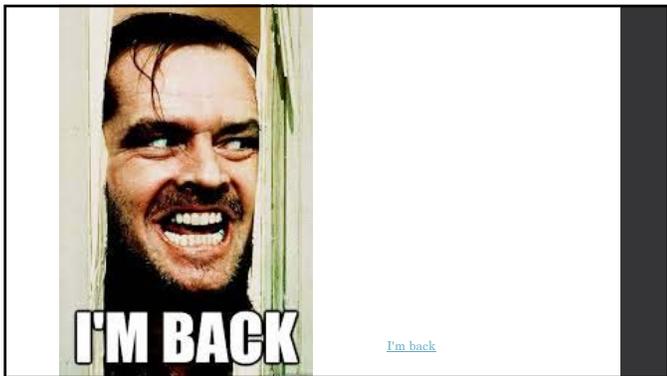


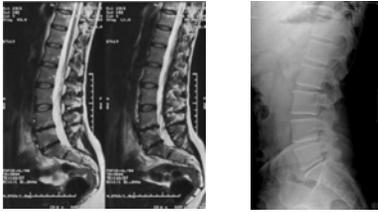
Two level lumbar fusion



Post laminectomy syndrome with 2 level DDD

- 31 yo 4 years s/p 2 level right partiel hemi laminectomy and discectomy had good resolution of right leg pain
 - began developing mechanical LBP 2 years ago
 - conservative Rx included Chiropractic care, Medication and Epidurals
- Facet blocks did not help pain

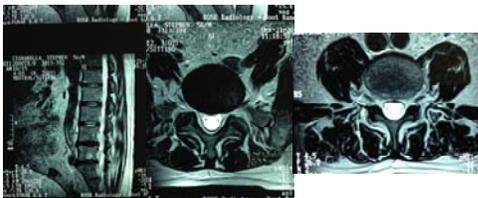
Two Level DDD



Options



Diagnostic Studies



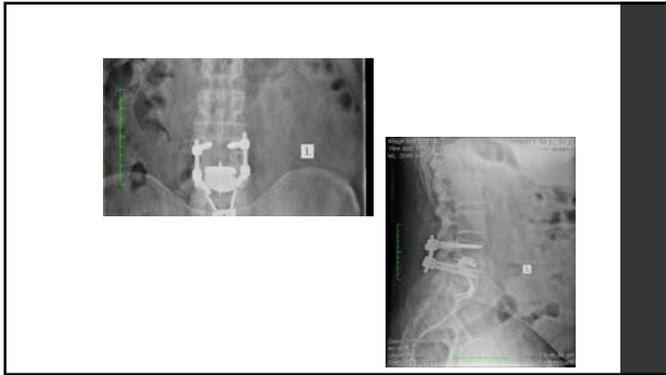
X-Ray





Follow up visit only ache in back as new C/O



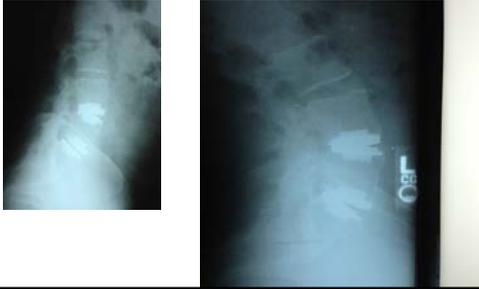


Case Presentation

- Prior L4-5-S1 Disc Arthroplasty 2005
- Pain free till motorcycle accident 2009
- Had thoracic disc surgery and did well
- Eventually developed low back pain
- Underwent multiple injections w/o relief
- 51 year old male
- 6' 220 lbs



Flex Ext Motion at L5-S1



Treatment Options

- Pain Management
- Posterior Fusion

Actually did well for 2 years then began to develop L-S pain



- Did well after DSS
- L5-S1 not done due to lordosis and size of implant
- Then began to develop L-S pain Patient asking for Coflex

Journal of Clinical Neuroscience
 Volume 34, December 2016
 Lackey A, Phan K, Mobbs R

- A systematic review and [meta-analysis was performed to assess the effect of hybrid constructs which involve a total disc arthroplasty \(TDA\) with stand-alone anterior lumbar interbody fusion \(ALIF\) versus non-hybrid constructs including multi-level TDA, multi-level transforaminal lumbar interbody fusion \(TLIF\) with posterior transpedicular fixation or multi-level stand-alone ALIF as a surgical intervention for degenerative disc disease \(DDD\) in the lumbar spine](#)
- Primary outcomes analysed included the Oswestry Disability Index (ODI) and the Visual Analogue Scale (VAS) for back pain
- Results so far slightly favour clinically significant improved VAS back pain score outcomes postoperatively and at 2-years follow-up for hybrid constructs in multi-level lumbar DDD of the spine when compared with non-hybrid multi-level LF or TDA. It cannot however be concluded that a hybrid construct is superior to multi-level LF or TDA based on this meta-analysis.

[J Craniovertebr Junction Spine. 2015 Oct-Dec;6\(4\):183-9. doi: 10.4103/0974-8237.167869.](#)
Combined transforaminal lumbar interbody fusion with posterolateral instrumented fusion for degenerative disc disease can be a safe and effective treatment for lower back pain.
[Deukmedjian AJ1, Cianciabella AJ1, Cutright J1, Deukmedjian A](#)

- Two-hundred and five consecutive patients with single or multi-level DDD underwent lumbar decompression and instrumented fusion for the treatment of chronic LBP between the years of 2008 and 2011.
- The average resolution of preoperative back pain per patient was 84% (n = 205) while the average resolution of preoperative leg pain was 90% (n = 190) while a mean follow-up period of 528 days (1.5 years). Average VAS for combined back and leg pain significantly improved from a preoperative value of 9.0 to a postoperative value of 1.1 (P ≤ 0.0001), a change of 7.9 points for the cohort. The average number of lumbar disc levels fused per patient was 2.3

Spine (Phila Pa 1976). 2012 Oct 15;37(22 Suppl):S133-43. doi: 10.1097/BRS.0b013e31826cadf2. Do lumbar motion preserving devices reduce the risk of adjacent segment pathology compared with fusion surgery? A systematic review.
 Wang JCI, Arnold PM, Hermsmeider JT, Norvell DC.

- A systematic search was conducted in PubMed and the Cochrane Library for literature published between January 1990 and February 2012
- Evidence demonstrates that the risk of clinical ASP requiring surgery is likely greater after fusion but the risk is still quite rare. The increased risk compared to TDR could be as small as less than 1% or as great as 10%.
- There is insufficient evidence to make a definitive statement regarding fusion versus other motion-sparing devices with respect to the risk of ASP.

Cochrane Database Syst Rev. 2012 Sep 12;(9):CD008326. doi: 10.1002/14651858.CD008326.pub2. Total disc replacement for chronic back pain in the presence of disc degeneration.
 Jacobs WJ, Van der Gaag NA, Tuschel A, de Kleuver M, Peul W, Verhout Ad, Oner FC

- Purpose
- In the search for better surgical treatment of chronic low-back pain (LBP) in the presence of disc degeneration, total disc replacement has received increasing attention in recent years. A possible advantage of total disc replacement compared with fusion is maintained mobility at the operated level, which has been suggested to reduce the chance of adjacent segment degeneration.

Conclusion

- Although statistically significant, the differences between disc replacement and conventional fusion surgery for degenerative disc disease were not beyond the generally accepted clinical important differences with respect to short-term pain relief, disability and Quality of Life. Moreover, these analyses only represent a highly selected population.
- The primary goal of prevention of adjacent level disease and facet joint degeneration by using total disc replacement, as noted by the manufacturers and distributors, was not properly assessed and not a research question at all

- Therefore, because we believe that harm and complications may occur after years, we believe that the spine surgery community should be prudent about adopting this technology on a large scale.

[J Neurosurg Spine. 2012 Dec;17\(6\):493-501. doi: 10.3171/2012.9.SPINE11498. Epub 2012 Oct 19.](#)

Five-year results of the prospective, randomized, multicenter, Food and Drug Administration investigational device exemption study of the ProDisc-L total disc replacement versus circumferential arthrodesis for the treatment of single-level degenerative disc disease.

[Zigler JE1, Delamarter RB.](#)

- The purpose of this study was to evaluate the long-term safety and effectiveness of the ProDisc-L total disc replacement (TDR) as part of an FDA-mandated postmarket approval study. This report summarizes the clinical findings after 5 years of follow-up.
- Patients in both groups maintained significant improvement during the 5-year follow-up. The TDR group had significantly better improvement on some scales. Although TDR patients avoid the stiffness of fusion and are more satisfied than fusion patients, both fusion and TDR are reasonable surgical options in this specific patient population.

[World Neurosurg. 2017 Apr 19. pii: S1878-8750\(17\)30572-7. doi: 10.1016/j.wneu.2017.04.077. \[Epub ahead of print\]](#)

Outcome of Anterior Lumbar Interbody Fusion: a Retrospective Study of Clinical and Radiological Parameters.

[Finson H1, Hallaert G2, Herregodts F3, Everaert K4, Couvreur T5, Caemaert J3, Kalala JP3, Van Roost D3.](#)

- This study aims to critically evaluate the long-term results of stand-alone anterior lumbar interbody fusion (ALIF), without use of rhBMP-2, as a therapeutic option for symptomatic patients with degenerative disc disease (DDD)
- 123 patients with 154 fusion levels were reviewed.
- The mean visual analogue scales (VAS) for back and leg pain improved significantly ($P < 0.001$) with 5 and 4.4 points respectively at 3 years follow-up
- The ALIF-technique is a durable treatment option for patients with DDD.

Neurosurg Rev. 2016 Dec 24. doi: 10.1007/s10143-016-0806-8. [Epub ahead of print]
Clinical outcomes after minimally invasive transforaminal lumbar interbody fusion and lateral lumbar interbody fusion for treatment of degenerative lumbar disease: a systematic review and meta-analysis.

- Fifty-eight studies were included for the analysis of MIS-TLIF; 40 studies were included for analysis of LLIF, and 1 randomized controlled trial (RCT) study was included for comparison of MIS-TLIF to LLIF. Overall, there were 9506 patients (5728 in the MIS-TLIF group and 3778 in the LLIF group). Indirect meta-analysis.
- MIS-TLIF provided better postoperative back and leg pain (VAS), disabilities (ODI), and risk of having complications when compared to LLIF
- MIS-TLIF had better ODI, VAS pain, and complication rate when compared to LLIF with direct and indirect meta-analysis methods. However, in terms of fusion rates, there were no differences between the two techniques.

J Neurosci Rural Pract. 2017 Apr-Jun;8(2):194-198. doi: 10.4103/inrp.inrp.472.16.
Minimally Invasive versus Open Spine Surgery: What Does the Best Evidence Tell Us?

[McClelland S 3rd1, Goldstein JA1](#)

- A total of 17 RCTs were identified,
- MIS transforaminal lumbar interbody fusion (TLIF) had significantly reduced 2-year societal cost, fewer medical complications, reduced time to return to work, and improved short-term Oswestry Disability Index scores
- more than twice the amount of intraoperative fluoroscopy.

J Spinal Disord Tech. 2011 Jul;24(5):288-96. doi: 10.1097/BSD.0b013e3181f9a60a.
Long-term durability of minimal invasive posterior transforaminal lumbar interbody fusion: a clinical and radiographic follow-up.

[Rouben D1, Casnellie M, Ferguson M](#)

- One hundred sixty-nine consecutive patients, with either isolated single-level or 2-level lumbar intervertebral segment pain manifested by back pain alone or back pain with leg pain associated with a primary diagnosis of degenerative spondylolisthesis, central herniated disc, central stenosis, Foraminal-lateral herniation of disc, Foraminal/lateral stenosis, or isolated degenerative disc or joint disease.
- Average surgery time was 183 minutes, with no difference between older and younger patients. Hospital stay averaged 15 hours with a median return to work time of 8 weeks. Return to work for patients working before surgery was 97%. ODI improved 36% at the first follow-up and was improved 41% at 49 months postoperative (P < 0.001)
- 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

PLoS One. 2017 Feb 16;12(2):e0171546. doi: 10.1371/journal.pone.0171546. eCollection 2017.
Minimally invasive procedure reduces adjacent segment degeneration and disease: New benefit-based global meta-analysis.
[Li XCT, Huang CMI, Zhong CPT, Liang RW1, Luo SJ1](#)

- 770 patients were included
- pooled data analysis demonstrated significantly lower ASP incidence rate in patients who underwent MIS procedure, compared with those who underwent open procedure ($p = 0.0001$ in the study)

Orthopedics. 2016 Nov 1;39(6):e1218-e1222. doi: 10.3928/01477447-20160721-04. Epub 2016 Aug 3.
Minimally Invasive Transforaminal Lumbar Interbody Fusion in the Outpatient Setting.
[Emami A, Falooni M, Issa K, Shafa E, Pourtaheri S, Sinha K, Hwang KS](#)

- This study assessed whether this procedure can be safely performed in outpatient settings.
- Ninety-six consecutive patients undergoing 1- or 2-level MIS-TLIFs were retrospectively reviewed.
- There were no statistically significant differences in overall postoperative complication rates, readmission rates, or final Oswestry Disability Index or visual analog scale scores between the 2 cohorts.

Eur Spine J. 2017 Mar;26(3):806-815. doi: 10.1007/s00586-016-4714-v. Epub 2016 Jul 23.
Total disc replacement versus fusion for lumbar degenerative disc disease: a systematic review of overlapping meta-analyses.
[Ding F1, Jia Z2, Zhao Z1, Xie L1, Gao X1, Ma D1, Liu M3](#)

- This study aimed to conduct a systematic review of overlapping meta-analyses comparing TDR with fusion for treating LDDD, to assist decision makers in selection among conflicting meta-analyses, and to provide treatment recommendations based on the best available evidence
- According to this systematic review of overlapping meta-analyses comparing TDR and fusion for LDDD, the current best available evidence suggests that TDR may be an effective technique for the treatment of selected patients with LDDD, and is at least equal to lumbar fusion in the short term. However, considering that disadvantages may appear after years, spine surgeons should be cautious about performing TDR on a large scale.

Minimally Invasive Lumbar Surgery

• Goal

- Same as open Surgery
- Lessen approach morbidity without compromising efficacy of procedure



Rationale for Mult-Level MIS

Avoid Approach-related Morbidity

- | | |
|--|---|
| <ul style="list-style-type: none"> • Avoid large midline muscle stripping incisions • Avoid muscle detachment from spine and associated muscle denervation • Avoid significant muscle retraction • Minimize epidural and myofascial scarring | <ul style="list-style-type: none"> • Minimize postoperative instability • Decrease blood loss • Decrease length of stay • Earlier mobilization • Less PAIN |
|--|---|

J Spinal Disord Tech. 2012 Aug;25(6):324-8. doi: 10.1097/
Acute hospital costs after minimally invasive versus open lumbar interbody fusion: data from a US national database with 6106 patients.

Wang MY1, Lerner J, Lesko J, McGirt MJ.

- MIS lumbar interbody fusion results in a statistically significant reduction in hospital LOS and a reduction in total hospital costs with 2-level surgery.
- The majority of cost savings from MIS surgery were due to more rapid mobilization and discharge, as well as a reduction in outliers with extended hospitalizations.

Muscle Preservation is KEY

- **Suwa Neurol Med Chir 2000**
 - MRI evaluation of paraspinal muscle thickness
 - Most decrease seen in PL fusion
 - Highest CPK in PL fusion group
- **Kim et al Spine 2006**
 - MIS vs. Open PLIF
 - Significant reduction in CPK, aldolase and cytokines in MIS group
- **Mayer et al Spine 1986**
 - Muscle Strength
 - Open Fusion patients significantly less than discectomy patients

Patient

- 39 year old male
- Intractable back and right leg pain
- Prior lami/disc L4-5-S1
- Severe clauditory symptoms
- Exhaustive conservative care/failed

AP/LAT



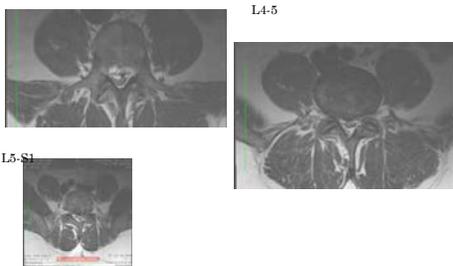
Flex/Ex

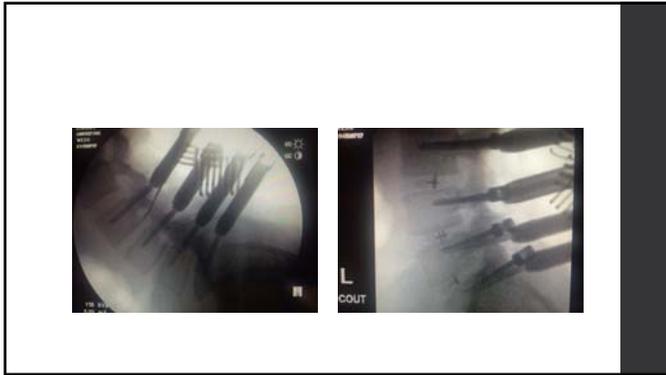


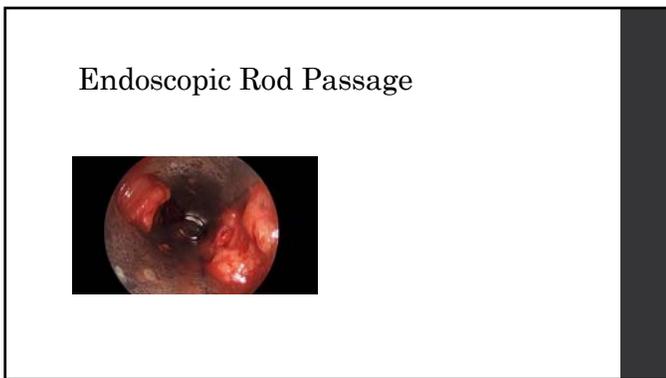
MRI T2/Stir



Axial L3-4









S4 Element MIS advantages

Decrease radiation exposure with Endoscopic visualized rod passage

Strong screw and tube connection

Tube easily removed and replaced as needed



Thank-You