Segmental Instability

Segmental instability refers to the loss of the normal pattern of motion between two adjacent vertebrae, leading to abnormal movement under physiological loads. It typically involves:

- **Excessive translation** or angulation of one vertebra relative to another
- **Failure of stabilizing structures**, including intervertebral discs, ligaments, facet joints, and musculature
- **Symptoms** may include mechanical back pain, neurological compression, or spinal deformity

It is often evaluated using **dynamic flexion-extension radiographs**, and is a key concept in conditions like:

- Degenerative spondylolisthesis
- Isthmic spondylolysis
- Post-laminectomy instability

Diagnosis

The diagnosis of **segmental instability** involves a combination of clinical assessment and imaging studies.

Clinical Features

- Mechanical back or neck pain exacerbated by movement or prolonged posture
- Possible radiculopathy or neurogenic claudication
- Sensation of “giving way” or spinal locking/unlocking
- Instability catch or painful arc on motion

Imaging Criteria

1. Dynamic Radiographs (Flexion–Extension X-rays)

- **Lumbar spine:**
  - > 4 mm of translation
  - > 10–15° of angular motion (L1–L5), > 20° at L5–S1
- **Cervical spine:**
  - > 3.5 mm of translation
  - > 11° of angular motion between adjacent vertebrae

2. MRI

- Disc degeneration or high-intensity zone (HIZ)
- Facet joint effusion (correlates with instability)

- Ligamentous disruption (e.g., interspinous ligament)

3. CT Scan

- Pars defects (in spondylolysis)
- Osteophytes or vacuum phenomena (suggest segmental hypermobility)

4. Functional Tests

- Standing vs supine MRI
- Upright dynamic MRI (where available)

Diagnostic Criteria

Instability is diagnosed when there is:

- Abnormal segmental motion beyond physiological limits
- Correlation with clinical symptoms
- Structural or dynamic evidence of failure of spinal stabilizers