Lumbar canal stenosis

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Stenosis – “being narrow”

A radicular syndrome from developmental narrowing of the lumbar vertebral canal.

- Verbiest H. JBJS (Br) 1954; 36-B: 230-237
<table>
<thead>
<tr>
<th>AGE</th>
<th>WIDTH (cm)</th>
<th>A-P (cm)</th>
<th>HEIGHT (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neonate</td>
<td>1.0</td>
<td>1.0</td>
<td>0.8</td>
</tr>
<tr>
<td>1 year</td>
<td>1.7</td>
<td>1.5</td>
<td>1.7</td>
</tr>
<tr>
<td>1 ½ years</td>
<td>1.6</td>
<td>1.5</td>
<td>1.8</td>
</tr>
<tr>
<td>3 years</td>
<td>1.8</td>
<td>1.5</td>
<td>2.0</td>
</tr>
<tr>
<td>5 years</td>
<td>1.8</td>
<td>1.5</td>
<td>3.3</td>
</tr>
<tr>
<td>12 years</td>
<td>1.8</td>
<td>1.5</td>
<td>3.5</td>
</tr>
<tr>
<td>Adults</td>
<td>2.1</td>
<td>1.7</td>
<td>3.9</td>
</tr>
<tr>
<td>Multiple of birth dimension</td>
<td>x 2</td>
<td>x 1.7</td>
<td>x 5</td>
</tr>
</tbody>
</table>

- Cross sectional area and mid-sagittal diameter of L1 to L4 - **Mature by 1 yr**
- L5 canal size matures by 5 years

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Canal area and mid-sagittal diameter similar in infants and adults
Space available for neural structures

Absolute stenosis – mid-sagittal diameter < 10 mm

Relative stenosis - 10 – 13 mm

- **Transverse area of dural sac** (more reliable)
  - < 100 mm² is absolute stenosis
  - 100-130 mm² is relative stenosis
  - > 130 mm² is normal

- **Lateral recess** - < 3 mm is absolute stenosis
  - 3 – 5 mm is relative stenosis
Classification:

Based on -

- Etiology
- Location of stenosis
Primary **stenosis** — Small original canal

1. **Congenital**
   a. Spinal dysraphism
   b. Failure of vertebral segmentation

2. **Developmental**
   a. Inborn errors of bone growth
   b. Idiopathic
     1. Bony hypertrophy of arch
     2. Absence of bony hypertrophy

1. Achondroplasia
2. Morquio disease
3. Multiple exostosis
Acquired stenosis – Normal original canal

- Degenerative
- Congenital + degenerative
- Iatrogenic
- Post – traumatic
- Miscellaneous
Miscellaneous

- Pagets disease
- Fluorosis
- DISH
- Hyperostotic lumbar spinal stenosis
- Oxalosis
- Pseudogout
Classification - Location of stenosis

- Central canal
- Lateral recess
- Foramen

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Disc degeneration

- Disc space reduces
  - Foraminal narrowing (up down)
  - Ligamentum flavum buckling

- Posterior bulging of disc and osteophytes

- Increased facetal stresses and movement
  - Facetal osteophytes

Disc pathology is the first stage in the degeneration cascade in a majority
Facet degeneration and synovitis

Thinning of facet cartilage and loosening of the capsule

Increased spinal movement and disc degeneration

Auto-stabilising facet osteophytes

Canal narrowing - superior facet osteophytes – lateral recess
- inferior facet osteophytes - central
Clinical features

**Disease of symptoms**

- **Neurogenic claudication**
- Back, buttock, thigh and calf pain – usually B/L
- Pain on standing and walking and relieved by sitting / lying with hips flexed
- **Neurological symptoms and signs**
## Table 2. Frequency of symptoms in patients with lumbar spinal stenosis

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Count (Percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numbness/tingling</td>
<td>50 (66.6)</td>
</tr>
<tr>
<td>Back pain</td>
<td>47 (62.7)</td>
</tr>
<tr>
<td>Neurogenic claudication</td>
<td>46 (61.3)</td>
</tr>
<tr>
<td>Weakness of the lower limbs</td>
<td>45 (60.0)</td>
</tr>
<tr>
<td>Radicular pain</td>
<td>35 (46.7)</td>
</tr>
<tr>
<td>Unsteadiness</td>
<td>15 (20.0)</td>
</tr>
<tr>
<td>Bladder symptoms</td>
<td>10 (13.3)</td>
</tr>
<tr>
<td>Bowel symptoms</td>
<td>4 (5.3)</td>
</tr>
</tbody>
</table>

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The Clinical Syndrome Associated with Lumbar Spinal Stenosis

Khean Jin Goh\(^a\)  Waël Khalifa\(^b\)  Philip Anslow\(^b\)  Tom Cadoux-Hudson\(^c\)
Neurogenic claudication

The onset of pain, tension and weakness upon walking in one or both legs progressively increasing until walking becomes impossible and subsequent disappearance of symptoms after a period of rest.

-Verbiest
Space for cauda equina reduces by 40 mm² (16 %)

Extension or rotation decreased the sagittal diameters and cross-sectional areas of the dural sac and spinal canal and increased the thickness of the ligamentum flavum, whereas flexion had the opposite effects.

Chung SS, Lee CS, Kim SH

Skeletal Radiol. 2000
Activities providing pain relief

Shopping cart test

Bicycle test
Two level central stenosis or a central stenosis with a root canal stenosis

90% with claudication had > 2 levels with dural cross-section below 100 mm²

Hamanishi et al 1994
Two level stenosis

Veins of root drain distally through foramen or proximally to the conus.

Two level block → congestion and pooling

Arterioles continue to feed the segment + Impaired drainage, ↓ blood flow, O2 and nutrition → Buildup of metabolites in the uncompressed segment
Central stenosis –
- B/L symptoms
- Non – dermatomal
- Paraesthesias
- Weakness is rare

Lateral recess stenosis -
- Usually unilateral
- Dermatomal distribution
- Neurological symptoms and signs more common
<table>
<thead>
<tr>
<th>Neurogenic</th>
<th>Vascular</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Pulses</td>
<td>+</td>
</tr>
<tr>
<td>2. Walk distance</td>
<td>Variable</td>
</tr>
<tr>
<td>3. Palliative factors</td>
<td>Bending</td>
</tr>
<tr>
<td>3. Provocative</td>
<td>Downhill</td>
</tr>
<tr>
<td>4. Neuro exam after walking</td>
<td>+</td>
</tr>
<tr>
<td>5. Bicycle test</td>
<td>No pain</td>
</tr>
<tr>
<td>6. Pain</td>
<td>Crampy</td>
</tr>
<tr>
<td>7. Atrophy</td>
<td>Uncommon</td>
</tr>
<tr>
<td>8. Back pain</td>
<td>Common</td>
</tr>
<tr>
<td>9. Back motion</td>
<td>Limited</td>
</tr>
</tbody>
</table>
Imaging – Plain Radiograph

**Congenital stenosis**
- Interpedicular distance – Achondroplasia
- Short pedicles – Developmental stenosis

**Degenerative stenosis**
- Spondylophytes / Hypertrophic facets
- Degenerative listhesis / Scoliosis
- Instability
- Post traumatic / Postoperative changes

- CT Myelogram
- MRI

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Tandem stenosis

Incidence - 5 – 25 %

- Intermittent claudication
- Gait disturbance
- Combined UMN and LMN signs

Concomitant hip and knee arthritis
Surgical versus nonsurgical therapy for lumbar spinal stenosis

- 289 patients - randomized cohort and 365 - observational cohort.

- Combined as-treated analysis, surgical patients showed significantly more improvement in all primary outcomes

Natural history of LCS

27 patients followed over 4 years

- 70 % – Unchanged
- 15 % - Improved
- 15 % - Worsened (no serious sequelae)


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Long-Term Outcomes of Surgical and Nonsurgical Management of Lumbar Spinal Stenosis: 8 to 10 Year Results from the Maine Lumbar Spine Study

Atlas SJ, Deyo RA et al. Spine 2005

A prospective observational cohort study.

148 patients (Surgery- 81) (Conservative – 67)

- One yr and four yr – Results of surgery were better
- 8-10 years - leg pain relief and back-related functional status continued to favor surgical group.
What can we infer from the natural history?

- A majority of the patients remain the same
- Some improve
- A few deteriorate
How does it affect clinical decision making?

- **Severe symptoms**
  - Surgery

- **Deteriorating symptoms**
  - Surgery

- **Mild/moderate symptoms**
  - Conservative treatment
Surgical principles

Decompression

- Laminectomy
- Laminotomy

Endpoint of surgery
- Mobile nerve roots
THANK YOU

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