MIS Lateral Lumbar Interbody Fusion (LLIF) vs. Transforaminal Lumbar Interbody Fusion (TLIF): Patient Centered Results

Briski D¹, Cook B¹, Frisch R², Billys J³, Zavatsky JM⁴

¹Ochsner Medical Center, New Orleans, LA
²Southeastern Spine Institute, Mount Pleasant, SC
³Florida Orthopaedic Institute, Tampa, FL
⁴Spine & Scoliosis Specialists, Tampa, FL
Disclosures

- Consultant – Globus\textsuperscript{2}, NuVasive\textsuperscript{3}, DePuy Synthes Spine\textsuperscript{4}, Biomet\textsuperscript{4}, Amendia\textsuperscript{4}, Innovative Surgical Solutions\textsuperscript{4}, Safe Wire\textsuperscript{4}

- Stock – Vivex\textsuperscript{4}, Amendia\textsuperscript{4}, Innovative Surgical Solutions\textsuperscript{4}, Safe Wire\textsuperscript{4}

- Royalties – Globus\textsuperscript{2}, NuVasive\textsuperscript{3}, Biomet\textsuperscript{4}
Introduction

- Minimally invasive spine surgery has demonstrated many benefits including:
  - Decreased soft tissue disruption
  - Decreased blood loss
  - Decreased infection rates
  - Shorter hospital stay

- However, MIS LLIF vs TLIF have not been extensively compared directly.
Lateral Lumbar Interbody Fusion (LLIF)

- Lateral Patient Position
- Retroperitoneal Transpsoas Approach
- Common Complications:
  - Anterior thigh dysesthesias (20 - 30%)
  - Psoas weakness > 3/5 motor strength (1 - 3%)
- Indirect Decompression
Transforaminal Lumbar Interbody Fusion (TLIF)

- Prone patient position
- Pedicle based approach:
  - Requires facetectomy w/ partial laminectomy
  - Requires dural retraction
- Complications:
  - Dural Tear
  - Nerve Root Injury
  - Infection
- Direct Decompression
TLIF
Direct vs Indirect Decompression

- LLIF: Indirect decompression
- TLIF: Direct decompression

Clinical Considerations:
- Lumbar lordosis / sagittal balance
- Surgical Level (L45 & iliac crest)
- Size of disc herniation / facets
- Strength of construct (subsidence & fusion rates)
LLIF Limitations with Access

Iliac crest

Iliac crest below L4/5 disc space
Large central HNP can be more difficult to address with indirect decompression

Kissing facets
Ligamentum hypertrophy
A Radiographic Assessment of the Ability of the Extreme Lateral Interbody Fusion Procedure to Indirectly Decompress the Neural Elements

Leonardo Oliveira, BSc,* Luis Marchi, MSc,† Etevaldo Coutinho, MD,* and Luiz Pimenta, MD, PhD†

- **Substantial dimensional improvement was evidenced in all radiographic parameters.**
- Increases of 41.9% in average disc height, 13.5% in foraminal height, 24.7% in foraminal area, and 33.1% in central canal diameter.
- Two patients (9.5%) required a second procedure for additional posterior decompression and/or instrumentation.
- Transient postoperative psoas weakness occurred in 3 (14.3%) cases.

- The XLIF procedure provides the necessary decompression for the treatment of central and lateral stenosis.
- **Indirect decompression may be limited in cases of congenital stenosis or locked facets.**
- **Its effect may also be reduced by postoperative subsidence or loss of correction.**
LLIF Cage Footprint can Affect Subsidence & Fusion Rates
In vitro comparison of endplate preparation between four mini-open interbody fusion approaches

Robert Tatsumi · Yu-Po Lee · Kaveh Khajavi · William Taylor · Foster Chen · Hyun Bae

- 24 disc spaces (48 endplates) from L2 to L5 were prepared in eight cadaveric torsos using mini-open anterior lumbar interbody fusion (mini-ALIF), minimally invasive posterior lumbar interbody fusion (MAS PLIF), minimally invasive transforaminal lumbar interbody fusion (MAS TLIF) or minimally invasive lateral, transpsoas interbody fusion (XLIF) on two specimens each, for a total of six levels and 12 endplates prepared per procedure type.

- The XLIF approach resulted in the greatest relative area of endplate preparation (58.3%) while mini-ALIF resulted in the lowest at 35.0%.

- Overall, there were no differences in percentage of preparation between cranial and caudal endplates, though this was significantly different in the XLIF group (65 vs 52 %, respectively).

- ALL damage was observed in 3 MAS TLIF levels.

- Percentage of endplate that was deemed to have complete disc removal was highest in XLIF group with 90% compared to 65% in MAS TLIF group, 43% in MAS PLIF, and 40% in mini-ALIF group.

- Endplate damage area was highest in the MAS TLIF group at 48% and lowest in XLIF group at 4%.

- XLIF resulted in the greatest endplate preparation and least endplate damage.
Effects of Endplate Removal on the Structural Properties of the Lower Lumbar Vertebral Bodies
Radiographic and clinical evaluation of cage subsidence after stand-alone lateral interbody fusion

Clinical article

Luis Marchi, M.Sc.,1,2 Nitamar Abdala, M.D., Ph.D.,1 Leonardo Oliveira, B.Sc.,2 Rodrigo Amaral, M.D.,2 Etvaldo Coutinho, M.D.,2 and Luiz Pimenta, M.D., Ph.D.2,3

- **Wider cages (22mm vs 18mm)** avoid subsidence and better restore segmental lordosis in stand-alone lateral interbody fusion.
- Cage subsidence is identified early in follow-up (6 weeks) and can be accessed using the proposed classification scale.
- Subsidence was detected early (6 weeks) and correlated with transient clinical worsening.
- Subsidence occurred predominantly (68%) in the inferior endplate.
- Fusion rate was not affected by cage dimension (p > 0.999) or by incidence of subsidence (p = 0.383).
- **Grade II and III resulted in higher rates of revision surgery.**
Would Resting a Lateral Interbody Cage Across the Ring Apophysis in the Lumbar Spine Mitigate Endplate Violation?

Results
Mean Max Failure Load

- Span the ring apophysis
- Do not violate the endplates
Fifty-four studies were included for analysis of MI-TLIF, and 42 studies were included for analysis of LLIF.

9714 patients (5454 in the MI-TLIF group and 4260 in the LLIF group).

13,230 levels fused (6040 in the MI-TLIF group and 7190 in the LLIF group).

A total of 1045 complications in the MI-TLIF group.

1339 complications in the LLIF group.

Total complication rate per patient was 19.2% in the MIS-TLIF group and 31.4% in the LLIF group (p < 0.0001).

Rate of sensory deficits and temporary neurological deficits, and permanent neurological deficits was 20.16%, 2.22%, and 1.01% for MI-TLIF vs 27.08%, 9.40%, and 2.46% for LLIF, respectively (p < 0.0001, p < 0.0001, p = 0.002, respectively).

Rates of intraoperative and wound complications were 3.57% and 1.63% for MIS-TLIF compared with 1.93% and 0.80% for LLIF, respectively (p = 0.0003 and p = 0.034, respectively).

No significant differences were noted for medical complications or reoperation.

Temporary anterior thigh dysesthesias were major difference between the 2 approaches.
Significant improvements were observed at the 2-year follow-up for both TLIF and LLIF with the Short Form-36 physical component summary, Oswestry Disability Index (ODI), visual analog scale (VAS) back pain and leg pain scores, and EuroQol-5D.

ICER calculations revealed similar mean cumulative QALYs gained at the 2-year interval (0.67 for TLIF and 0.60 for LLIF; P = 0.33).

Median total costs of care after TLIF and LLIF were $44,068 and $45,574, respectively (P = .96).

Minimum cost-effective difference thresholds with an anchor of < $50,000 per QALY were higher than minimum clinically important difference thresholds for all patient-reported outcome measures.

Total mean cost and EuroQol-5D were statistically equivalent between the 2 treatment groups.
One patient who underwent TLIF had a surgical site infection that required surgical debridement; this patient was thereafter excluded from the study. None in the LLIF Group.

OR time or blood loss not reported.

Mean length of stay for the LLIF vs TLIF Group was 2 vs 4.4 days, respectively.
55 patients undergoing surgical treatment for degenerative spondylolisthesis (29 - XLIF and 26 – TLIF).

Blood loss was significantly lower in the XLIF group, with 79% of XLIF cases and 27% of MIS TLIF cases resulting in <100 mL of blood loss, P < 0.001.

Operative time and length of stay were similar between the XLIF and MIS TLIF groups (171 vs 186 minutes; two days for each group).

Hip flexion weakness was more common in the XLIF group (31%) than in the MIS TLIF group (0%).

Back and leg pain for both XLIF and MIS TLIF groups improved significantly from baseline to 24 months post-operative, with 73% improvement in the XLIF and 64% in the MIS TLIF group. Disability (ODI) improved 53% in the XLIF group and 57% in the MIS TLIF group.

Despite different mechanisms of action (indirect vs direct decompression), mid-term clinical outcomes between XLIF and MIS TLIF were similar.

Authors concluded that their two-year results suggest that both XLIF and MIS TLIF are reasonable MIS approaches for the treatment of lumbar degenerative pathology.
Methods

- Retrospective Multi-Center Review
- Study Period: 2008-2014
- Outcome Measures:
  - Total operative time
  - Blood loss
  - Immediate post-op & day of discharge VAS patient score
  - Length of stay (LOS)
- Patient Groups:
  - Group 1: Lateral Lumbar Interbody Fusion (LLIF)
  - Group 2: Transforaminal Interbody Fusion (TLIF)
Results

- Group 1 (LLIF): 74 Patients
- Group 2 (TLIF): 99 Patients

- **No statistical difference** found in:
  - BMI
  - Levels Fused
  - Peri-operative complications
  - Immediate post-op VAS pain scores
  - Discharge VAS pain scores
  - Post-op ipsilateral leg dysesthesias or weakness
    - 20 mg IV Decadron immediately after psoas dissection and 20 mg at case completion.
    - No longer than 20 minutes spent with retractor open at each operative level.
Results

- Significant benefits of LLIF vs. TLIF:
  
  - **POD 1 discharge:** 48% vs. 0% (p<0.001)
  
  - **Overall length of stay:** 2.1 vs. 3.5 days (p<0.001)
  
  - **Mean operative time:** 154 vs. 265 minutes (p<0.001)
  
  - **Total operative blood loss:** 102 vs. 206 cc (p<0.001)
Hypothesis

Blood and Nerve Supply of Bone

- Bone is richly supplied with blood
  - **Periosteal arteries** accompanied by nerves supply the periosteum and compact bone
  - **Epiphyseal veins** carry blood away from long bones
- Nerves accompany the blood vessels that supply bones
  - The periosteum is rich in sensory nerves sensitive to tearing or tension
Conclusion

- Advantages of LLIF vs. TLIF:
  - Overall length of stay – Decreased (2.1 vs. 3.5 days)
  - Number of patients discharged on POD 1 – Increased (48 vs 0%)
  - Operative time and blood loss – Decreased

- Considerations:
  - Similar long-term outcomes
  - Similar cost profile?
    - Decreased LOS
  - Complication rates?
    - Technique (transient neurological, dural tear, infection)

- Further prospective analysis required to better evaluate the benefits of one procedure over another.
Thank you
Questions