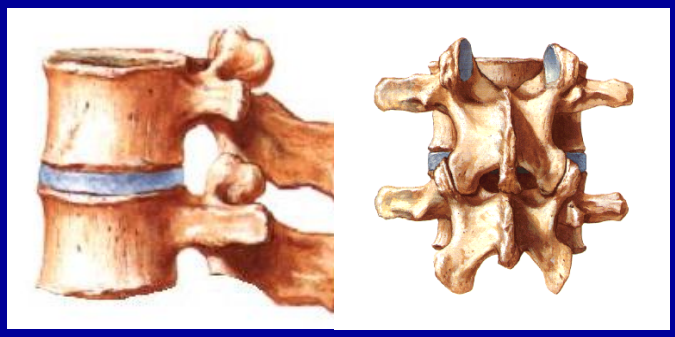
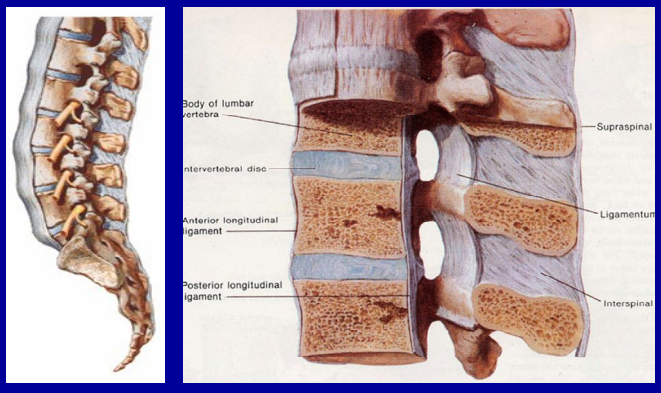
Lumbar Spine Motion Segment

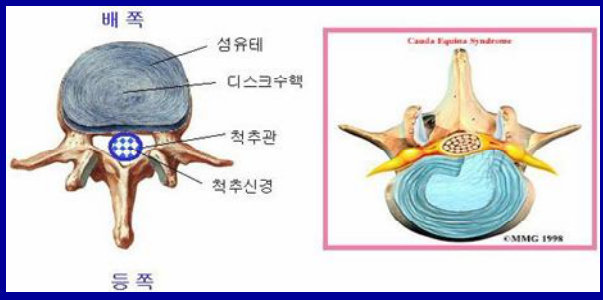
- Three joint complex
- Intervertebral disc + 2 facet joint
- Ligamentous structure, vertebral body





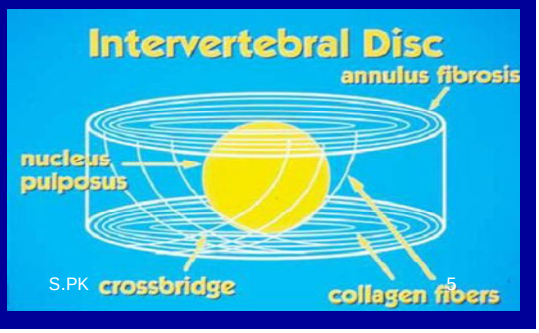
Intervertebral Disc

- Hydrostatic, load bearing structure between the vertebral bodies
- Nucleus pulposus + annulus fibrosus
- No blood supply
- L4 - 5, largest avascular structure in the body



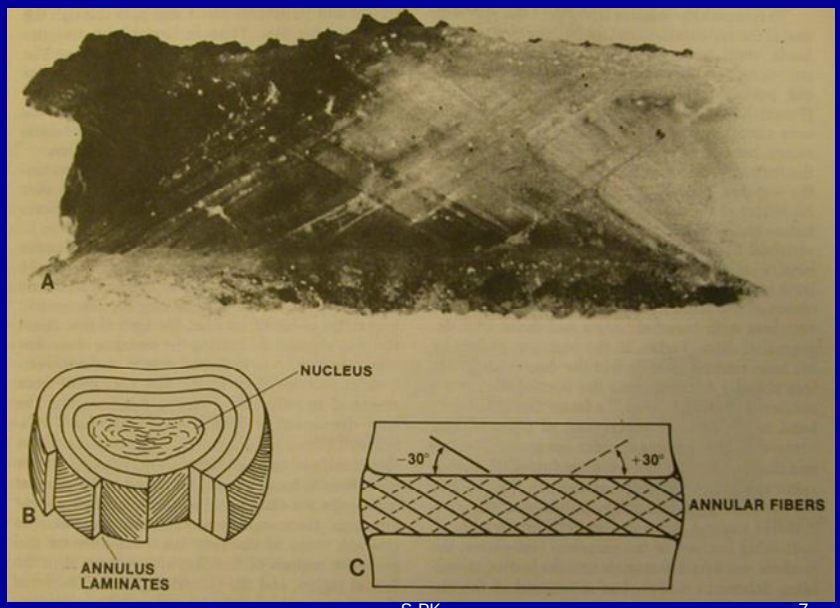
Nucleus Pulposus

- Type II collagen strand + hydrophilic proteoglycan
- Water content 70 ~ 90%
- Confine fluid within the annulus
- Convert load into tensile strain on the annular fibers and vertebral end - plate
- Chondrocyte manufacture the matrix component



Annulus Fibrosus

- Outer boundary of the disc
- More than 60 distinct, concentric layer of overlapping lamellae of type I collagen
- Fibers are oriented 30 - degree angle to the disc space
- Helicoid pattern
- Resist tensile, torsional, and radial stress
- Attached to the cartilaginous and bony end - plate at the periphery of the vertebra



Vertebral End-Plate

- Cartilaginous and osseous component
- Nutritional support for the nucleus
- Passive diffusion

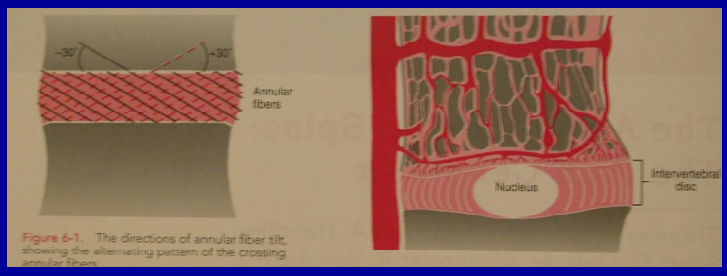
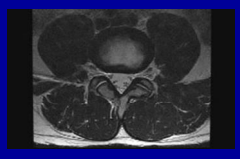


Figure 6-1. The directions of annular fiber tilt, showing the alternating pattern of the crossing annular fibers.

Facet Joint

- Synovial joint
- Rich innervation with sensory nerve fiber
- Same pathologic process as other large synovial joint
- Load share 18% of the lumbar spine



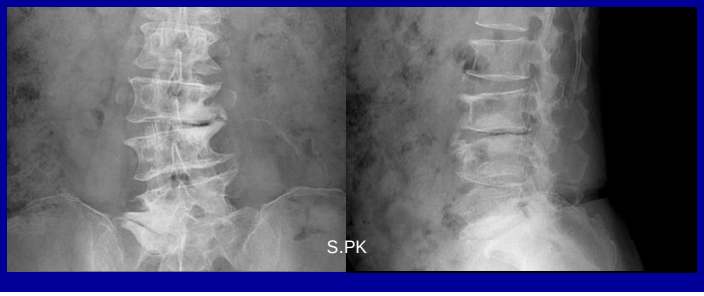
Spondylosis

- Generalized process of the axial skeleton
- Sequence of degenerative change
- Start biochemical and cellular level
- Manifest biomechanical and morphologic level

Initiating Factor in Degenerative Cascade

- Injury to annulus fibrosus
- Matrix composition alteration of the nucleus pulposus
- Vascularity and permeability change of end - plate

- Primary causitive agent??
- The process of disc degeneration is multifactoral



Disc Degeneration

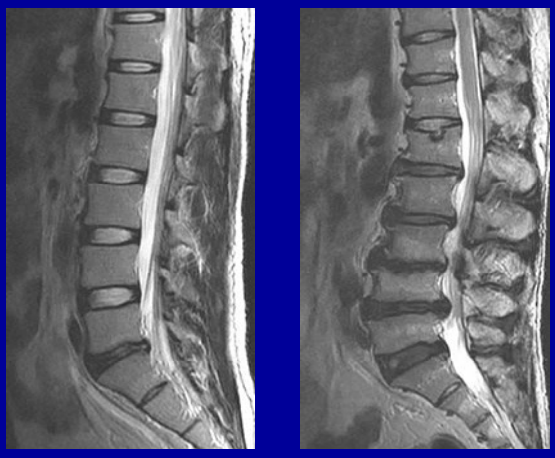
- Environmental factor
- Genetic predisposition
- Normal aging process

* Biomechanical stress
  → Degeneration of soft tissue and bone
  → progressive morphologic change

Intervertebral Disc

Cellular and Biochemical Change

- Decrease proteoglycan content
- Loss of negative charged proteoglycan side chain
- Water loss within the nucleus pulposus
- Decrease hydrostatic property
- Loss of disc height
- Uneven stress distribution on the annulus

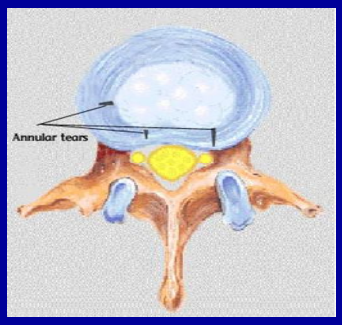


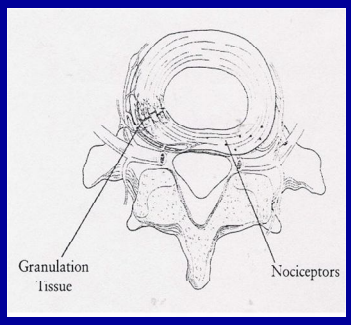
Morphologic Changes

- bulging of the annulus fibrosus
- radial tear
- in-growth of granulation tissue in the annulus
- annular defect, cleft and fissure
- cellular necrosis → loss of distinction between the nucleus and annulus
- focal extrusion of disc material

Aging Progress

- disc become more fibrous and disorganized
- replaced by amorphous fibrocartilage
- no clear distinction between nucleus and annulus
- gas formation and vacuum disc sign





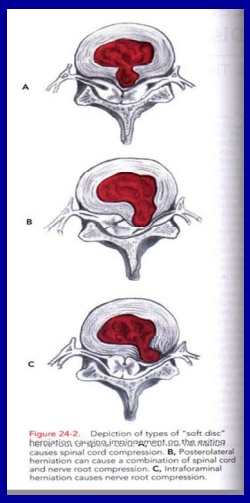
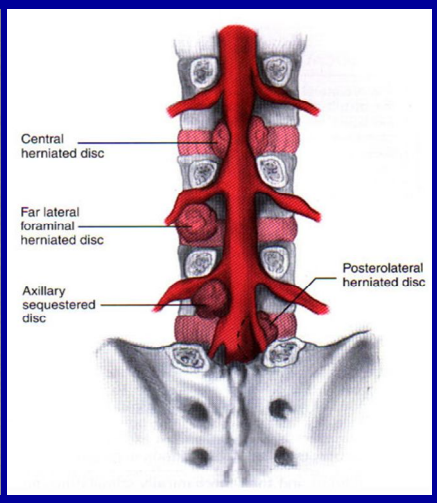
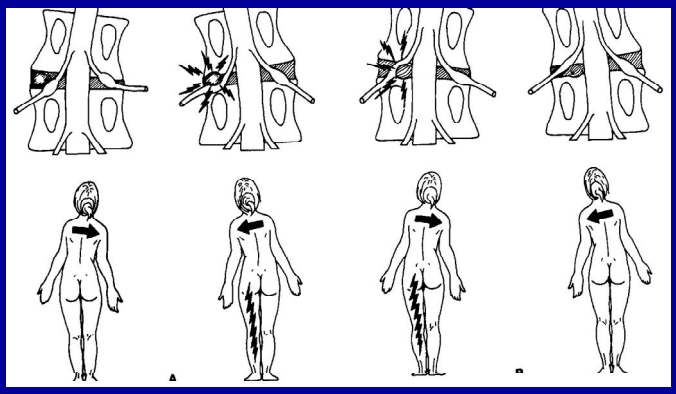


Figure 24-2. Depiction of types of "soft disc" herniation. **A,** Posterolateral herniation causes spinal cord compression. **B,** Posterolateral herniation can cause a combination of spinal cord and nerve root compression. **C,** Intraforaminal herniation causes nerve root compression.

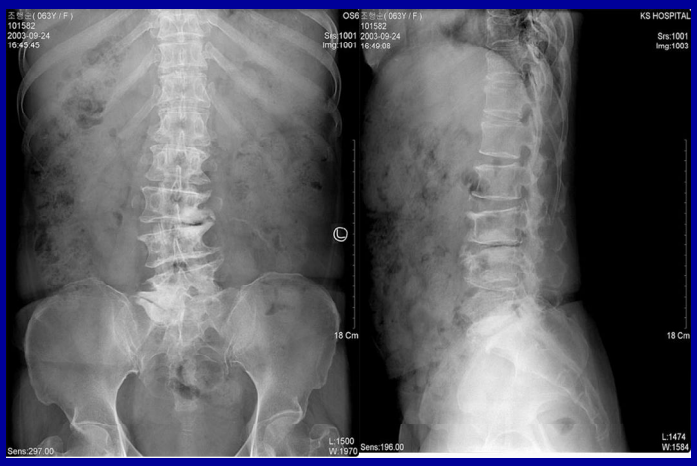


Pain and movements



Vertebral End-Plate

- Become thinner and hyalinized
- Decrease permeability
- Inhibit nucleus metabolism
- Disc space narrowing
- Osteophyte formation at the end-plate and annular junction
- Marrow change with increased axial loading
- Subluxation and instability

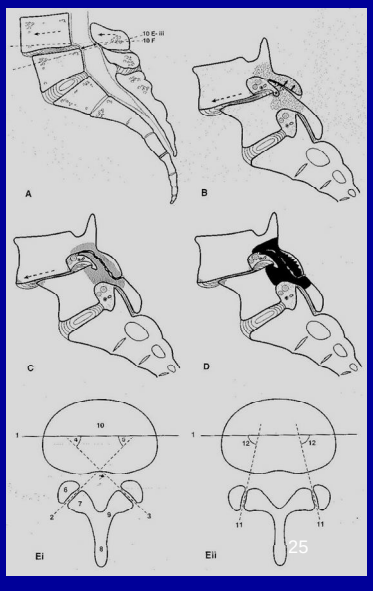


Facet Joint

Disc height reduction →

- Facet joint capsule become lax
- Increased load transfer to the facet joint
- Accelerate degeneration
- Joint subluxation, hypertrophy, osteophyte formation

** Primary disc degeneration
→ Secondary change in the posterior facet joint and soft tissue



Lumbar Disc Disease

Discogenic Back Pain

A. Internal Disc Disruption (IDD)
B. Degenerative Disc Disease (DDD)
C. Segmental Instability

Lumbar Disc Herniation and Radiculopathy

Lumbar Disc Herniation

How pain is generated?

- Inflammatory
- Biochemical
- Vascular
- Mechanical compression

Inflamation

- Central role in radiculopathy
- Olmarker(1995, spine)
  Epidural application of autologous nucleus without any pressure
  → Nerve function impairment
  → Axonal injury with significant primary cell damage
- Nucleus is totally avascular
  → Perceived as an antigen
  → Intense inflammation response
- Application of annulus fibrosus
  → No reduction of nerve conduction velocity

Biochemical Effect

- Nuclear herniation
  → Incsease phospolipase A2, prostaglandin E2 cytokine, nitric oxide
- Disc herniation and sciatica
  → Neurofilament protein and S-100 increase in CSF
  → Axonal and Schwann's cell damage

Mechanical Compression

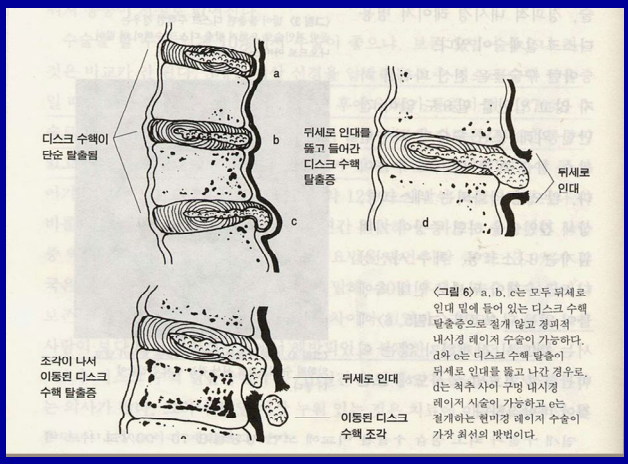
- Local damage and intraneural ischemia

Vascular Pathophysiology

* Application of nucleus pulposus to nerve root
  → increase endoneurial pressure
  → decrease blood flow in the dorsal root ganglia
  → compartment syndrome

Clinical Anatomy

- Disc injury
  - annular disruption, fissuring, annular defect
- Contained herniation
  Noncontained herniation
  Extruded
  Sequestrated
- L4 - 5 and L5 - S1 herniation most common
  - 90% of disc herniation
  - Great axial load, lordotic shear



〈그림 6〉 a, b, c는 모두 뒤세로 인대 밑에 들어 있는 디스크 수핵 탈출증으로 절개 않고 경피적 내시경 레이저 수술이 가능하다. d와 e는 디스크 수핵 탈출이 뒤세로 인대를 뚫고 나간 경우로, d는 척추 사이 구멍 내시경 레이저 시술이 가능하고 e는 절개하는 현미경 레이저 수술이 가장 최선의 방법이다.

History

- symptom of disc herniation : acute or gradual
- after trauma or without and inciting event
- most common 3rd and 4th decade

Chief Complain

- Pain, radiating from the back or buttock into the leg
- Numbness and weakness
- Sharp, lancinating, shooting/radiating down the leg posteriorly below the knee
- Coughing, Valsalva maneuver → increase intracecal pressure → increase pain
- Sitting position, driving → out of lordosis → increase intradiscal pressure → increase pain

Sciatica

- radiating pain down the leg

Radiculopathy

- radiating pain down the leg as a result of nerve root irritation

Back Pain

- irritation of the posterior primary ramus
  - facet capsule, local musculature
- sinuvertebral branch - posterior annulus
- change in disc loading and shape, biomechanics
- loss of viscoelasticity.
- 90% of radiating pain have long-standing prior episodic low back pain

Quality of pain and associated symptom

- dullache or sharp, stabbing pain?
- eletricity, tingling, numbness, shooting down the leg?
- any associated weakness?
- dose anything make the pain better or worse?
- forward flexion or hyperextension exacerbate or relieve pain?
- standing more comfortable than sitting?

** Back pain abated when leg pain developed
→ relief of annular tensile stress, nerve root irritation
** Isolated leg pain → acute disc extrusion

Differential Diagnosis

Vascular claudication

- Vascular assessment and flow study
- Dorsalis pedis palpation

Spinal stenosis

- leg pain, dysesthesia, paresthesia, often not dermatomal
- pain d/t mechanical compression of spinal canal and foramen
- lordosis and axial loading
- symptomatic on walking, relief by sitting

Thrombophlebitis

Metabolic and peripheral neuropathy

Physical Examination

Inspection

- Old scar, muscle spasm, cutaneous stigma, spinal alignment, loss of lordosis

Palpation

- Midline, sciatic notch, iliac crest, SI joint, coccyx
- Paraspinal tenderness, rigidity
- Costovertebral angle, abdomen
- Kidney, stone, retroperitoneal abnormality

Hip pathology

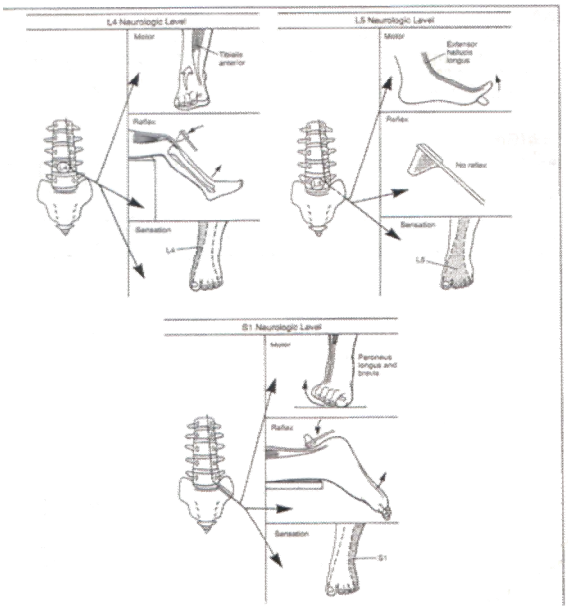
- Patrick test

Skin

- Temperature and atrophic change

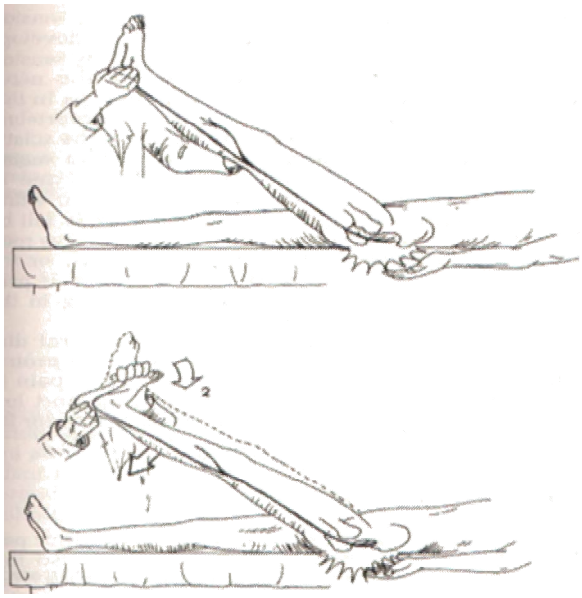
Neurologic Examination

Root	Sensory	Motor	Reflex
L-1	Groin		—
L-2	Anterior thigh	Iliopsoas	—
L-3	Lateral thigh/knee	Quadriceps	—
L-4	Medial leg (postero-lateral thigh, across patella, anteromedial leg)	Anterior tibialis, quadriceps	Patella
L-5	First dorsal web space; medial foot (posterior thigh, anterola-teral leg, medial foot, and great toe)	Extensor hallucis longus; extensor digitorum lon-gus and brevis, gluteus medius	None (post-tibialis)
S-1	Lateral foot (poste-rior thigh and leg, posterolat-eral foot, lateral	Gastrocnemius; peroneus lon-gus and brevis, gluteus maximus	Achilles



Root Tension Signs

- Straight - leg raising : L5, S1 root
- Contralateral SLR : sequestrated or extruded disc
- Femoral stretching, reverse SLR : L3, L4 root



Diagnostic Test

Simple x - ray

- Disc space narrowing

MRI(magnetic resonance imaging)

- Disc pathology, neural structure, musculoligamentous structure
- Soft tissue edema, hematoma, intrinsic cord abnormality
- Synovial cyst, neurofibroma, perineural cyst
- 30% of asymptomatic individual have abnormal MRI

CT, Myelography


Nonoperative Treatment

- 90% of patient improve with conservative treatment
- Short - term rest, NSAID, analgesics, antispamodic medication, exercise
- Physical therapy
- Oral corticosteroid

** Conservative treatment should continue for 6weeks, before other measure are attempted

Indication of Surgery

Ideal candidate

- history, physical examination, radiographic finding, are consistent with one another
- when discrepancy exist, the clinical picture should serve as the principal guide.

Absolute surgical indication

- cauda equina syndrome
- acute urinary retension/incontinence,
  saddle anesthesia, back/buttock/leg pain, weakness, difficulty walking

Relative indication

- progressive weakness
- no response to conservative treatment

Best predictive factor

1. persistent leg pain, that fail to respond to a 6-week trial of nonoperative care
2. well-defined neurologic deficit
3. positive SLR test
4. positive imaging that correlates anatomically to clinical findings

** 3 of these factor, at least 90% success rate

Other factors

- duration of sciatica, sick leave stress, depression, level of education, work/disability