Minimally invasive fusion techniques in lumbar degenerative disc disease
Evidence of the superiority to open procedures

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What is Minimally invasive fusion techniques in lumbar DDD

1) Posterior technique

2) Anterior technique

3) Combined
Theoritical advantages

• Less blood loss
• Less tissue damages
• Less muscular ischemia
• Less post op pain?

Is there evidence to support?
Posterior techniques
Two important tricks

- Tubular retractor
- Canulated screws
Specific retractor
The Wiltse Paraspinal Approach to the Lumbar Spine Revisited
R. Vialle, P. Wicart, O. Drain, J. Dubousset, C. Court
Clin orthop and related research; 2006:445:175-80
Surgical plan for approach

Muscle-preserving interlaminar decompression for the lumbar spine: a minimally invasive new procedure for lumbar spinal canal stenosis


- Outcomes of muscle-preserving interlaminar decompression (MILD) for the lumbar spine Although there was a good ratio of benefit to harm for both procedures, balloon kyphoplasty appears to offer the better adverse event profile.
- CONCLUSION: In MILD for the lumbar spine, damage to the posterior stabilizing structures such as the intervertebral facet joints, paravertebral muscles, thoracolumbar fascia, supra- and interspinous ligaments, can be minimized, while preserving the function of the spinous processes as lever arms for lumbar extension.
# 29 open/32 MIS

<table>
<thead>
<tr>
<th></th>
<th>MIS</th>
<th>Open</th>
<th>P</th>
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<tbody>
<tr>
<td>Blood loss (ml)</td>
<td>432.8</td>
<td>737.9</td>
<td>&lt; 0.0001</td>
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<tr>
<td>Postop drainage (ml)</td>
<td>175</td>
<td>482.9</td>
<td>&lt; 0.0001</td>
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<tr>
<td>Stand up (j)</td>
<td>1.22</td>
<td>2.97</td>
<td>&lt; 0.0001</td>
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<tr>
<td>Hospital stay (j)</td>
<td>5.3</td>
<td>10.8</td>
<td>&lt; 0.0001</td>
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<tr>
<td>operating time (min)</td>
<td>191.7</td>
<td>148.8</td>
<td>&lt; 0.0001</td>
</tr>
</tbody>
</table>

- Park, Spine 2007 Volume 32, Number 5, pp 537–543
D +90
Open surg.

Less muscle damages

D +90
MIS surg.
Anterior techniques

video-assisted anterior approach at L5-S1

• Is a validated technique:
  – Mayer (spine 96), Onimus (spine 96)

• Is safe with low complication rate:
  – Brau, the spine J (286 cases), Le Huec (247 cases) EMC 2004
RPS
ANTERO-LATERAL
rétropéritonéale APPROACH
Mini-Open Vidéo-assisted Technique
Rétroperitoneal: X LIF, D LIF, etc…..
Clinical case

L5-S1 discopathy, back pain, intermittent radicular pain
Combined techniques

Anterior cage insertion

Posterior screw fixation: Sextant technique (Medtronic)

Less invasive for both approaches

BUT

Same disadvantages: ANT + POST
To analyse evidence of superiority
1) indications to analyse
2) results to analyse

Literature review
To analyse evidence of superiority

1) indications to analyse

1) LUMBAR STENOSIS with fusion

2) Degenerative SPONDYLO-listhesis

3) SCOLIOSIS

4) TRAUMA

5) METASTASES
To analyse evidence of superiority

2) results to analyse

1) Posterior technique: PLIF, TLIF

2) Anterior technique: ALIF

3) Combined: combination of both inconvenients
To analyse evidence of superiority
2) results to analyse

Posterior technique: PLIF, TLIF
A laminotomy was performed in patients with spinal stenosis. Of 72 patients, 39 underwent additional laminotomy for spinal stenosis. No differences were registered in respect of the numbers of fused segments or cages. No infection at the site of surgery or severe wound healing disorder was encountered. We registered no difference in blood loss, drainage, or the length of the hospital stay between the three BMI groups. We also observed no difference in complication rates between the three groups. This study confirms the low soft tissue damage of minimal access surgery techniques, which is an important type of surgery in obese patients. Moreover, deeper regions of wounds are clearly visualized with the aid of tubular retractors.
Minimally invasive transforaminal lumbar interbody fusion using a single interbody cage and a tubular retraction system: technical tips, and perioperative, radiologic and clinical outcomes.

Lee CK, Park JY, Zhang HY.

**CONCLUSION:**
MIS TLIF achieved good clinical outcomes and high fusion rates.
MIS TLIF performed with a single interbody cage and a tubular retractor system can be used as a standard MIS TLIF technique.
CONCLUSION:
The results of this study support the long-term clinical effectiveness of MIS TLIF for varying diagnoses. These results suggest that those undergoing a 1-level or 2-level lumbar fusion improve equally, and that older patients do well with MIS surgery long term. Reoperation rates were acceptable, with excellent surgical durability at 49 months. The benefit of decompression was not assessed in this study, and future studies should assess its impact long term.
Minimally invasive or open transforaminal lumbar interbody fusion as revision surgery for patients previously treated by open discectomy and decompression of the lumbar spine.


52 patients (28 M, 24 F) with an average age of 55.7 (31-76) were prospectively evaluated. All patients who had previous discectomy (n = 13), hemilaminectomy (n = 16), laminectomy (n = 12) and facetectomy (n = 11) underwent monosegmental and bisegmental minimally invasive transforaminal lumbar interbody fusion (MiTLIF) (n = 25) or open transforaminal lumbar interbody fusion (OTLIF) (n = 27) by two experienced surgeons.

Complications included three cases of small dural tear in the MiTLIF group. There were five cases of dural tear and two cases of superficial wound infection in the OTLIF group. One case of nonunion was observed from each group.

Minimally invasive TLIF is a safe and effective procedure for treatment of selected revision patients previously treated by open surgery with some potential advantages. However, this technique needs longer X-ray exposure time.
Radiation exposure to the surgeon during open lumbar microdiscectomy and minimally invasive microdiscectomy: a prospective, controlled trial. Mariscalco MW, Yamashita T, Steinmetz MP, Krishnaney AA, Lieberman IH, Mroz TE.

CONCLUSION:
MIS lumbar microdiscectomy cases expose the surgeon to significantly more radiation than open microdiscectomy. One would need to perform 1623 MIS microdiscectomies to exceed the exposure limit for whole-body radiation, 8720 cases for the lens of the eye, and 11,235 cases for the hand. Standing in a substerile room during x-ray localization in open cases is not fully protective.
Minimal access versus open transforaminal lumbar interbody fusion: meta-analysis of fusion rates.

Wu RH, Fraser JF, Härtl R.

**STUDY DESIGN:** A quantitative meta-analysis was conducted on published studies reporting fusion rates after open or minimally invasive/mini-open transforaminal lumbar interbody fusion (TLIF) procedures for single or multilevel degenerative disease including stenosis with spondylolisthesis and degenerative disc disease.

**RESULTS:** Twenty-three articles were identified that fit inclusion criteria. In each of the 23 studies, TLIF was performed with pedicle fixation and fusion was evaluated using radiograph or computed tomography scan at minimum 6-month follow-up.

**CONCLUSION:**
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.
Minimally invasive transforaminal lumbar interbody fusion for the treatment of degenerative lumbar diseases.
Shunwu F, Xing Z, Fengdong Z, Xiangqian F.

CONCLUSION:
Minimally invasive TLIF as a management of 1-level degenerative lumbar diseases is superior to the traditional open procedure in terms of:
- postoperative back pain,
- total blood loss, need for transfusion,
- time to ambulation, length of hospital stay,
- soft-tissue injury, and functional recovery.

However, this procedure takes longer operative duration and requires close attention to the risk of technical complications.

Longer-term studies involving a larger sample are needed to validate the long-term efficacy of minimally TLIF.
To analyse evidence of superiority
2) results to analyse

Anterior technique: ALIF
complications


Trajectory of the main sensory and motor branches of the lumbar plexus outside the psoas muscle related to the lateral retroperitoneal transpsoas approach.

Dakwar E, Vale FL, Uribe JS.

Conclusions
- There is risk of direct injury to the main motor/sensory nerves that supply the anterior abdominal muscles during the early stages of the lateral retroperitoneal transpsoas approach while obtaining access to the retroperitoneum.
- There is also a risk of injury to the ilioinguinal, iliohypogastric, and lateral femoral cutaneous nerves in the retroperitoneal space where they travel obliquely during the blunt retroperitoneal dissection.
- There is a latent possibility of lesioning these nerves with the retractor blades against the anterior iliac crest.
Intraoperative and early postoperative complications in extreme lateral interbody fusion: an analysis of 600 cases.
Rodgers WB, Gerber EJ, Patterson J.

Conclusions Compared with traditional open approaches, the MIS lateral approach to fusion by using the XLIF technique resulted in a lower incidence of infection, visceral and neurologic injury, and transfusion as well as markedly shorter hospitalization. Complications in MIS XLIF compare favorably with those from other MIS fusion procedures; duration of hospitalization is shorter than with any previously reported technique.
Economical advantages?

The economics of minimally invasive spine surgery: the value perspective.
Allen RT, Garfin SR.

CONCLUSION: Although the CE of MIS surgery is yet to be carefully studied, the few economic studies that do exist suggest that MIS has the potential to be a cost-effective intervention, but only if improved clinical outcomes are maintained (durable). Longer follow-up and better outcome and cost data are needed to determine if incremental CE exists with MIS techniques, versus open.
ELDERLY advantages

The economics of minimally invasive spine surgery: the value perspective.
Allen RT, Garfin SR.

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.
RESULTS: No clinically significant differences in demographics, diagnoses, or comorbidities were found between groups.
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: 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.
Minimally invasive surgery for thoracolumbar spinal deformity: initial clinical experience with clinical and radiographic outcomes.

Wang MY, Mummaneni PV.

RESULTS:
The mean preoperative Cobb angle was 31.4 degrees, and it was corrected to 11.5 degrees at follow-up. The mean blood loss was 477 ml, and the operative time was 401 minutes.

The mean visual analog scale score improvement for axial pain was 3.96. Clear evidence of fusion was seen on radiographs at 84 of 86 treated levels, with no interbody pseudarthroses. Complications included 2 returns to the operating room, one for CSF leakage and the other for hardware pullout. There were no wound infections, pneumonia, deep venous thrombosis, or new neurological deficits.

However, of all patients, 30.4% experienced new thigh numbness, dysesthesias, pain, or weakness, and in one patient these new symptoms were persistent.
To analyse evidence of superiority
2) results to analyse

Combined
Two-level anterior lumbar interbody fusion with percutaneous pedicle screw fixation: a minimum 3-year follow-up study. Lee DY, Lee SH, Maeng DH.

RESULTS: The mean segmental lordosis, whole lumbar lordosis, and sacral tilt significantly increased after surgery (from 25.1 degrees, 39.2 degrees, and 32.6 degrees to 32.9 degrees, 44.5 degrees, and 36.6 degrees, respectively). Solid fusion was achieved in 21 patients. ASD was found in 8 of the 24 patients. No patient underwent revision surgery due to nonunion or ASD. Two-level ALIF with percutaneous PSF yielded satisfactory clinical and radiological outcomes and could be a useful alternative to posterior fusion surgery.
Does minimal access tubular assisted spine surgery increase or decrease complications in spinal decompression or fusion?

Fourney DR, Dettori JR, Norvell DC, Dekutoski MB.

RESULTS: From the 361 articles identified, 13 met a priori criteria and were included for review. All of the studies evaluated only lumbar spine surgery. The single large randomized study showed less favorable results for MAS discectomy, but no significant difference in complication rates. The quality of the other studies, particularly for fusion surgery, was low. Overall, the rates of reoperation, dural tear, cerebrospinal fluid leak, nerve injury, and infection occurred in similar proportions between MAS and open surgery. Blood loss was reduced in MAS fusion; however, the quality of those studies was very low. Operation time and hospital length of stay was variable across studies. There was no evidence to assess the effectiveness of strategies to reduce the risk of complications in MAS. Some data suggests that the rate of complications may decrease with experience.

CONCLUSION:

(1) Compared to open techniques, MAS does not decrease the rate of complications for posterior lumbar spinal decompression or fusion.

(2) There is no evidence to assess the effectiveness of strategies to reduce the risk of MAS-related complications.
CONCLUSION

INDICATIONS

1) Additional stabilisation to anterior interbody arthrodesis (ALIF)

2) In combination with PLIF, TLIF: tubular tech, percut screw

3) Postero-lat. arthrodesis after lumbar stenosis decompression from one side: tubular tech, percut screw

4) Temporary internal fracture stabilisation?

5) First step for fracture reduction
CONCLUSION

Minimally invasive fusion techniques in lumbar DDD: IS EFFECTIVE AND SAFE

Evidence of the superiority to open procedures IS NOT WELL DOCUMENTED
CONCLUSION

Minimally invasive fusion techniques in lumbar DDD: has demonstrated superiority

• Less blood loss
• Less tissue damages
• Less muscular ischemia
• Less post op pain
• Less hospital stay
CONCLUSION

Minimally invasive fusion techniques in lumbar DDD: is not superior

• Fusion rate equivalent
• Spine shape restoration not well documented
• Operating time is higher
• Global cost ???
CONCLUSION

Minimally invasive fusion techniques in lumbar DDD: is inferior to open

• Radiation dose is higher in MIS