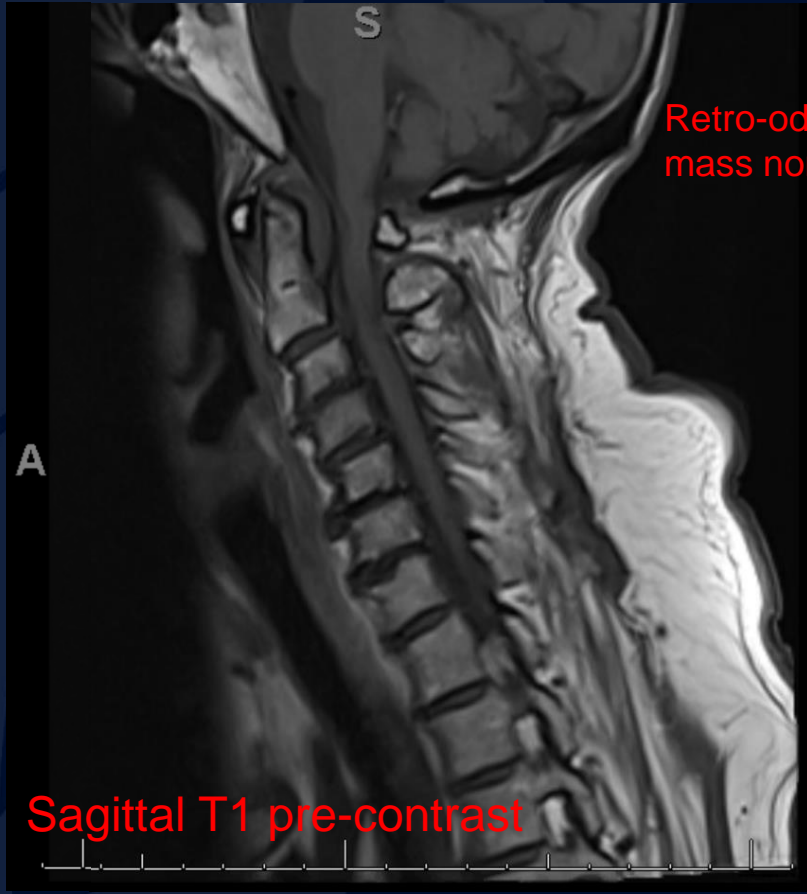
No T2 hyperintense signal surrounding spinal cord at C1/C2 level



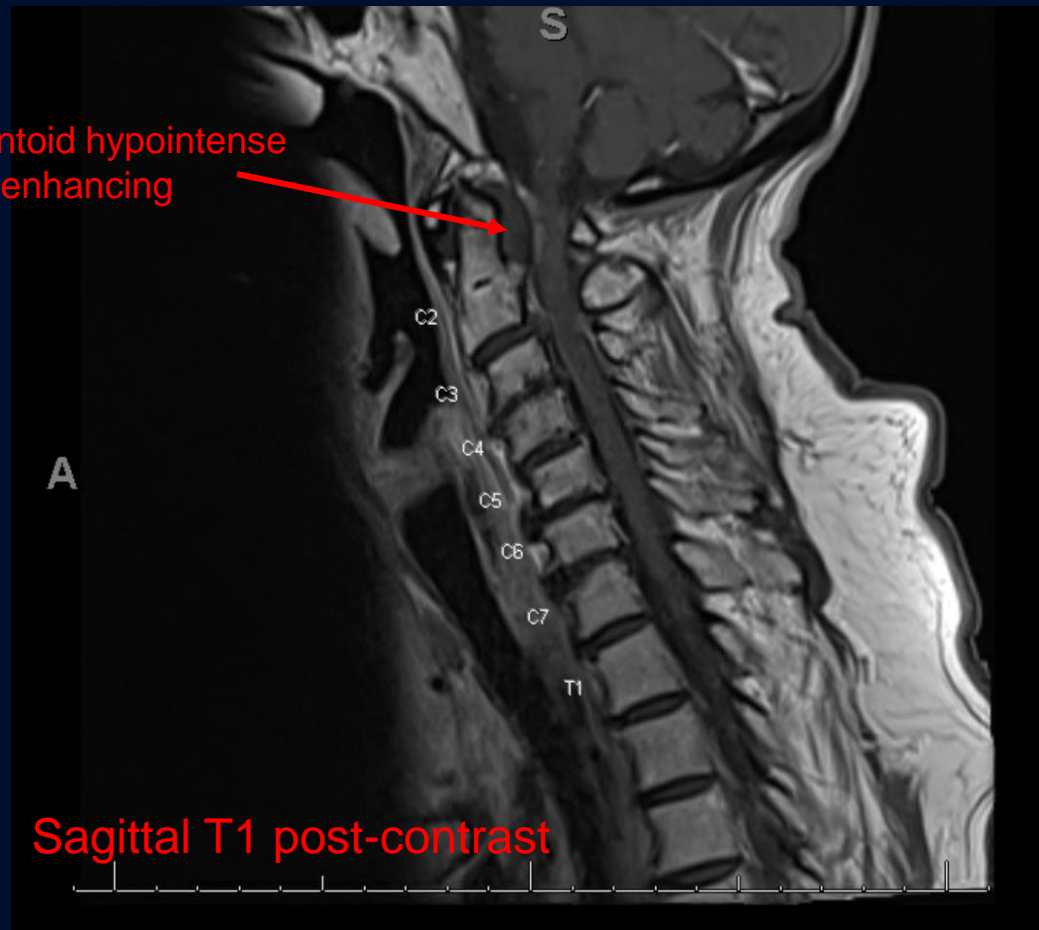
Axial T2

MRI C Spine w/ and w/o Contrast





Retro-odontoid hypointense mass non enhancing



A large, stylized oak leaf graphic in a dark blue color, positioned on the left side of the slide. The leaf has a prominent central vein and several smaller veins branching off it. The leaf's edge is serrated.

Diagnosis?

Dx = Retro-Odontoid Pseudotumor

- Retro-odontoid pseudotumor (ROP)
 - Defined as soft tissue proliferative changes at the atlantoaxial junction surrounding the region of the transverse ligament
- Clinical presentation
 - Often asymptomatic
 - Acute inflammation in these masses can manifest as neck pain/headache
 - As a chronic process, mass effect on cervical spine can manifest as myelopathy, including sensory and motor deficits

DDx Retro-Odontoid Pseudotumor

The following entities may cause retro-odontoid pseudotumor:

- Chondrocalcinosis
 - Calcific deposits in transverse ligament- tend to be linear and diffuse
 - Associated pyrophosphate arthropathy → narrowing of intervertebral discs, bony sclerosis, osteophyte formation, often with bony erosions and subchondral cysts
- Hemodialysis-associated amyloidosis
 - Bony erosion and cystic change
- Pigmented villonodular synovitis
 - Heterogeneously low signal intensity
 - Rarely forms osteolytic bone lesions
 - Blooming on GRE sequences secondary to hemosiderin content
- Chronic odontoid fracture
 - Poor healing → altered/increased movement → formation of fibrous soft tissue mass around fracture site
- Gout
 - Tophi may be faintly calcified
 - MRI appearance of tophus can be indistinguishable from calcium hydroxyapatite crystal deposit
- Pannus (RA)- can be hypervascular, hypovascular, or fibrous
- Osteoarthritis

**although ROP has been shown to be related to mechanical instability, prior studies have not shown a single specific cause for soft tissue proliferation*

DDx Retro-Odontoid Pseudotumor

Other retro-odontoid entities:

- Retro-odontoid synovial cyst
 - Simple fluid signal intensity cystic structure (although occasionally can have a complex appearance due to neovascularization and hemorrhage)
- Epidural lipomatosis
 - High T1 signal, fat suppression on T1 FS, low T2 signal
- Epidural hematoma
 - MRI appearance of hemorrhage varies based on acuity
 - High T1 signal, no fat suppression on T1 FS, low T2 signal
 - >75% found dorsally within spinal canal
- Ossification of posterior longitudinal ligament
 - Isointense to cortex and usually extends caudal to craniocervical junction
 - Unlike in pseudotumor- varied signal intensity, centered at posterior aspect of dens

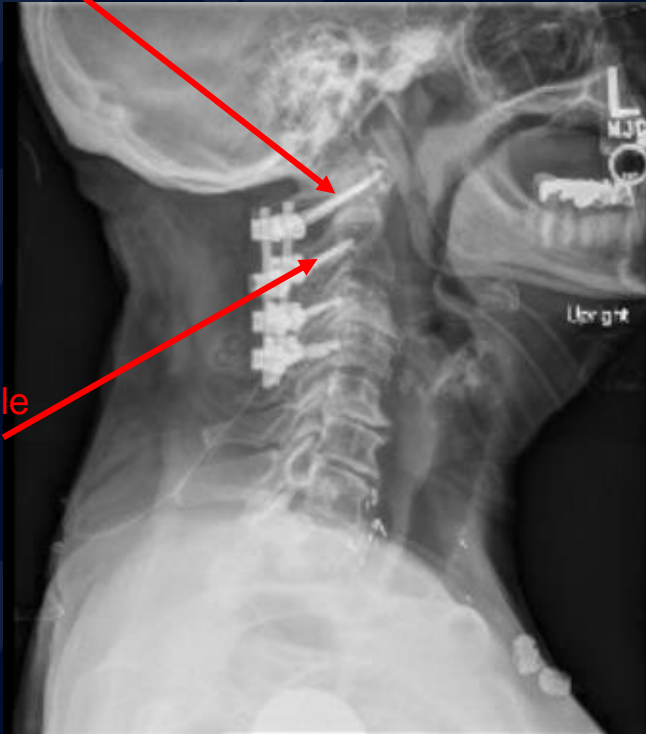
Surgical Intervention

- C1-C3 posterior decompression and C1-C4 instrumented posterior spinal fusion
- Resulted in significant interval decrease in prominence of soft tissue pannus along the posterior aspect of the dens, along with no cord compression at the C1 level

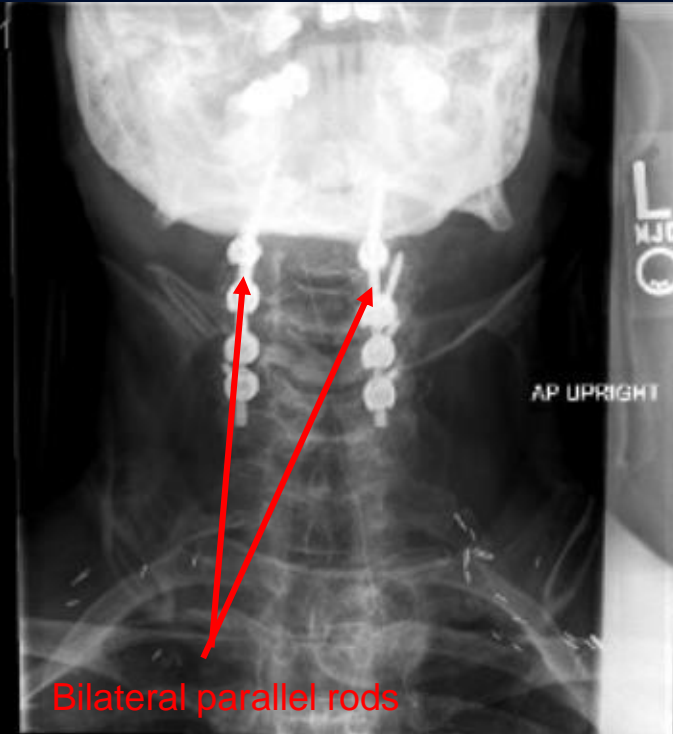


Post-Op XR C Spine

Bilateral lateral mass screws at C1



Bilateral pedicle screws C2-C4



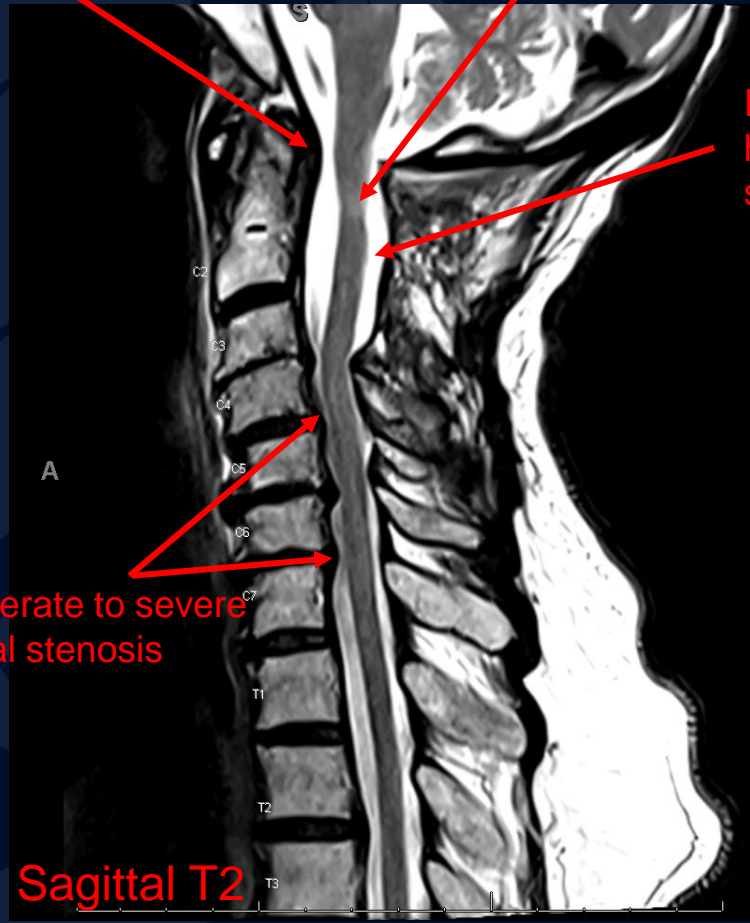
Bilateral parallel rods

Post-Op MRI C Spine w/o Contrast (6 mo f/u)



Interval decrease in soft tissue prominence along posterior aspect of dens

Persistent mild heterogeneous T2 signal intensity suggestive of focal residual myelomalacia



Restoration of T2 hyperintensity surrounding spinal cord at C1-C3

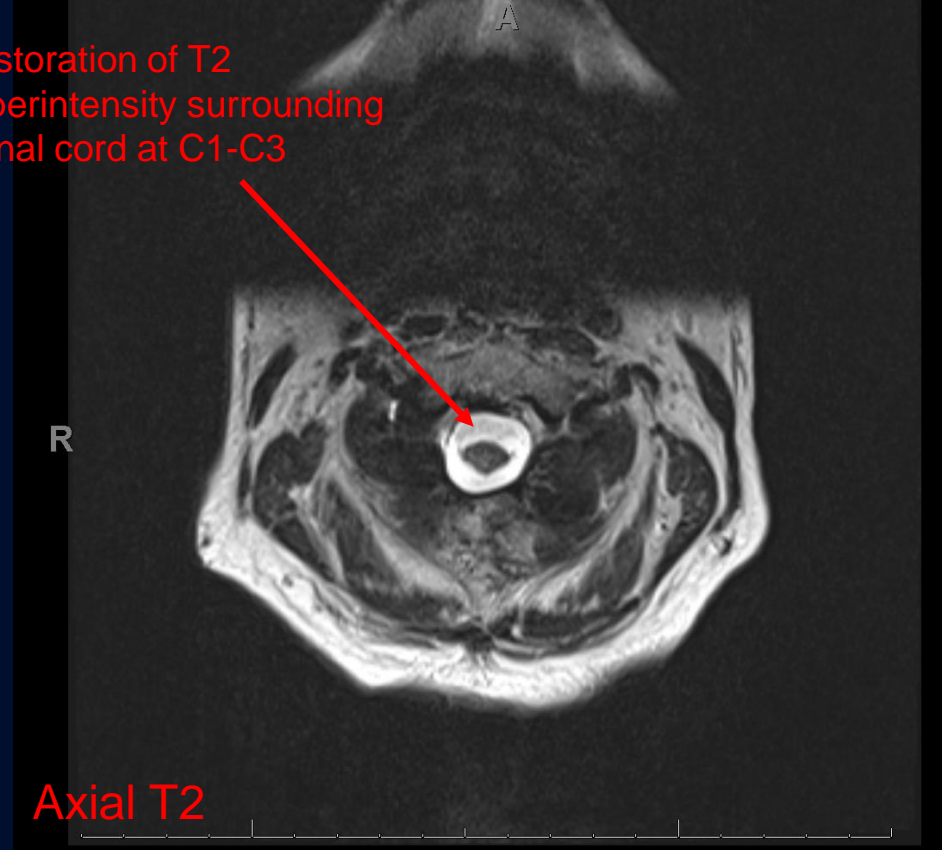
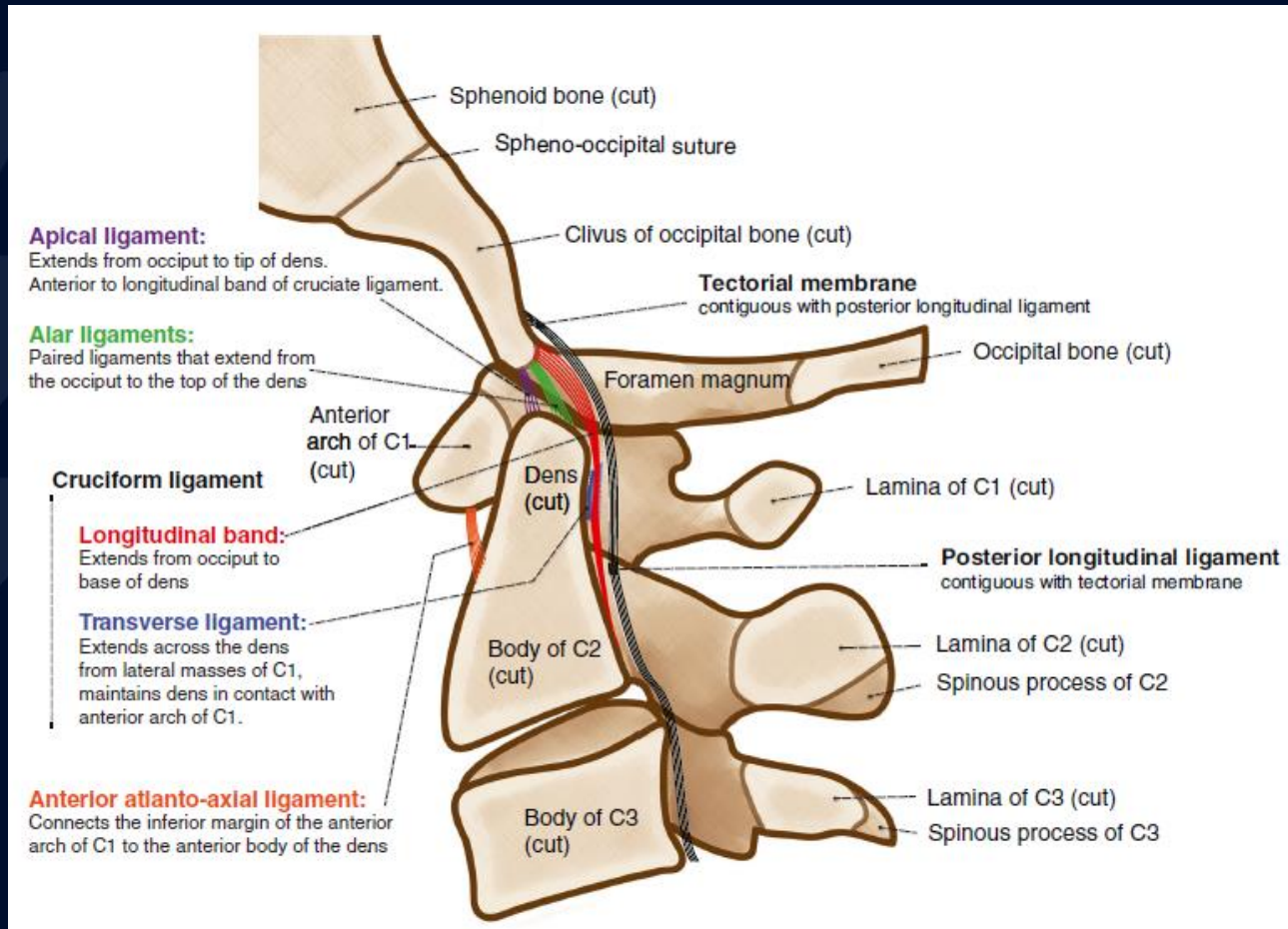


Table 1 Imaging features of various causes of retro-odontoid pseudotumor

Etiology	T1 signal	T2 signal	STIR signal	Ossification	Erosions	Histopathology
Rheumatoid arthritis						
Hypervascular pannus	High	High	High	No	Yes	Granulation tissue with large amount of inflammatory cells, angioblasts, vessels, and edema [35, 38]
Hypovascular pannus	Low	High, mixed	Low			Connective tissue with poorly vascularized collagen fibers [35, 38]
Fibrous pannus	Low	Low	Low			Nonvascularized fibrous connective tissue with few cells [35, 38]
Osteoarthritis	Low	Low	Low	No	Rarely	Dense fibrous tissue proliferation with immature bone formation [72]
Retro-odontoid synovial cyst	Low	High	High	No	No	Degenerative ligamentous changes with inflammatory reaction [22, 67]
Hemodialysis-associated amyloidosis	Low to intermediate	Low to intermediate	Low	No	Yes	Extracellular deposition of the fibrous protein β 2-microglobulin [59, 60]
CPPD	Low	Variable, heterogenous	Low	Yes	Yes	Inflammatory cells with positively birefringent rhomboid crystals (calcium pyrophosphate) [73]
PVNS	Low to intermediate	Low to intermediate	High	No	Yes	Mononuclear histiocytes mixed with multinucleated giant cells; interspersed hemosiderin deposition [62]
Ossification of Posterior Longitudinal Ligament	Low	Variable	Low	Yes	No	Formation of ossific-calcific components in the PLL [71]
Gout	Low	Variable, heterogenous	High	Yes, faintly calcified	Yes	Deposition of monosodium urate crystals [74]
Fracture	Low	High, mixed	High	Yes	Maybe	Callus formation, remodeling of fracture, reactive fibrous changes [65]
Epidural lipomatosis	High	Low	Low	No	No	Mature adipose tissue [68]
Epidural hematoma	High	Low	Low	No	No	Blood clot [69, 70]

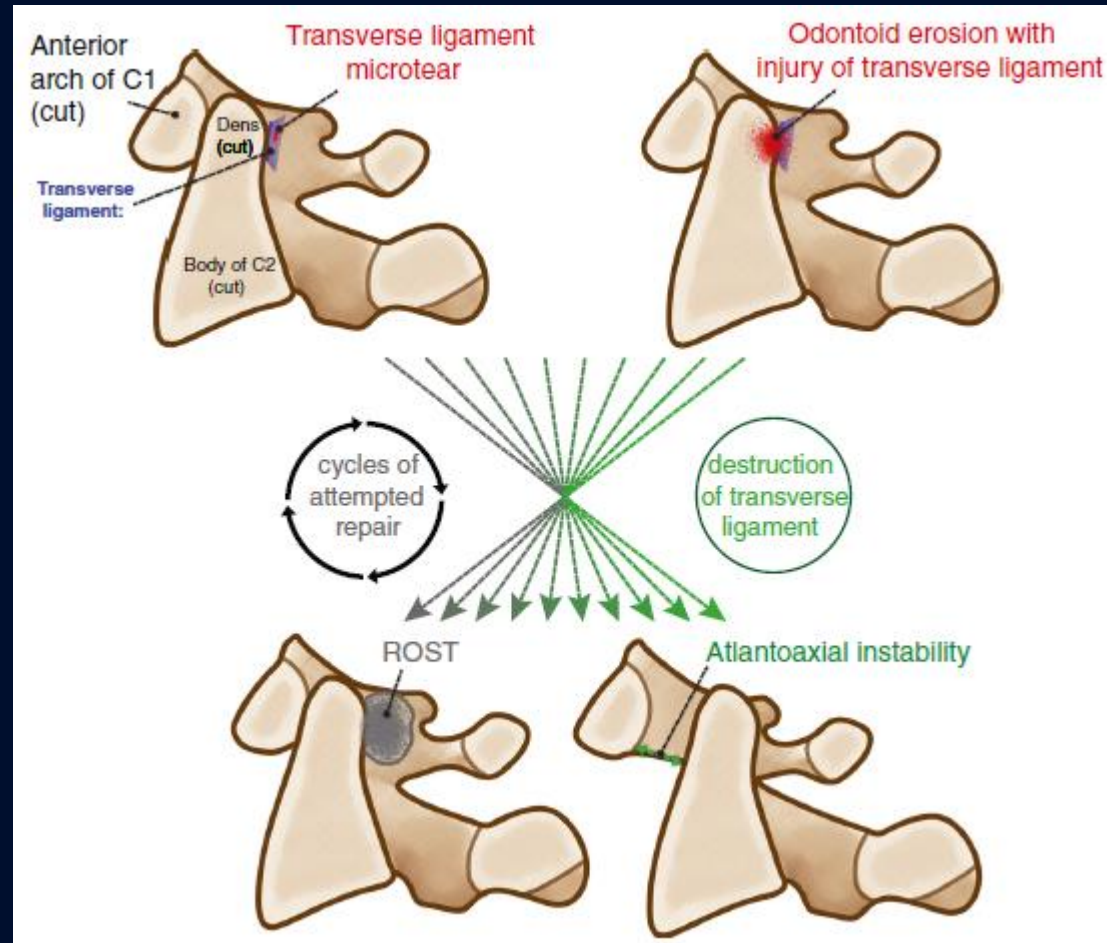
Anatomy

- Normal soft-tissue anatomy of retro-odontoid region:
 - Cruciate ligament (transverse ligament and longitudinal band)
 - Posterior longitudinal ligament
 - Thecal sac
- Given the synovial articulation b/w the transverse ligament and odontoid, there is a potential space that can be affected by inflammatory and reparative processes → resulting in proliferative soft tissue



Pathophysiology

- Repetitive cycle of ligamentous injury and repair likely drive development, initiated by transverse ligament damage from inflammation, minor trauma, degenerative changes, or altered biomechanics
- *Regardless of the etiology, spontaneous regression of ROP is commonly observed following surgical fusion (as in this case)
 - This further supports the theory that XS motion at the craniocervical junction may be a major contributing factor in the development of abnormal soft tissue



Radiographic Features

Soft tissue thickening at the atlantoaxial junction around the expected location of the transverse atlantal ligament, posterior to the dens

- CT
 - Mineralization within the pseudotumor
 - Bony erosion may be present in RA, CPPD, gout, pigmented villonodular synovitis
- MRI- signal changes vary by etiology → no reliable imaging features that distinguish RA-related pannus from non-RA retro-odontoid pseudotumor
 - T1- usually hypointense
 - T1 precontrast- identification of hemorrhage, fibrous tissue, mineralization
 - T2 post contrast- to characterize vascularity of pseudotumor
 - T2- variable, often heterogeneous
 - This sequence can be used to identify edema within odontoid pseudotumor, or C spine

Discussion/Conclusion

- Retro-odontoid pseudotumor is an uncommon entity with varied and overlapping imaging appearances described on MRI in patients with and without RA
 - ROP is a diverse entity commonly mislabeled as pannus
 - In the setting of RA, retro-odontoid soft tissue proliferation is most commonly referred to as pannus, although histological reports are rare and do not always confirm inflammation
- Pannus-like lesions have been reported in patients with severe degenerative disease in the cervical spine
 - This patient had extensive multilevel degenerative changes
 - No prior diagnosis of RA
- Imaging findings in this case (low T1 signal (nonenhancing) and low T2 signal) consistent with soft tissue proliferation seen in osteoarthritis (dense fibrous tissue with immature bone formation), or a fibrous pannus (nonvascular fibrous connective tissue with few cells)
- Regardless of etiology, ROP tend to regress after stabilization of the C spine, which was observed in this patient

References

- Shi J, Ermann J, Weissman BN, Smith SE, Mandell JC. **Thinking beyond pannus: a review of retro-odontoid pseudotumor due to rheumatoid and non-rheumatoid etiologies.** Skeletal Radiol. 2019 Oct;48(10):1511-1523. doi: 10.1007/s00256-019-03187-z. Epub 2019 Mar 13. PMID: 30868232.
- Kushchayev SV, Glushko T, Jarraya M, Schuleri KH, Preul MC, Brooks ML, Teytelboym OM. **ABCs of the degenerative spine.** Insights Imaging. 2018 Apr;9(2):253-274. doi: 10.1007/s13244-017-0584-z. Epub 2018 Mar 22. PMID: 29569215; PMCID: PMC5893484.
- Joyce AA, Williams JN, Shi J, Mandell JC, Isaac Z, Ermann J. **Atlanto-axial Pannus in Patients with and without Rheumatoid Arthritis.** J Rheumatol. 2019 Nov;46(11):1431-1437. doi: 10.3899/jrheum.181429. Epub 2019 Apr 1. PMID: 30936276.
- Park JH, Lee E, Lee JW, Kang Y, Ahn JM, Yeom JS, Kang HS. **Postoperative Regression of Retro-odontoid Pseudotumor After Atlantoaxial Posterior Fixation: 11 Years of Experience in Patients With Atlantoaxial Instability.** Spine (Phila Pa 1976). 2017 Dec 1;42(23):1763-1771. doi: 10.1097/BRS.0000000000002222. PMID: 28459776.
- Pierce JL, Donahue JH, Nacey NC, Quirk CR, Perry MT, Faulconer N, Falkowski GA, Maldonado MD, Shaeffer CA, Shen FH. **Spinal Hematomas: What a Radiologist Needs to Know.** Radiographics. 2018 Sep-Oct;38(5):1516-1535. doi: 10.1148/rg.2018180099. PMID: 30207937.
- <https://radiopaedia.org/articles/retro-odontoid-pseudotumour?lang=us>