Anterior Approaches for Lumbar Interbody Fusion

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Anterior Techniques

- ALIF
- Lateral transpsoas approaches (XLIF/DLIF)
Anterior Approaches - Contraindications

• ALIF
  • Contraindications
    • Calcified aorta
    • Prior vascular reconstructive surgery
    • Prior intra-abdominal or retroperitoneal surgery
    • History of severe pelvic inflammatory disease
    • Prior anterior spinal surgery

• Transpsoas
  • Contraindications
    • At L5/S1 and sometimes at L4/5 because of obstruction from iliac crest
    • Prior retroperitoneal surgery or scarring
Clinical Presentation DDD

• 20 -50 year-old, recurrent or persistent back pain

• Pain
  • Dull ache in lower back
  • Often involves buttocks and sacroiliac joints
  • Exacerbated with flexion
  • Worsened with prolonged sitting or walking
  • Radiculopathy may be seen late in disease due to disc collapse
  • Claudication only seen with concomitant stenosis

• Exam
  • Decreased back range of motion, flexion
  • Paraspinal muscle and sacroiliac joint tenderness
  • Normal sensorimotor exam
  • Normal reflexes
  • Generally negative straight leg raise
Radiographic Findings DDD

- Plain X-rays
  - Disc space narrowing
  - Endplate sclerosis
  - Osteophytes
  - Advanced – secondary spondylolisthesis
Radiographic Findings DDD

• MRI
  • “High intensity zone” (annular tear)
    • Radial tear from nucleus to outer posterior annulus
  • Dark disc
  • Endplate signal changes (Modic)
    • Stage I - edema
      • Dark on T1, bright on T2
    • Stage II - fatty degeneration
      • Bright on T1, intermediate on T2
    • Stage III – advance degenerative changes and endplate sclerosis
      • Dark on T1 and T2

January 2003

- Committee formed by the leadership of the American Association of Neurological Surgeons and Congress of Neurological Surgeons Joint Section on Disorders of Spine and Peripheral Nerves

- 12 orthopedic and neurosurgical spine surgeons active in the Joint Section and/or North American Spine Society

- Perform an evidence-based review of the literature on lumbar fusion for degenerative spine disease and formulate treatment recommendations
One or Two-Level Degenerative Disease without Stenosis or Spondylolisthesis

- **Standard**
  - Lumbar fusion recommended for patients with disabling low back pain due to one or two-level degenerative disease without stenosis or spondylolisthesis

- **2001 Fritzell et al.**
  - 294 surgical candidates randomized; 2-year follow-up
  - PT, education, pain relieving measures vs. PLF, PLF + pedicle screws, or interbody fusion + PLF + pedicle screws

  - Surgical group statistically significant better results in:
    - Outcome measures (pain VAS, ODI, Million VAS, GFS)
    - Return to work status
    - Patient satisfaction
    - Independent analysis by second spine surgeon

- **Option**
  - Intensive physical therapy and cognitive therapy
Fusion for DDD

- Posterolateral fusion
  - Patients with some level of residual discogenic pain due to micromotion

Eur Spine J. 2008 December; 17(Suppl 4): 428–431
Fusion for DDD

- **Interbody techniques**
  - Remove pain generator

- Large surface area for fusion where majority of spinal load bearing occurs
  - 90% of the surface area
  - 80% of the load

- Compressive force through graft

- Correction coronal and sagittal alignment
History – Minimally Invasive Spine Surgery

1829: Lumbar Laminectomy for Discectomy (Smith)
1893: Lumbar Laminectomy for Stenosis (Lane)
1911: Lumbar Fusion (Albee, Hibbs)
1925: Cervical Laminectomy for Discectomy (Elsberg)
1933: Anterior Lumbar Interbody Fusion – ALIF (Burns)
1939: Internal Spine Fixation (Hadra)
1952: Posterior Lumbar Interbody Fusion – PLIF (Cloward)
1955: ACDF (Robinson)
1958: ACDF (Cloward)
1966: Lumbar Artificial Disc Replacement – ADR (Fernstrom)
1967: Lumbar Microdiscectomy (Yasargil)
1982: Transforaminal Interbody Fusion – TLIF (Harms)
1983: Thoracic Discectomy (Benjamin)
1969: Chymopapain Chemonucleolysis (Smith)
1975: Percutaneous Nucleotomy (Hijikata)
1982: Percutaneous Pedicle Screws (Magerl)
1984: Laser Percutaneous Discectomy - LPD (Ascher)
1985: Automated Percutaneous Lumbar Discectomy - APLD (Maroon, Onik)
1987: Lumbar Arthroscopic Discectomy (Kambin)
1987: Vertebroplasty (Galibert)
1991: Laparoscopic Anterior Lumbar Discectomy (Obencahn)
1993: Percutaneous Facet Fusion (Wang)
1994: MIS-Thoracic Discectomy (Horowitz)
1995: MIS-ALIF (Mathews, Zucherman)
1997: Microendoscopic Discectomy - MED (Foley)
1998: Lateral Transpsoas Approach-DLIF, XLIIF (McAfee, Pimenta)
1999: MIS-Cspine-odontoid Screw Placement (Horgan)
2000: Intradiscal Electrothermy - IDET (Saul)
2000: MIS-Cervical Laminoforaminary (Roh)
2000: Kyphoplasty (Wong)
2001: Sextant Percutaneous Pedicle Screw System (Foley)
2002: MIS-Lumbar Laminectomy for Stenosis (Guiot, Khoo, Palmer)
2002: MIS-PLIF (Khoo)
2003: Tubular Discectomy using Microscope-METRX (Foley)
2004: Transaxial Approach (Cragg)
2004: MIS-Cervical Laminoplasty (Perez-Cruet)
2006: Interspinous Device-XSTOP (Kondrashov)
2006: MIS-TLIF (Holly)
2008: MIS-ACDF (Ruetten)
2008: MIS-Cervical Nucleoplasty (Li)

Oppenheimer et al Neurosurg Foc 2009
Technical Goals LIF

- Complete discectomy
- Place large graft
  - Restoration of disc height
    - Indirect decompression
  - Restablish/maintain lordosis
  - Maximize surface area for fusion
  - Minimize risk of subsidence
PLIF/TLIF

- Posterior interbody techniques (PLIF TLIF)
  - Problems
    - Muscle dissection, denervation
      - Acute postop pain
        - Blood loss
        - Longer length of stay
        - Narcotic requirements
        - Limited postop mobility
          - Perioperative complications
      - Chronic dysfunction
        - Muscle atrophy
        - Core deconditioning
        - Chronic pain
• Posterior interbody techniques (PLIF TLIF)

• Problems

  • Limited window to disc space
    • Thecal sac/nerve root retraction
    • Weakness (2-7%)
    • Postop neuralgia (5%)

• Dural tears (5-20%)
• Posterior interbody techniques (PLIF TLIF)

• Problems

• Graft size vs. nerve root injury vs endplate fracture
  • Suboptimal restoration of disc height and surface area for fusion

• Poor visualization of disc space/endplates
  • Limited endplate preparation for fusion
  • Endplate damage/fractures graft subsidence

• Time

• Blood loss
## Comparison Implant Dimensions

<table>
<thead>
<tr>
<th>IMPLANT TYPE</th>
<th>HEIGHT (mm)</th>
<th>ANTERO-POSTERIOR (mm)</th>
<th>MEDIO-LATERAL (mm)</th>
<th>LORDOSIS (degrees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>XLIF</td>
<td>8 – 16</td>
<td>18 - 26</td>
<td>45 - 60</td>
<td>0 - 10</td>
</tr>
<tr>
<td>ALIF</td>
<td>10 - 20</td>
<td>23 - 30</td>
<td>32 - 42</td>
<td>8 - 12</td>
</tr>
<tr>
<td>PLIF, TLIF</td>
<td>6 - 12</td>
<td>22 - 32</td>
<td>8 - 10</td>
<td>0 - 8</td>
</tr>
</tbody>
</table>
Advantages Anterior Approaches

• More complete discectomy

• Better endplate preparation
Advantages Anterior Approaches

- Larger graft placement without manipulation of nerve roots
- Deformity correction
- Indirect decompression
- Greater fusion surface area
Advantages Anterior Approaches

- Preservation of posterior stabilizing structures
  - Interspinous ligaments
  - Facet capsules

- No muscle disruption
  - Postop muscle atrophy
  - Chronic pain
ALIF - Complications

• Rates variable – highly surgeon dependent

• Vascular complications of exposure for anterior lumbar interbody fusion.

• 212 ALIF exposures

• 2% rate of “serious” vascular complication
  • 1 arterial injury required thrombectomy and stent
  • 4 venous injuries required multi-suture repair
  • No mortalities
ALIF - Complications

- Retrograde ejaculation
  - Most series < 1% to 7%
  - Much higher with transperitoneal approaches and with laparoscopic approaches
  - Blunt dissection versus electrocautery
  - Large majority of patients recover within 6 – 12 months
- Bowel
- Ureter
Extreme Lateral - Complications

- Damage to lumbosacral plexus which progressively migrates anteriorly beginning at L1/2 level
- Psoas muscle injury and pain
- Traction injury to plexus postop dysesthesias
Extreme Lateral - Complications

- New procedure introduced 2001
  - Reporting of complications has been inconsistent 3% - 60%)
    - Genitofemoral, ilioinguinal or lateral femoral cutaneous nerve injuries
      - Thigh numbness, paresthesias
    - Femoral nerve
      - Leg weakness

- An analysis of postoperative thigh symptoms after minimally invasive transpsoas lumbar interbody fusion.
  - Neurosurg Spine 15:11–18, 2011 Department of Neurological Surgery, University of Miami Miller School of Medicine, Miami, Florida
    - 62% patients had thigh symptoms postop - mostly numbness and dysesthesias
    - 23% had weakness
    - 50% had complete resolution at 3 months
    - 90% complete resolution at 1 year.
Extreme Lateral - Complications

- **Learning curve**
  - Supra-psoas Shallow Docking in Lateral Interbody Fusion
    Neurosurgery 73[ONS Suppl 1]:ons48-ons52, 2013
    - Avoid blind dilation through psoas muscle fibers

- **Complications in 775 XLIF cases.**
  - WB Rodgers. Spine Vol 10 (9). Supplement S95
  - 7.4% overall complication rate
  - 4 neural complications
• Outcomes After ALIF vs TLIF For Treatment of Symtomatic L5-S1 Spondylolisthesis: A Prospective, Multi-Institutional Comparative Effectiveness Study

  Neurosurgery. 60():171, August 2013

  Higher complication rates for TLIF (12.3 vs 7.8%)

  ALIF more rapid reduction in 1-year back and leg pain VAS scores

• Comparison of anterior- and posterior-approach instrumented lumbar interbody fusion for spondylolisthesis


  Adjacent level disease in 44% of ALIF and 83% of PLIF
Conclusions

• Both anterior and posterior approaches for interbody fusion are associated with good fusion rates and outcomes in patients with symptomatic lumbar degenerative disease.

• Anterior approaches allow better access to and visualization of the disc and endplates which facilitate:
  • More complete discectomy
  • Larger surface area for fusion
  • Better endplate preparation
  • Larger graft placement for disc height restoration and lordosis

• With a good access surgical team, the complications associated with ALIF are minimal

• Extreme lateral interbody fusion is a relatively new procedure. As surgeons become more proficient in the operation and as surgical technique is refined, sensory dysesthesias and psoas trauma associated with the procedure are becoming less prevalent.