MINIMALLY INVASIVE SPINE SURGERY: MORE THAN JUST A SMALLER INCISION
NO DISCLOSURES OR CONFLICTS OF INTEREST
OVERVIEW

OBJECTIVES

▸ Rationale for minimally invasive spine surgery (MISS)
▸ Benefits of MISS
▸ Common conditions appropriate for MISS
▸ Who is appropriate for and when to use MISS
RATIONALE

PARASPINAL MUSCLE ANATOMY

- Psoas
- Multifidus (M)
- Iliocostalis (IL)
- Longissimus (LO)
- Quadratus lumborum (QL)
- Intertransverserii (IT)

PARASPINAL MUSCLE INJURY - MECHANISM

- Direct injury by dissection
- Stripping of tendinous attachments
- Thermal injury and necrosis by cautery
- “Crush Injury” by self-retaining retractors (elevated intramuscular pressures decrease perfusion)
PARASPINAL MUSCLE INJURY – HISTOPATH CHARACTERISTICS

- Denervation
- Muscle atrophy (decreased force production)
- Fiber type grouping and reinnervation
- “Moth eaten” appearance of muscle fibers
- Worst with midline approach and long retraction times
- Multifidus is most severely injured
CLINICAL EFFECTS OF MISS

- Minimize injury to structures that provide dynamic stability
- No self-retaining retractors
- Less “crush injury”
- Less muscle stripping
- Less damage to neuromuscular supply
RATIONALE

CLINICAL EFFECTS OF MISS

- Compared trunk muscle strength
- Open vs percutaneous instrumentation
- 50% improvement in extension strength for percutaneous instrumentation
- Correlated with multifidus preservation on MRI
CLINICAL EFFECTS OF MISS

- Marked intermuscular edema on MRI at 6 months for open TLIF vs MIS TLIF (Stevens et al, J Spinal Discord Tech, 2006)

- 2- to 7-fold increases in systemic skeletal muscle injury markers (CK, aldolase, pro- and anti-inflammatory cytokines) in open group up to 7 days (Kim et al, Spine, 2006)

- Multifidus CSA and creatinine kinase levels correlated with VAS and ODI (Fan et al, Our J Spine, 2010)
RATIONALE

GOALS OF MISS

- Paramedian or lateral approaches directly over surgical target
- Limit disruption of spinal anatomy and preserve posterior stabilizing structures
- Decrease physiological burden
- Decrease postop pain, expedite mobilization, and recovery

BENEFITS OF MISS

- Shorter operative time
- Decreased length of stay
- Diminish acute postop pain
- Quick access to spine in obese patients
- Decrease risk of symptomatic CSF leak
- May be amplified in elderly

Smith ZA, Fessler RG. Paradigm changes in spine surgery: evolution of minimally invasive techniques. Nat Rev Neurol. 201...
ELDERLY

- Comorbidities
- Poor nutrition (poor wound healing)
- Osteoporotic bone (poor fixation)
- Impaired immune function (increased risk of infection)
- Easily deconditioned
INDICATIONS

SPINAL STENOSIS AND NEUROGENIC CLAUDICATION
INDICATIONS

SPINAL STENOSIS - SURGICAL OPTIONS

- Laminectomy +/- facetectomy and foraminotomy
- Interspinous spacer
- Laminectomy + instrumented fusion
- Laminectomy + non-instrumented fusion
INDICATIONS

LUMBAR LAMINECTOMY - OPEN VS MIS
INDICATIONS

MIS LUMBAR LAMINECTOMY
INDICATIONS

MIS LUMBAR LAMINECTOMY
INDICATIONS

MIS LUMBAR LAMINECTOMY
INDICATIONS

MIS LUMBAR LAMINECTOMY - POSTOP MRI
INDICATIONS

OPEN VS MIS LAMI FOR STENOSIS

- Superior satisfaction rates
- 2-fold lower postop VAS scores
- Shorter hospitalization by 2.1 days
- Less blood loss
- Fewer re-operations
- Complications and infx rate same
- Longer surgery duration
INDICATIONS

MIS LUMBAR MICRODISCECTOMY

- Similar complications and recurrence rates
- Slightly longer surgery time (Level 2)
- EBL same or slightly decreased (Level 2)
- Similar outcomes (Level 1)
- Decreased analgesia (Level 2)
- Lower hospital charges (Level 3)

Clark et al. Tubular microdiscectomy: techniques, complication avoidance, and review of the literature. *Neurosurg Focus* 43:1-9, 2017
FUSION
INDICATIONS

SPONDYLOLISTHESIS WITH LUMBAR STENOSIS AND CLAUDICATION
MIS TRANSFORAMINAL INTERBODY FUSION

- STEP 1: Percutaneous pedicle screw placement
- STEP 2: Facetectomy
- STEP 3: Discectomy
- STEP 4: Placement of interbody cage
- STEP 5: Laminectomy (if needed)
INDICATIONS

OPEN VS MIS TLIF

- 72 patients in each group
- F/u at 6 months and 2 years
- Similar OR time
- Less blood loss (51ml vs 447ml)
- Less morphine needed
- Quicker ambulation (1.2 vs 3.4 days)
- Earlier discharge (3.2 vs 6.6 days)
- Same improvement in VAS, ODI, SF-36, and return to function at follow up

Clinical and radiological outcomes of open versus minimally invasive transforaminal lumbar interbody fusion

Kong Hwee Lee · Wai Mun Yue · William Yeo · Henry Soeharno · Seang Beng Tan

DOI 10.1007/s00586-012-2281-4
ORIGINAL ARTICLE

Clinical and radiological outcomes of open versus minimally invasive transforaminal lumbar interbody fusion
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OPEN VS MIS TLIF

- Systematic review
- Compare effectiveness and adverse event rates
- Equipoise in patient-reported clinical outcomes
- Equivalent rates of surgical complications but less medical complications
INDICATIONS

LATERAL INTERBODY FUSION (TRANSPSOAS)

- STEP 1: Lateral retroperitoneal dissection
- STEP 2: Discectomy
- STEP 3: Placement of interbody cage
- STEP 4: Posterior percutaneous pedicle screw placement
- STEP 5: Laminectomy (if needed)
INDICATIONS

LATERAL INTERBODY FUSION (TRANSPOAS)

Why is it appealing?

- Reduces posterior insult
- Large interbody cage
- Potential for higher fusion rates
- Indirect decompression
- Less morbid
- Effective at restoring spinal balance
INDICATIONS

LATERAL INTERBODY FUSION (TRANSPSOAS) - POSITIONING
INDICATIONS

LATERAL INTERBODY FUSION (TRANSPOAS) - WORKING CORRIDOR
INDICATIONS

LATERAL INTERBODY FUSION (TRANSPSOAS)
Indications

LLIF - INDIRECT DECOMPRESSION

- Prospective, non-randomized
- Study indirect decompressive effect of XLIF
- 21 pts (14 female), 43 lumbar levels
- Avg OR time 47 mins
- Avg 23 ml EBL
- Mean LOS 29.5 hrs
- Increase in avg disc height (42%), foramina height (13.5%), foramina area (25%), and central can diameter (33%)
- Only 2 its required posterior decamp or instrumentation
MIS TLIF vs LLIF - OUTCOMES

- MIS TLIF vs LLIF

- 46 pts (29 - TLIF, 17 - LLIF)

- Significant improvement in post VAS, ODI in both groups (similar between groups)

- Similar duration of postop narcotic use (TLIF 5.2m, LLIF 4.8m)

- Significantly more LLIF cleared for work and longer time to return to work for TLIF (7.1m vs 2.3m for LLIF)

- Greater incidence of reop for TLIF
MISS IN THE ELDERLY
DECOMPRESSION IN PATIENTS OLDER THAN 75

- 57 pts (avg age 81 yrs)
- 68 interbody fusions
- No major complications or deaths
- Back pain VAS scores decreased 5.7 to 2.2
- Leg pain VAS scores decreased 5.7 to 2.3
- ODI and SF-36 Body Pain and Functional scores significantly decreased
- Safe and effective in elderly
MIS FUSIONS IN PATIENTS OLDER THAN 70

- 66 pts (avg age 74.9 yrs, range 70-86 yrs)
- 68 interbody fusions
- F/u 14.7 months
- 41 XLIF, 27 MIS-TLIF
- 5 major and 17 minor complications
- 4 interbody subsidences, 1 adjacent level degeneration
- No medical complications or deaths
- Age should not be a deterrent
Lumbar Fusion in Octogenarians
The Promise of Minimally Invasive Surgery

William Blake Rodgers, MD, Edward J. Gerber, PAC, and Jody A. Rodgers, MD, FACS

Study Design. Retrospective chart review of prospectively collected data from 2 nonrandomized, nonconcurrent cohorts.

Objective. Early results of 2 lumbar interbody fusion procedures—open posterior lumbar interbody fusion (PLIF) and minimally invasive (extreme lateral interbody fusion [XLIF])—were compared in octogenarians to demonstrate the safety of each in the extreme elderly populations.

Summary of Background Data. Although spinal pathologies are common in the elderly patients, additional health conditions often preclude operative treatment because anesthesia, blood loss, and recovery are too demanding. Minimally invasive approaches reduce procedure-related morbidity and recovery time.

Methods. In our single-site prospective series of XLIF patients, 40 were identified as those aged ≥80 years with a minimum of 3-month follow-up. A complete, retrospective review of surgical patients treated in the same practice with traditional open posterior (PLIF) approach found 20 patients aged ≥80 years. Comparisons were made between groups to identify differences in morbidity and mortality rates.

Results. No clinically significant differences in demographics, diagnoses, or comorbidities were found between groups. Complication rate, blood loss/transfusion rate, and hospital stay were significantly lower in the minimally invasive surgery (MIS) group ($P < 0.0001$). MIS patients left the hospital an average of 4 days earlier than the open PLIF patients, most discharged home (92.5% XLIF vs. 0% PLIF) rather than to skilled nursing facilities. Six deaths occurred in the PLIF follow-up, 3 within 3 months postoperatively; there was 1 death at 6 months postoperatively XLIF.

Conclusion. Surgical treatment need not be withheld on the basis of age; elderly patients can successfully be treated using MIS techniques, and are—in our experience—among the most satisfied with their outcomes, enjoying significant improvements in pain, mobility, and quality of life.

Key words: minimally invasive, elderly, fusion, PLIF, XLIF. Spine 2010;35:S355–S360
CONCLUSION

- MISS minimizes retraction injury and subsequent stabilizing structures
- Create corridor directly over target
- Equipoise vs open techniques
- Less blood loss
- Less postop narcotic use
- Shorter hospital stays
- Quicker to ambulation
- Elderly may benefit most