Lumbar Fusion: Interbody Fusion is Optimal

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Disclosures

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  – J&J/Depuy Synthes Spine
  – Nuvasive
  – Biomet
Should we be doing Surgery?

- Patients undergoing surgery fare better than those with nonsurgical treatment.
What are our surgical goals?

- Resolve leg pain
- Improve back pain
- Obtain fusion
- Restore alignment
- Minimize Complications
- Reduce adjacent disease
Degenerative Spondylolisthesis

• Laminectomy and fusion does better than laminectomy alone.
  – Better reproducible clinical results

• Laminectomy alone can lead to progression of the spondylolisthesis and worsening deformity


Clinical Outcome

• Decompression/fusion is the apparent right choice

• Treatment options:
  – Lami + noninstrumented fusion
  – Lami + instrumented fusion
  – mTLIF/TLIF
  – ALIF/post fusion +/- lami
  – LLIF/post fusion +/- lami
• Is fusion necessary?

• Does clinical outcome correlate with fusion success?
Fusion

Degenerative Lumbar Spondylolisthesis With Spinal Stenosis
A Prospective Long-Term Study Comparing Fusion and Pseudarthrosis

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David A. Abraham, MD,‡ David L. Berkower, DO,§ and Jeff S. Ditkoff||

• Long-term clinical outcome success favored successful arthrodesis
SPORT Data

- **Early:**
  - Outcomes equal across fusion methods.

- **Two years:**
  - Anterior/Posterior Fusion Patients area significantly better in SF-36 Back pain and Physical Function compared to posterolateral fusion with pedicle screws.
    - Back Pain = 39 vs 29; p=0.003
    - Physical Function = 32 vs. 25; p=0.04
  - A non-significant trend to worse outcomes in the posterolateral fusion group at 4 years.

Fusion Is Necessary

**Solid Fusion**
- Tsutsumimoto
  - Long term results JOA scores
    - Solid fusion group
      - Leg – 2.4 (p=0.018)
      - Back – 2.3 (p=0.035)
- Kornblum
  - Good to excellent results
    - 86% of patients (p=0.01)
    - 56% of patients with a pseudarthrosis (P 0.01).

**Pseudoarthrosis**
- Tsutsumimoto
  - Long term results JOA scores
    - Pseudoarthrosis group
      - Leg – 1.8 (p=0.018)
      - Back – 1.6 (p=0.035)
- Kornblum
  - Good to excellent results
    - 56% of patients with a pseudarthrosis (p= 0.01).


While both minimally invasive techniques and open decompression and fusion, with or without instrumentation, demonstrate significantly improved clinical outcomes for the surgical treatment of degenerative lumbar spondylolisthesis, there is conflicting evidence which technique leads to better outcomes.
How do outcomes of decompression with posterolateral fusion compare with those for 360 degree fusion in the treatment of degenerative lumbar spondylolisthesis?

There is insufficient evidence to make a recommendation for or against the use of either decompression with posterolateral fusion or 360 fusion in the surgical treatment of patients with degenerative lumbar spondylolisthesis.
Posterolateral Fusion

- Fischgrund et al (1997)
  - 82% fusion rate
  - Prospective trial, 120 patients
  - 52% ICBG vs 54% Grafton DBM
  - Retrospective, 76 patients
  - 75% ICBG vs 67% local bone
Interbody Fusion: TLIF

  - Retrospective review of 100 consecutive patients
  - 93% fusion rate

- Lee et al (2010)
  - 77% fusion rate

  - Meta-analysis of open vs MIS TLIF
    - MIS TLIF 94% (heavy BMP)
    - Open TLIF 90%

• Comparison of fusion rates for mTLIF (92%) versus open TLIF (93%)

Wong et al. Neurosurgical Med Clinic (2014)
Interbody Fusion: Lateral/Anterior

• Youssef et al (2010)
  – Review of LLIF literature
  – 91 to 100% fusion rates (primarily NON BMP)
  – CT based analysis
• Rodgers et al (2010)
  – Prospective CT assessment of fusion
  – 97% fusion rate
• Pimenta et al (2012)
  – 92% fusion rate
• Zavatsky et al (2014)
  – 98% fusion rate
Summary of Fusion Data

- Posterolateral fusion: 50-85%
- TLIF/mTLIF: 78-93%
- ALIF/LLIF: 91-100%

*If we believe FUSION = IMPROVED OUTCOME then interbody fusion is the wiser choice*
Outcomes

**Interbody Fusion**

- Ha, et al.
  - Reduction in ODI
    - 42% +/- 18%
  - Reduction in VAS
    - 6 +/- 2
- Christensen, et al.
  - 5-9 years post op
    - ODI – 28 (p=0.004)
    - SF 36 (Physical) – 39 (p=0.005)
    - SF 36 (Physical) – 57(p=0.093)

**Posterolateral Fusion**

- Ha, et al.
  - Reduction in ODI
    - 22% +/- 16%
  - Reduction in VAS
    - 3 +/- 2
- Christensen, et al.
  - 5-9 years post op
    - ODI – 40 (p=0.004)
    - SF 36 (Physical) – 33 (p=0.005)
    - SF 36 (Mental) – 52 (p=0.093)

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Interbody Fusion

• Better reduction of spondylolisthesis and deformities
  – Less local kyphosis
  – Improved biomechanics
  – Lower pseudoarthrosis rate.

• Indirect nerve decompression
  – 42% disk height increase yields:
    • 14% increase foraminal height
    • 25% increase foraminal area


Improved Alignment

- Fusion in physiologic alignment
  - Logically expect less stress on the adjacent segments
  - Lower rates of ASD
  - Intuitively we know this will not do well long term
Why do we care?

- **ASD driven (in part) by malalignment!**

- Rothenfluh et al (ESJ, 2014)
  - Evaluate spinopelvic parameters in patients with ASD versus controls
  - **10x greater risk of ASD** with PI/LL mismatch > 10 degrees
Segmental Alignment

- Laminectomy with PSF/fixation
  - No significant change in segmental parameters
  - Improve segmental alignment with interbody fusion (ALIF/LLIF)

Sembrano JN, Sharma AK, Horazdovsky RD, Santos ERG, Polly DW. Radiographic comparison of lateral fusion vs ALIF vs TLIF vs posterior fusion: Analysis of segmental sagittal contour change
Segmental Alignment

- TLIF (open and/or MIS)
  - Lee et al (Neurosurg, 2008)
    - 2 degrees increase lordosis
  - Yson et al (2012)
    - Bilateral TLIF can restore up to 7-8 degrees
  - Wong et al (Neurosurg, 2014)
    - 5.6 degrees improvement
Segmental Alignment

- Acosta et al (2011)
  - Average 3 degree increase
- Kepler et al (2012)
  - 3.7 degree increase
  - 7.4 degree improvement with anterior cage position
- Multiple hyperlordotic (>15 deg) options now available
- Greater focus on posterior fixation compression
Correction of Sagittal Balance

• Hyperlordotic transpsoas placed cages may improve segmental lordosis
  – Overall sagittal vertical alignment improved from 12cm to 6cm.

• Correlation with slip angle
  – Restoration of slip angle associated with improvement in pain outcomes scores


Mean decrease in PT and increase in SS and LL

Decrease in VAS from 6.1 to 2.4

VAS score changes >3 associated with higher correction of SS and LL and lower PT

Improvement significantly correlated with restoration of SA, increase of SS and decrease of PT
Complication Rates

**Posterolateral/Open**
  - Open posterolateral fusions in elderly (>65 y/o)
  - 80% complication rate
- Dekutoski et al (2010)
  - >500,000 open fusions for degenerative spondy
  - 14%

**MIS TLIF**
  - 7-25% rate (meta analysis)
  - MIS 7.5%, Open 12.6%

**LLIF**
- Rodgers et al (2010) ~ 7%
- Isaacs et al (2010) ~ 9.1%
Cost

• Initial cost
  – Interbody fusion is costlier $47k vs 42k

• Long term (4-9 years)
  – Cost saving of circumferential fusion (TLIF or PLIF) compared with Posterolateral Fusion
    • Incremental Cost Utility Ratio $49k/QALY
      – Due to lower revision rates


# SUMMARY

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