



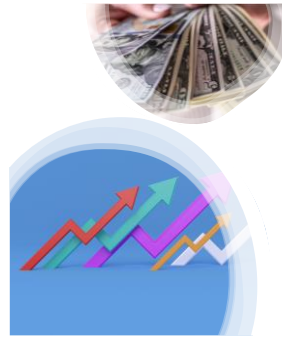
## SPINAL STENOSIS: Evaluation and Management

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NO  
DISCLOSURES

### Overview

- LUMBAR AND CERVICAL SPINAL STENOSIS
- Epidemiology
- Anatomy
- Clinical Presentation
- Differential Diagnosis
- Work Up and Imaging
- Management and Treatment



### Why are we always talking about spinal pain?

- Cost and prevalence
- "Spine pain is a common problem throughout the world and is a significant cause of pain and loss of function. Lifetime prevalence estimates are as high as 84% for back pain[1] and 67% for neck pain[2]. Please note these numbers are from more than 20 years ago
- Greater than 15 years ago, cervical and lower back pain was estimated to have 256 billion in health care expenditures in the US [3]
- 1. Walker BF: The prevalence of low back pain: a systematic review of the literature from 1966 to 1998. *J Spinal Disord* 2000;13:205-17.
- 2. Cole P, Cassidy JD, Carroll LJ, et al: The annual incidence and course of neck pain in the general population: a population-based cohort study. *Pain* 2004;112:767-73.
- 3. Martin BI, Devro RA, et al: Expenditures and health care status among adults with back and neck problems. *JAMA* 2008; 299:656-64. Erratum in: *JAMA* 2008; 299:2630.

### Epidemiology: Lumbar Spinal Stenosis

- Congenital lumbar spinal stenosis 9% of cases and relatively uncommon, presents age 30-40 years old
- Acquired spinal stenosis very common and usually presents over age 60 years old
- Estimates 250-500 million US residents and 103 million worldwide with symptoms of spinal stenosis [4] [5]
- Most common lumbar level L4-S5 with reports as high as 91% [5]
- Spinal stenosis is the leading cause of spine surgery for adults over 65 [5]
- 600,000 surgical procedures yearly in US for spinal stenosis, from JAMA 2022 [4]



### Epidemiology Cervical Spinal Stenosis

- Very common and present in 4.9% of adults
- 6.8% individuals older than 50
- 9% individuals older than 70
- Risk factors: genetics, trauma, osteoporosis, cigarette smoking
- Prevalence of cervical spinal stenosis: anatomical study in cadavers. *JBS* 2007 feb1;89(2):376-80





### #1 Case Study: Lumbar MRI evaluation

- Failure of conservative care after 4 months MRI without contrast
- T2 weighted image upper sagittal view and lower axial view
- L3-4 Severe spinal stenosis
- L4-5 moderate to severe spinal stenosis



### #2 Case Study: Lumbar Spinal Stenosis

- 81 year old male with a 30 year history of lower back pain with radiculopathy
- After 10 years of conservative care, he had a successful L4-5 laminotomy decompression in 2004 as well as bilateral TKA
- He is very active and has walked 1500 miles over the past year with increased symptoms of LBP and intermittent radiculopathy with standing or walking over the past 6 months. Mild gait instability but no assist devices. Denies weakness or numbness. Several episodes of bladder incontinence
- Pain free sitting
- Greater than 3 months of formal PT and continues a home program
- Only using mild analgesics
- VHS 5-8/10 and he feels pain is causing a negative impact on his quality of life and function
- Physical exam: positive facet loading L3-4 and L4-5
- Next steps....



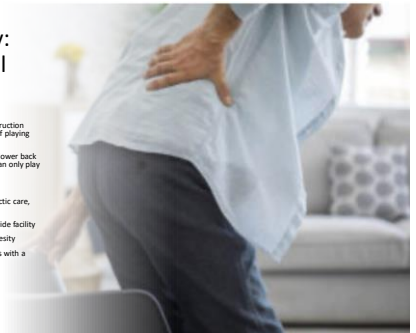
### #2 Case Study: Lumbar Spinal Stenosis

- Lumbar MRI was ordered to evaluate
- T2 weighted Sagittal view stir image showing severe multilevel degenerative disc disease
- L3-4 scoliosis, posterior disc osteophytes, facet arthropathy, ligamentum hypertrophy and buckling creating severe spinal stenosis
- L1-2 mild to moderate spinal stenosis



### #3 Case Study: Lumbar Spinal Stenosis

- 72 year old male retired from construction business and pursuing his passion of playing golf 3-4 days/week
- Past several years progressive pain lower back and gluteal standing and walking, can only play 2 rounds per week with difficulty
- Pain free sitting
- Failure of PT, aquatherapy, chiropractic care, massage
- Failure of facet injections at an outside facility
- PMH: CAD, femoral artery stent, obesity
- Physical Exam: VHS 8/10, ambulates with a forward flexed gait and limping
- Motor and sensory exam wnl



### #3 Case Study: MRI Lumbar

- MRI Lumbar T2 weighted image non contrast
- L3-4 with moderate to severe spinal stenosis with clumping of nerve roots, facet hypertrophy, ligamentum flavum hypertrophy and foraminal stenosis
- L4-5 with moderate stenosis due to similar changes
- L2-3 with mild stenosis due to similar changes
- Multilevel degenerative disc disease
- Next steps....



### Clinical Presentation Lumbar Stenosis

- Back pain worse with extension or ambulation and generally improved sitting
- Lumbar radiculopathy worse standing
- 60% lumbar with bilateral leg symptoms
- Neurogenic claudication: pain numbness and discomfort with walking
- Wide based gait
- Improved sitting and flexion
- Often find no neurological deficit at rest



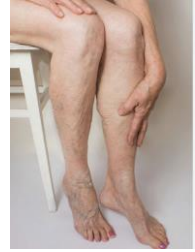
## Differential Diagnosis and Imposters of Lumbar Spinal Stenosis

- Vascular Claudication
- Rheumatological disease: ankylosing spondylitis, DISH
- Metastatic cancer: Prostate, breast, piglet
- Epidural/subdural abscess, discitis
- Trauma
- Hip joint pathology
- Sacroiliitis
- Lumbar compression fracture
- Piloniform syndrome
- Lumbar facet arthropathy
- Herniated nucleus pulposus



## Vascular Claudication

- Intermittent claudication due to peripheral arterial disease
- Buttock and lower extremity pain, cramping or fatigue which is brought on quickly with exercise and relieved by rest.
- Reproducible pain after walking a specific distance, but slower improvement with rest
- Night pain with burning symptoms
- Not improved by spinal position or posture. No improvement with forward flexion
- Diminished peripheral pulses
- Testing: ABI, vascular studies



Neurogenic Claudication vs. Vascular Claudication		
	Neurogenic Claudication	Vascular Claudication
Postural changes	Yes	No
Walking upright	Causes symptoms	Causes symptoms
Standing stationary	Causes symptoms	Relieves symptoms
Sitting	Relieves symptoms	Relieves symptoms
Stair climbing	Up easier (back flexed)	Down easier
Stationary bicycle (back flexed)	Relieves symptoms	Causes symptoms
Pulses	Normal	Abnormal

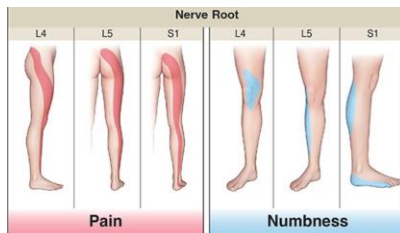
Orthobullets, 2020/24 spinal stenosis

## Lumbar Herniated Disc with Radiculopathy

- Possible lower back pain
- Lumbar radiculopathy in a specific nerve root distribution
- Deficit on physical exam depends on superficial impingement
- Can also cause central spinal stenosis
- The majority will improve with conservative care



NEJM 2016; 374: 1544 (B)



Distribution of Pain and Numbness According to Nerve Root.  
Published November 6, 2024 | N Engl J Med 2024;391:e38

## Hip Joint Pathology: Osteoarthritis

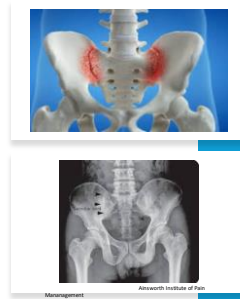
- Pain in the groin, thigh, buttock and worse weight bearing and with activity
- Stiffness in the morning and limited rotation
- Possible clicking, grinding or locking sensation often due to fragments and uneven joint surface interfering with movement
- Weakness, limping, challenges with stair climbing
- Trochanteric Bursitis with lateral hip and thigh pain



Hip Osteoarthritis Orthobullets.org

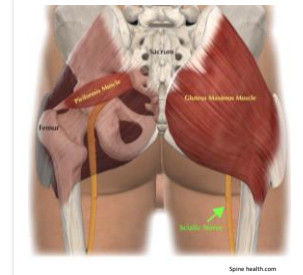
## Sacroiliitis

- Lower back and gluteal pain with or without radiating posterior gluteal and lower extremity pain
- Possible hip or groin pain
- Difficulty with sitting, standing, rotation
- Etiology degenerative arthritis, ankylosing spondylitis, adjacent segment disease following lower lumbar fusion
- Provocative testing on exam: distraction, thigh thrust, compression, FABER, Gaenslen



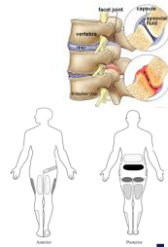
## Piriformis Syndrome

- Sciatic nerve entrapment at the level of the ischial tuberosity
- Approximately 80% sciatic nerve lies under piriformis muscle
- Piriformis muscle attaches from anterior S2-4 to greater trochanter of hip
- Piriformis muscle injury from trauma, muscle hypertrophy in athletes, prolonged sitting
- Compression of the sciatic nerve in addition to muscular pain
- Patients present with buttock and hip pain, difficulty sitting, pain with hip mobility as well as sciatica



## Facet Joint Arthropathy

- Typical clinical presentation of axial low back pain without radiculopathy
- Pain worse sitting, standing, hyperextension, and axial rotation
- Commonly associated with degenerative disc disease, trauma, elderly, adjacent segment following fusion
- Hypertrophy and osteophytes can add to spinal stenosis and foraminal stenosis
- Referral pattern for lumbar facet pain can be confuse with radicular pain

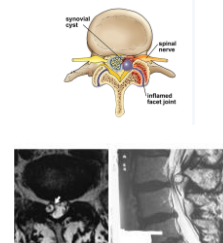


Lumbar facet pain referral patterns. The most common pattern of referral pain from the lumbar facets are noted in black. Blue lines indicate the pattern of referral pain from the superior articular process. Each facet joint refers pain to a number of locations, with a great deal of overlap between the different facets. Although there are trends, there are no direct associations between specific joints and referral back regions.

From Cohen, SA. Atlas of Arthropathies, Degenerative and Traumatic. (Springer) (Lippincott Williams & Wilkins) 2012:120-121.

## Facet Joint Synovial Cyst

- Degenerative changes in the facet joints can lead to the formation of synovial cysts
- More common in lumbar spine and can create spinal stenosis and specific nerve root compression
- L4-5 incidence 60-89% due to greatest mobility at this segment (11)
- L3-4 incidence 14%
- L5-S1 incidence 12%
- Can be treated with injection, aspiration, rupture or surgery if neurological compromise



Orthobullets.com (11)

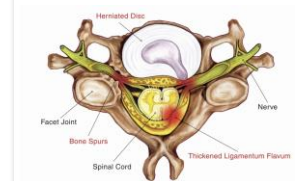
## Definition Cervical Spinal Stenosis

- Cervical Spinal Stenosis:
- Crowding in the central canal or foramin with decreased space for the spinal cord or exiting nerve roots which may or may not cause neurological deficits
- Central, lateral recess or foraminal
- Congenital or acquired/degenerative
- Concern for myelopathy



## Cervical Anatomy and Classification

- Central Stenosis
- Lateral Recess Stenosis
- Foraminal Stenosis



Examples of spinal nerve compression in the cervical spine. (Photo Source: Spinalwire.com)

## Cervical Spinal Stenosis: Congenital, Acquired

- CONGENITAL
- Shortened pedicles and anatomical variants
- Hereditary
- Ossification of the Posterior Longitudinal Ligament
- 2% Asian population with progressive cord compression in neck extension. Ligament thickens and becomes less flexible
- Radiopaedia.org, <https://doi.org/10.5334/rpd-2020-172>



(12)

## Cervical Spinal Stenosis: Congenital Acquired

- ACQUIRED
- Degenerative changes, disc dehydration and loss of height
- Ligamentum flavum hypertrophy posterior
- Osteophytes facets and uncovertebral joints
- Disc changes: bulging, protrusions or herniations
- Tumor
- Trauma
- Epidural Abscess



Complete Orthopedics

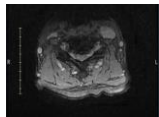
## #4 Case Study: Cervical Spinal Stenosis

- 73 year old woman with 2 years of progressive cervical pain and intermittent left upper extremity numbness and weakness in thumb and index finger
- Neck pain and occipital pain worse at night
- Neck stiffness with limited motion
- Some gait instability
- Physical therapy with moderation of symptoms
- VNS 4-8/10
- Mild analgesics not very helpful, patient prefers to avoid medications
- Physical Exam: limited ROM left, pain hyperextension, paraspinous and trapezius tenderness left, motor 5/5, sensation wnl
- Next assessment....



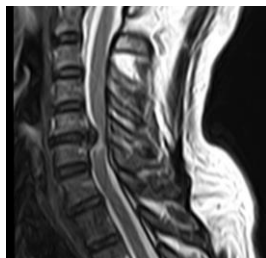
## #4 Case Study: Cervical Spinal Stenosis

- MRI Cervical noncontrast
- Multilevel degenerative disc disease
- C5-6 and C6-7 with severe spinal stenosis and severe bilateral foraminal stenosis, C5-6 being worse and indentation of the cord at that level
- She has had a neurosurgical consultation but not a surgical candidate at this point
- Next steps...



## Cervical Myelopathy

- Cervical spinal cord compression leading to neurological dysfunction
- Combination of congenital cervical spinal stenosis with progressive cervical spondylosis lead to a higher risk of cervical myelopathy
- Degenerative cervical spondylosis most common cause
- Other causes include HNP, trauma, cervical kyphosis, neurological injury or ischemic injury to the anterior spinal artery
- Differential diagnosis can include stroke, ALS, MS, other movement disorders



Compressive myelopathy, Radiopaedia.org/articles/61360 (13)

## #5 Case Study: Cervical Spinal Stenosis

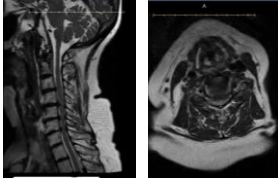
- 79 year old female with a history of lumbar spinal stenosis
- Lower back pain with diagnosed lumbar radiculopathy
- Newer symptoms of cervical pain with bilateral radiculopathy
- VNS pain score 6/10
- Numbness 1st, 2nd and 3rd digits bilateral and weakness opening jars
- Progressive gait instability and balance
- Denies bowel or bladder dysfunction
- No improvement with mild analgesics, chiropractic care or PT
- Pain impacting ADLs and function





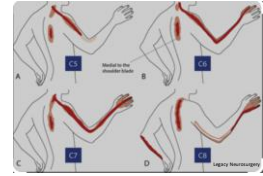
## #5 Case Study: Cervical MRI

- Cervical MRI without contrast
- C4-5 with severe spinal stenosis and possible myelopathy signals in the cord at this level
- C5-6 with severe spinal stenosis
- C6-7 with moderate to severe spinal stenosis
- Severe foraminal stenosis bilateral at all of these levels with multilevel degenerative disc disease
- Next steps...



## Clinical Presentation Cervical Spinal Stenosis

- Mild cervical stenosis can often be asymptomatic.
- Cervical pain which is worse with hyperextension and flexion which reduces diameter of the spinal canal
- As the level of stenosis increases, can see further symptoms due to spinal cord compression
- Lateral stenosis can cause symptoms of more specific radiculopathy. This can often be the presenting symptom.
- Always need a detailed history and physical exam



## Clinical Presentation Cervical Stenosis and Myelopathy

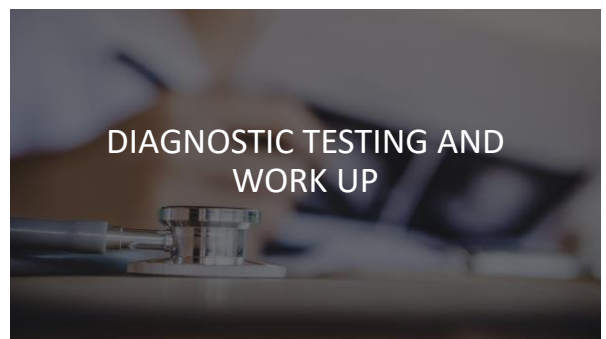
- HISTORY: combined radicular and myelopathy symptoms common
- Lower motor neuron radiculopathy in upper extremity
  - Occipital pain and headaches
- Upper motor neuron dysfunction below the stenosis
  - Hyperreflexia, spasticity and clonus in the lower extremities
  - Bowel or bladder dysfunction, urinary retention or incontinence
  - Gait instability, inability to walk or maintain balance
  - Lots of fine motor control, and limited dexterity, dropping objects
  - Diffuse paresthesias with nondermatomal numbness

## Clinical presentation cervical stenosis and myelopathy

- PHYSICAL EXAM FINDINGS:
  - Cervical neck extension worsens symptoms due to canal compression
  - Exam of cervical nerve roots on neuromuscular exam
  - Gait assessment: often broad based and jerky
  - Lower extremity weakness more concerning and possible spasticity
  - Hyperreflexia in lower extremities can be absent if other peripheral nerve disease or lower lumbar stenosis
  - Lhermitte's sign: neck flexed and compressed sends electric shocks down spine
  - Hoffmann sign: snapping distal phalanx of middle finger leads to spontaneous flexion of other fingers
  - Sustained clonus greater than 3 beats
  - Babinski test: positive with great toe extension

## Cervical Radiculopathy versus Myelopathy

	RADICULOPATHY	MYELOPATHY
Neurological level affected	Typically 1	Greater than 1
Bilateral symptoms	Depends on specific root compression	Common
Motor deficit	Weakness or atrophy of specific innervated muscles	Diffuse weakness or disuse atrophy
Sensory	Decrease or change in specific dermatomal distribution	Diffuse or paresthesias
Reflexes	Hyporeflexic	Hyperreflexic
Gait	Not typically affected due to cervical pathology	Balance issues, wide based
Neurological findings	Pain along specific dermatome	Clonus, babinski sign
		Spine, C. Bono;2004;9. (14)



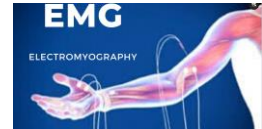
## Diagnosis Testing: Imaging

- MRI preferred imaging
- MRI with contrast indicated post surgical, tumor, infection
- CT without contrast evaluate bony elements of the spine
- CT Myelogram similar diagnostic capacity as MRI although more risk and more invasive
- Standing X-ray helpful for scoliosis, axial loading, degenerative disc disease
- Dynamic X-rays if spondylolisthesis to rule out instability
- Bone scans helpful for spinal metastatic disease, facet arthropathy, spondylolysis



## Diagnostic Testing: Electrodiagnostic Studies

- Inconclusive imaging or inconsistent physical exam
- Differentiate radiculopathy from peripheral neuropathy
- Example: cervical radiculopathy vs carpal tunnel
- Determine segmental level and acute vs chronic injury
- Distinguish spinal myelopathy from nerve root radiculopathy



## Management Options Spinal Stenosis

- Conservative Management
- Physical therapy
- Chiropractic care
- Acupuncture
- Activity modification
- Medication
- Interventional Management and Injection Therapy
- Surgical Interventions



## Physical Therapy

- Typically first step or other work up might be limited
- Goals of improved mobility, function and reduce pain
- Focus on core strengthening, posture, stretching, strengthening
- Cycling and aquatherapy good options especially if associated joint pain
- Balance and gait training to reduce fall risk
- Increase exercise tolerance
- Weight loss



## Physical Therapy Cervical Spinal Stenosis

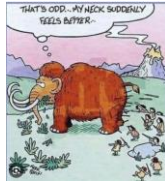
- Neck strengthening
- Balance and gait training
- Monitoring motor function and improving or declining strength
- Avoid cervical hyperextension
- Massage therapy
- Lifestyle modification
- Surgical consultation if any signs or symptoms of myelopathy





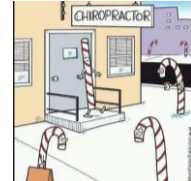
## Acupuncture

- Global market worth estimated \$24.55 billion in 2017 and was estimated to double in 7 years according to Marketwatch, 10/20/21
- Integrative medicine technique to restore balance and the body's qi or energy through meridians using acupuncture points
- Cost can often be a limiting factor since often not covered by insurance
- Can combine with other treatments



## Chiropractic care

- Complementary medicine approach for spinal pain
- Therapeutic adjustments and manipulations
- Coverage from many insurance plans

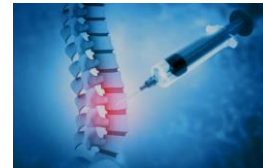


## Medication Management

- Many choices with many limitations
- Risk benefit ratio
- Polypharmacy
- Tylenol
- NSAIDS
- Neuropathic pain medications
- Muscle relaxants
- Opioids

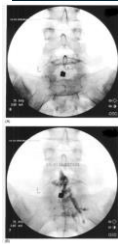
## Interventional treatment

- Injection Therapy:
  - Lumbar and Cervical Epidural Steroid Injections
  - Lumbar Transforaminal Epidural Steroid Injections
  - Lumbar and Cervical Facet Injections, Medial Branch Blocks and Ablation
  - Other joint injections
  - Trigger point injections
- Injections have both a diagnostic and therapeutic value



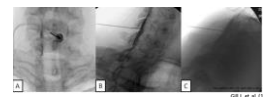
## Lumbar Epidural Steroid Injections

- Lumbar epidural steroid injections typically best for inflammatory radiculopathy
- Indications for pain and not necessarily for numbness or weakness
- Image guided injection to deposit a corticosteroid into the epidural space to reduce inflammation and swelling
- Approach can be translaminar or transforaminal
- Temporary relief might then allow the patient to participate in PT and other conservative care plan options or possibly reduce medication needs
- Risks of spinal injections include bleeding, infections, spinal injury, dural puncture.
- Also balancing risk for patients if need to hold anticoagulant medications prior to injections



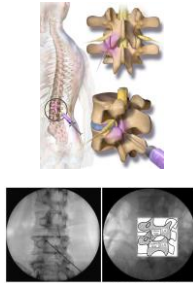
## Cervical Epidural Steroid Injection

- Indications: cervical pain with radiculopathy and a failure of conservative treatment
- It does not necessarily improve numbness or weakness
- Image guided injection most typically with fluoroscopy, local anesthetic and no or very minimal sedation.
- Cervical epidural space is very narrow and entry is typically in lower cervical levels
- Steroid can take 1-2 weeks for full effect
- Success with even 50% reduction in pain might allow the patient to progress with other conservative care options or reduce medication use
- Risk benefit ratio must be optimized for each patient
- This is an elective and not an emergent procedure



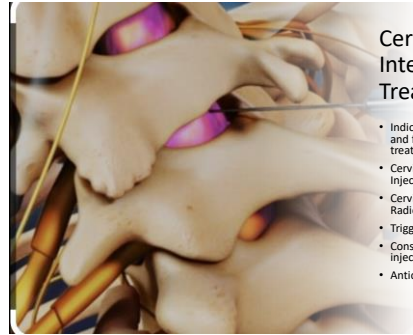
## Lumbar Facet Injections

- Diagnostic to help differentiate axial low back pain originating from spinal stenosis from low back pain originating from facet arthropathy
- Injections have diagnostic and therapeutic value
- If a patient has greater than 80% improvement with diagnostic injections, they could be considered a candidate for radiofrequency ablation.
- RF of the sensory nerves which innervate the facet joints can offer a potentially longer period of pain relief
- 2024 has encountered many insurance obstacles especially with Medicare for prior authorizations for facet procedures



## Cervical Interventional Treatment

- Indications are typically for pain and failure of more conservative treatment
- Cervical Epidural Steroid Injections
- Cervical Facet Injections and Radiofrequency Ablation
- Trigger point injections
- Consider risk benefit ratio of injections
- Anticoagulation concerns



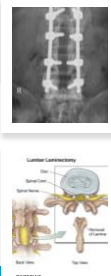
## Surgery Lumbar Spinal Stenosis

- Indications:
- Progressive neurological dysfunction with radiculopathy
- Bowel and or bladder dysfunction
- Failure of conservative care for intractable back pain due to spinal stenosis
- Surgery does NOT always improve back pain
- Other spinal pathology will affect surgical planning, spondylolisthesis, scoliosis or previous surgery



## Surgery Lumbar Spinal Stenosis

- Laminectomy with or without fusion
- Spinal stenosis associated with other spinal deformity or instability is more complicated, including degenerative spondylolisthesis, instability after laminectomy, scoliosis or kyphosis



## Complex Lumbar Spine Surgery

- Patient with spinal stenosis, spondylosis with radiculopathy
- Scoliosis
- Spinal decompression and instrumented fusion with corrective surgery



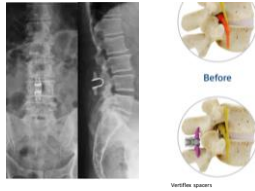
## MILD Procedure

- Minimally invasive lumbar decompression done percutaneously to debulk the hypertrophied ligamentum flavum
- Using fluoroscopic imaging to visualize an epidurogram of contrast flow to assess the amount of decompression of the spinal canal
- Procedure done outpatient with local anesthesia and option of sedation
- Does not preclude future surgery if needed



## Interspinous and Interlaminar Spacers

- Implants/spacers which stabilize or distract the adjacent lamina and/or spinous processes
- Restrict extension to reduce pain with spinal stenosis
- Interspinous spacers implanted between the spinous processes and then expanded to expand space between foramen
- Interlaminar spacers implanted midline between adjacent lamina either with or without decompression surgery



## Spinal Surgery Cervical

- Anterior and posterior approaches
- With and without stabilization or fusion



## CASE STUDIES REVIEW



## #1 Case Study: Lumbar Spinal Stenosis

- 39 year old golfer with axial back pain
- Severe L3-4 spinal stenosis due to congenital stenosis with a disc protrusion
- **MANAGEMENT:**
- LESI with marginal success of axial LBP but improvement of radiculopathy
- Great results with lumbar facet injections giving 80% improvement in axial pain for greater than 6 months.
- Consider radio frequency ablation for axial LBP and facet arthropathy
- Conservative care and PT improved radiculopathy symptoms
- No surgical referral needed at this time



## #2 Case Study: Lumbar Spinal Stenosis

- 81 year old male with severe ddd and severe spinal stenosis with previous laminectomy
- Lumbar radiculopathy and neurogenic claudication
- **MANAGEMENT:**
- Failure of conservative care with 6 weeks of physical therapy
- Lumbar ESI very helpful with resolution of his symptoms
- Patient has returned to an active walking schedule
- No current surgical referral needed at this time
- Neurogenic claudication resolved



## #3 Case Study: Lumbar Spinal Stenosis

- 72 year male retired contractor and an avid golfer
- Further evaluation with repeat MRI imaging showing severe spinal stenosis at L3-4 and L4-5
- Diagnosis spinal stenosis with neurogenic claudication
- **MANAGEMENT:**
- Successful treatment with LESI giving him 80% improvement for 3-4 months and able to participate in PT and return to golf for almost 2 years.
- Symptoms have now progressed with difficulty standing short period of time, increasing bilateral leg pain, unable to stand straight, weakness 4/5 quad bilaterally, gait disturbance and balance issues
- Failure of LESI injections with only 50% improvement for only several weeks
- Vascular workup negative since history PVD
- Severe multilevel spinal stenosis with neurogenic claudication
- Recommendations for surgical evaluation
- Surgical consultation: Plans for posterior lumbar decompression and instrumented fusion L3-5 next month



## #4 Case Study: Cervical Spinal Stenosis

- 73 year old woman with 2 years of cervical pain and intermittent radiculopathy
- Cervical MRI with severe spinal stenosis and severe foraminal stenosis
- MANAGEMENT:**
- Neurosurgical consultation
- No symptoms of myelopathy
- Radiculopathy resolved with conservative care
- VNS 3-4/10 consider acupuncture , massage PT
- Consider injection therapy and possible cervical facet injection for left cervical pain if escalates
- Consider CESI for left C6 radiculopathy if returns
- Follow in 6 months to monitor spinal stenosis



## #5 Case Study: Cervical Spinal Stenosis

- 79 year female with a history of both lumbar spinal stenosis and severe cervical spinal stenosis
- Bilateral upper extremity weakness and numbness
- Progressive gait instability and balance
- L'hermittes sign
- Failure of conservative care
- MANAGEMENT:**
- URGENT surgical assessment
- Posterior cervical laminoplasty and decompression



### CONCLUSIONS

- There are some amongst us that continue to defy the aging process.
- At 81 years old last summer Mick Jagger continued to jump, dance and perform without any obvious signs of stenosis or slowing down.

THANK YOU!



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