Minimally Invasive TLIF
5th Annual UCSF Techniques in Complex Spine Surgery Course
November 6, 2015

Rishi K. Wadhwa, M.D.
Assistant Clinical Professor
Dept. Of Neurosurgery
Co-director: UCSF Spine Center
University of California,
San Francisco

Praveen V. Mummaneni, M.D.
Professor
Vice-Chairman
Dept. of Neurosurgery
Co-director: UCSF Spine Center
University of California,
San Francisco

Disclosure

• PM:
  • Depuy Spine – Other financial support (royalty)
  • Quality Medical Publishers, Thieme Publishers – other financial support (royalty)
  • Globus - Honoraria
  • Spinicity – Stock

• RW:
  • Globus- Consultant
TLIF Approaches

- Open Approach

- Mini-open TLIF via paramedian approach
  - Unilateral expandable tube for TLIF with contralateral percutaneous fixation
  - Bilateral expandable tube

- Tubular TLIF via nonexpandable tube
  - Percutaneous screw fixation

- Deutsch H: NS Focus 2006

Mini-Open: Expandable Tubular Retractor

- Mimics open exposure
  - Can use
    - microscope
    - loupes/headlight
  - More room to work in deep patients
    - Can expand retractor to counteract muscle creep
  - Place pedicle screws similar to open approach
Tubular vs. Mini-open

- **Tubular**
  - Combine with percutaneous pedicle screws

Minimally invasive microendoscopy-assisted transforaminal lumbar interbody fusion with instrumentation.


PATIENT SELECTION for MIS TLIF
Patient Selection: MIS TLIF

- one segment
  - DDD
    - L4-5 or L3-4 preferred
  - Grade I spondylolisthesis
    - AVOID Grade 2 or higher listhesis
  - Caution: L5-S1 MORE DIFFICULT
- Start with relatively thin individuals with good bone quality

- Mummaneni, Rodts: The Mini-Open TLIF. Neurosurgery 2005

MIS Deformity Correction with TLIF

- Can decompression be achieved?
  - Yes
- Can hardware be placed safely?
  - Yes
- Can sag balance be restored?
  - Yes (need 2 cm SVA correction)
- Will you match LL-PI within 10 degrees?
  - Yes
  - 55 degrees PI – 30 degrees LL = 25 degrees
  - Need 15 degrees of additional LL
    - each TLIF can provide 7-8 degrees of correction
- Can a successful fusion be established? Yes
When To Do MIS for Deformity?

- Need an algorithm...
- Validated by MIS subgroup of ISSG

When To Do MIS for Deformity?

NS FOCUS May 2014:
- Praveen Mummaneni
- Chris Shaffrey
- Lawrence Lenke
- Paul Park
- Michael Wang
- Frank LaMarca
- Justin Smith
- Greg Mundis
- David Okonkwo
- Bertrand Moal
- Richard Fessler
- Neel Anand
- Juan Uribe
- Adam Kanter
- Behrooz Akbarnia
- Kai Ming Fu
- MIS ISSG
MiSLAT Algorithm

Degenerative Adult Lumbar Scoliosis with Radiculopathy

- SVA < 6 cm
- PT < 25
- LL-PI mismatch < 10°
- Lateral Olisthesis < 6 mm
- Coronal Cobb < 20°

Flexible Curve

- SVA < 6 cm
- LL-PI mismatch < 30°
- Thoracic hyperkyphosis < 60°

Class I: MIS surgery with decompression only or fusion of listhetic level regardless of curve apex

Class II: MIS/mini-open surgery with MIS decompression and lordotic interbody fusion of apex of the curve or the entire Coronal Cobb of the curve

Class III: open surgery with osteotomies +/- extension of fusion to the thoracic spine

Deformity TLIF’s

- Consider L5-S1 TLIF to avoid pseudoarthrosis at the base of long constructs
Relative Contraindications for MIS TLIF

- Fusion greater than two levels
- Extensive disruption of anatomy
  - rotation-scoliosis
  - high grade listhesis
- Obesity and osteoporosis
  - difficult to visualize bony anatomy adequately


OR SET-UP
**Patient Positioning**

- Prone on radiolucent table
  - Don’t place lumbar spine into a “flat back” position
- Make sure patient is “squared up” on the table
- Check that fluoro is adequate **BEFORE** prep/drape
- Draw the landmarks…

**Location of the Incision**

1- MicroDisc  
2 – PLIF  
3 - TLIF
Surgical Approach

- Incise the fascia
  - Reduce force needed to pass the dilators and expand the retractor
- Use fluoro when advancing narrow dilator
- Dock on bone
- Avoid the canal

PEDICLE SCREW PLACEMENT

- For miniopen cases, cannulate the pedicles before TLIF
  - Provides visual landmarks
- Place pedicle screws on side of the TLIF after the cage is in place
  - Screws interfere with interbody instruments
Percutaneous pedicle screws

• Vertebral endplates parallel on Flouro
  – Avoid parallax inaccuracy
  – A/P Flouro entry point for Jamshidi needle is the 3 o’clock position of the right pedicle and aim to be at 9 o’clock position at 20 mm of depth

Percutaneous pedicle screws

• Place Jamshidi needle
• Place K-wire through the needle
• Tap over the K-wire
• Screw over the K-wire
If you bend the K-wire, it may migrate or break

TLIF: Surgical Technique

- Cage Trials
- Insert bone graft and cage
Complications

• Nerve root radiculopathy
  – Direct trauma (inadequate facet removal)

• Violation of the endplate
  – Be careful with endplate shavers and interbody tools

• Iliac injury with violation of ALL

• Inadequate disc removal or too little bone graft - pseudarthrosis

  – Mummaneni, Rodts: The Mini-Open TLIF (Neurosurgery 2005)

Pseudarthrosis example
CSF Leaks

- Try to repair with 6-0 prolene suture covered with small muscle patch and fibrin glue

- Close skin with running nylon suture

Mummaneni, Rodts: The Mini-Open TLIF (Neurosurgery 2005)

Comparison of Mini-open to Open TLIF

Clinical and radiographic comparison of mini-open transforaminal lumbar interbody fusion with open transforaminal lumbar interbody fusion in 42 patients with long-term follow-up

Clinical article

Sudeep S. Dhall, M.D.,* Michael Y. Wang, M.D.,† and Pradhan V. Mummaneni, M.D.*

Department of Neurosurgery, University of California, San Francisco, California; University of Miami, Department of Neurosurgery, Miami, Florida; and Department of Neurosurgery, Emory University, Atlanta, Georgia

Object: A minimally invasive approach to spine surgery, clinical outcomes and effectiveness of mini-open transforaminal lumbar interbody fusion (TLIF) compared with traditional open TLIF have yet to be established. The authors retrospectively compared the outcomes of patients who underwent mini-open TLIF with those who underwent open TLIF.

Methods: Between 2000 and 2006, 67 patients underwent TLIF for degenerative disc disease or spinal stenosis. Thirty-three patients underwent open TLIF. The mean age of each group was 52 years, and there was no statistically significant difference in age between the groups (p = 0.07). There was no difference in sex distribution. At least 12 months of follow-up were completed in 62 patients (92.5%).

Results: No patients had to follow-up. The mean follow-up was 14 months for the mini-open group and 14 months for the open group. The mean estimated blood loss was 211 mL for the mini-open group and 135 mL for the open group (p = 0.01). The mean LOS was 3 days for the mini-open group and 5 days for the open group (p = 0.01). The mini-open group required less muscle release (2.2 mL versus 3 mL in the mini-open group and 4.3 mL in the open group). There was no statistical difference in the rate of complications (p = 0.21). In the mini-open group, there were 2 cases of subligamentary loss, 1 case of a migrated cage, and 1 case of a migrated cage that required conversion. In the open group, there was 1 case of infection, and 2 cases of aneurysm, with no cases in the mini-open group.

Conclusion: TLIF is a safe alternative to traditional open TLIF with a significantly reduced estimated blood loss and LOS. However, the authors found a higher incidence of lumbar-associated complications with the mini-open TLIF. (J Neurosurg Spine 9:389-395, 2008)

Keywords: degenerative disc disease • minimally invasive surgery • transforaminal lumbar interbody fusion
Comparison of Open and Mini-open TLIF

The minimally invasive TLIF patients had statistically lower blood loss and hospital stay for one level spine fusions.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mini</th>
<th>Open</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (yrs)</td>
<td>54</td>
<td>53</td>
<td>0.496742774</td>
</tr>
<tr>
<td>Mean mPSS score</td>
<td>8</td>
<td>8.4</td>
<td>0.665549572</td>
</tr>
<tr>
<td>Mean EBL (ml)</td>
<td>194</td>
<td>392</td>
<td>0.000093985084</td>
</tr>
<tr>
<td>Mean op time (min)</td>
<td>198.5</td>
<td>199</td>
<td>0.666782039</td>
</tr>
<tr>
<td>Mean LOS (days)</td>
<td>3</td>
<td>5</td>
<td>0.0030512406</td>
</tr>
<tr>
<td>Mean follow-up (mos)</td>
<td>23</td>
<td>34</td>
<td>NA</td>
</tr>
</tbody>
</table>

Comparison of Mini-open to Open TLIF

- Meta-analysis: Reviewed 23 publications

- “Fusion rates for both open and mTLIF are relatively high and in similar ranges. Complication rates are also similar, with a trend toward mTLIF having a lower rate.”

Mini-Open TLIF
To Treat 3X-recurrent L5/S1 Disc Herniation

Beejal Y. Amin, M.D.
Tsung-Hsi Tu, M.D.
Praveen Mummaneni, M.D.
Department of Neurosurgery
University of California, San Francisco

** SAVE THE DATE **
Section Chair Dr. Praveen Mummaneni invites you to attend:
32nd Annual Meeting of the AANS/CNS Section on Disorders of the Spine & Peripheral Nerves
March 16 – 19, 2016
“Global Challenges: Universal Solutions”
Orlando, Florida
Loews Universal Resort

Meritorious Award Winner
Debate:
Christopher Shaffrey, MD &
Larry Lenke, MD