MIS Spinal Surgery - Where Are we?

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USA

Weill Cornell Medical College

Four pillars of Minimally Invasive Spinal Surgery

Access:
Percutaneous
Mini-Open

Microsurgery:
Microscope
Endoscope

Navigation:
2D
3D

Instrumentation:
percutaneous
Mini-open

MIS Spine

- A procedure that by virtue of the extent and means of surgical techniques results in …
  - *less collateral tissue damage*,
  - measurable *decrease in morbidity* and
  - more rapid *functional recovery* than traditional exposures,
  - without differentiation in the intended surgical goal

- McAfee PC, Phillips FM, Andersson G, et al. (2010) Minimally invasive spine surgery. *Spine*


[Summary Statement] Table of Contents | Next Article

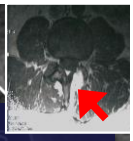
Minimally Invasive Spine Surgery

McAfee, Paul C. MD, MBA; Phillips, Frank M. MD; Andersson, Gunnar MD, PhD; Buvenenadran, Asokumar MD; Kim, Choll W. MD; Lauryssen, Carl MD; Isaacs, Robert E. MD; Youssef, Jim A. MD; Brodke, Darrel S. MD; Cappuccino, Andrew MD; Abdamia, Behrooz A. MD; Mundis, Gregory M. MD; Smith, William D. MD; Uribe, Juan S. MD; Garfin, Steve MD; Allen, R. Todd MD; Rodgers, William Blake MD; Pimenta, Luiz MD, PhD; Taylor, William MD

MIS Spine: Where are we?

- "Targeted MIS" based on *clinical presentation* and *radiology findings*
  - Treat pathology
  - Minimize overtreatment
  - "Surgical Strike" *vs.* "Carpet Bombing"
- MIS technique principles
  - Contralateral decompression
  - Minimize iatrogenic instability
  - Indirect decompression
- Minimize fusion need
- "Total Navigation"

MIS Principles

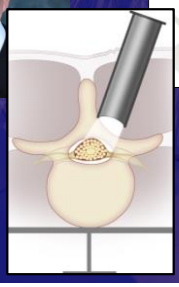


- Avoid muscle injury by …
  - »Muscle splitting self-retaining retractors
  - »Limiting the width of the surgical corridor
  - »Using known anatomic neurovascular and muscle planes
- Do not disrupt tendon attachment of key muscles, particularly at the sp

Scientific Basis of Minimally Invasive Spine Surgery

Prevention of Multifidus Muscle Injury During Posterior Lumbar Surgery

Chull W. Kim, MD, [illegible]



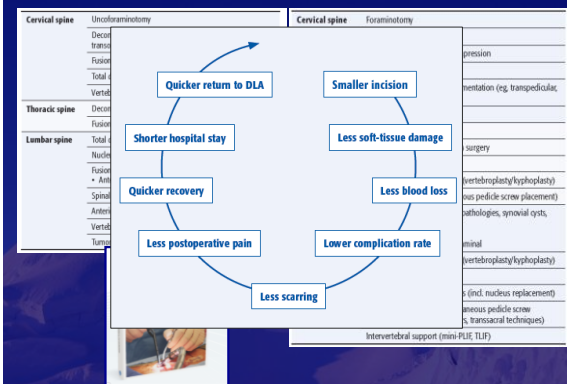
HAE-DONG JHO, MD, PHD

The (cool) tools we use in MIS surgery…

- Tubes
- Microscopes / Endoscopes
- 3D Navigation System "GPS of the Spine"
- Implants

- Sorry…no lasers !

Anterior and Posterior MIS Approaches



Spinal MIS

- Three Principles of Spinal MIS:
  1. Contralateral Decompression
  2. Minimize Instability
  3. Indirect Decompression

1. Principle

- **Contralateral Decompression:**
  - **You can perform a bilateral decompression and a contralateral foraminotomy through a unilateral minimally invasive approach**

Bilateral Decompression *via* Unilateral Approach

Acta Neurochir (Wien) (1997) 139: 392–396

Acta Neurochirurgica

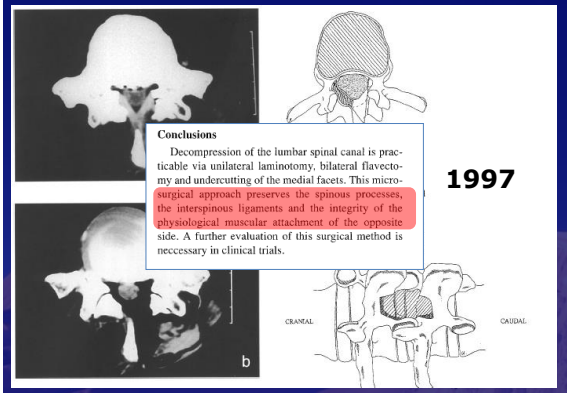
Printed in Austria

1997

Unilateral Laminotomy for Bilateral Decompression of Lumbar Spinal Stenosis
Part I: Anatomical and Surgical Considerations

U. Spetzger[1], H. Bertalanffy[1], C. Naujokat[2], D. G. v. Keyserlingk[2], and J. M. Gilsbach[1]

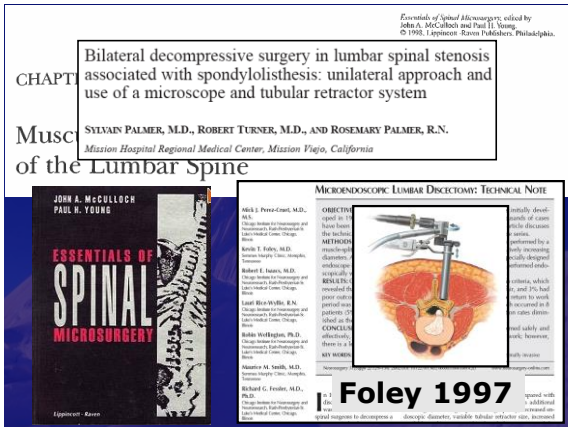
[1] Department of Neurosurgery and [2] Department of Anatomy, Medical Faculty, Technical University of Aachen, Federal Republic of Germany

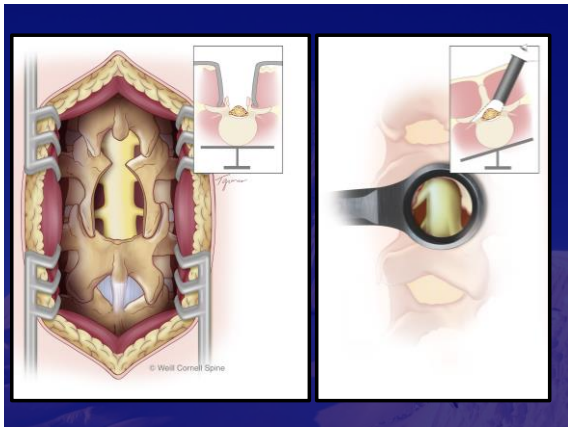


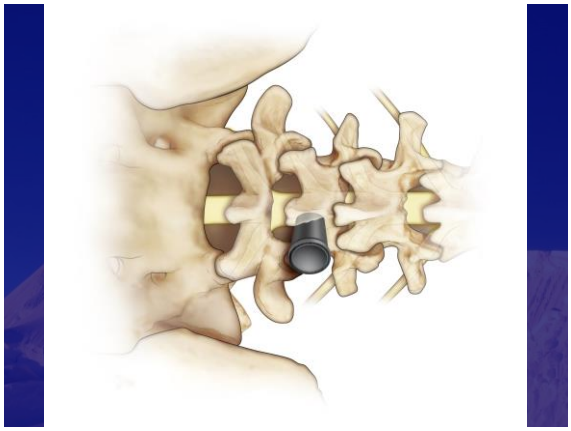
Conclusions

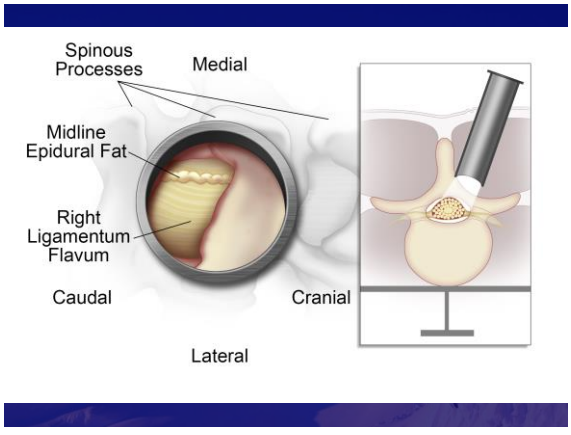
Decompression of the lumbar spinal canal is practicable via unilateral laminotomy, bilateral flavectomy and undercutting of the medial facets. This microsurgical approach preserves the spinous processes, the interspinous ligaments and the integrity of the physiological muscular attachment of the opposite side. A further evaluation of this surgical method is neccessary in clinical trials.

1997


Essentials of Spinal Microsurgery, edited by John A. McCulloch and Paul H. Young.
© 1998, Lippincott-Raven Publishers, Philadelphia.
Bilateral decompressive surgery in lumbar spinal stenosis associated with spondylolisthesis: unilateral approach and use of a microscope and tubular retractor system
Sylvain Palmer, M.D., Robert Turner, M.D., and Rosemary Palmer, R.N.
Mission Hospital Regional Medical Center, Mission Viejo, California
CHAPT
Musc
of the Lumbar Spine
JOHN A. McCULLOCH
PAUL H. YOUNG
ESSENTIALS OF
SPINAL
MICROSURGERY
Lippincott-Raven
Microendoscopic Lumbar Discectomy: Technical Note
Foley 1997


© Weill Cornell Spine

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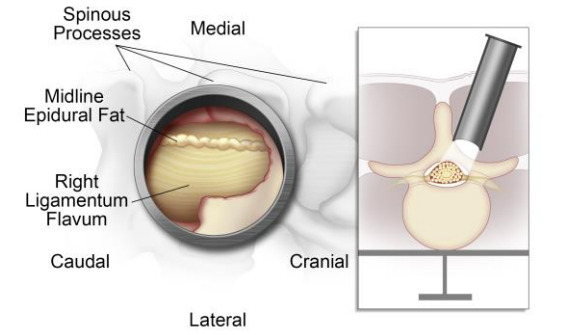
Midline Epidural Fat
Right Ligamentum Flavum
Caudal
Cranial
Lateral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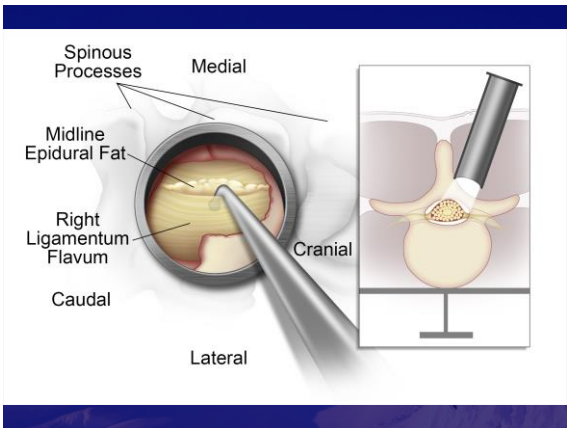
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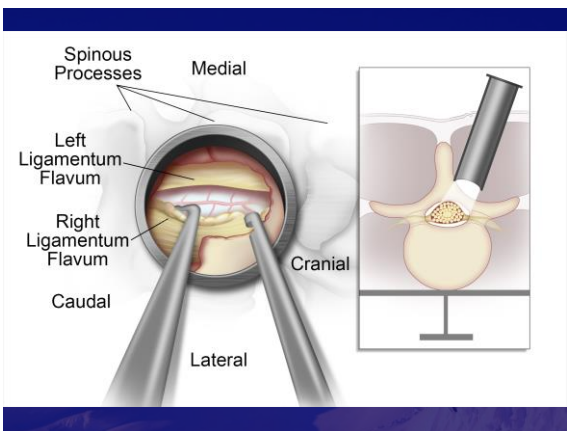
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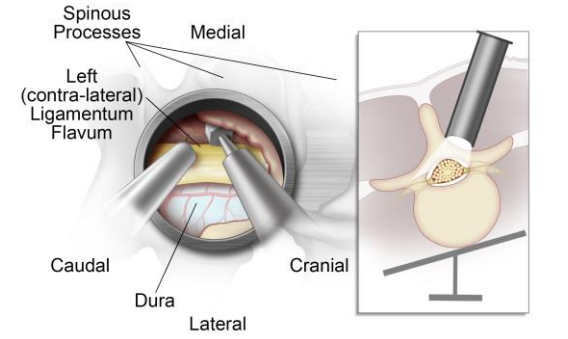
Right Ligamentum Flavum
Caudal
Cranial
Lateral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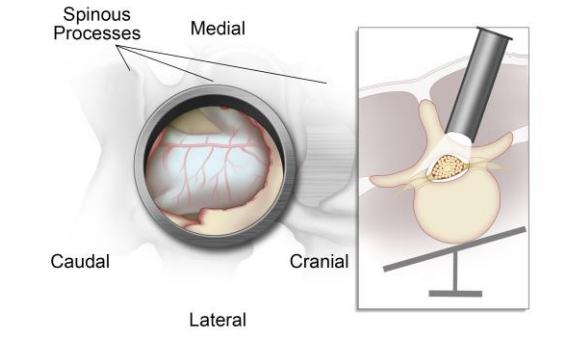
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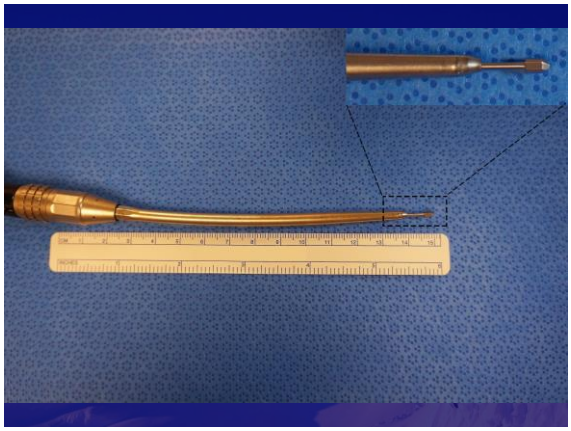
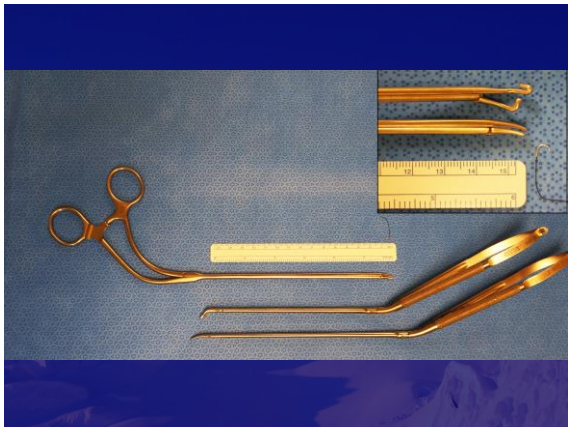
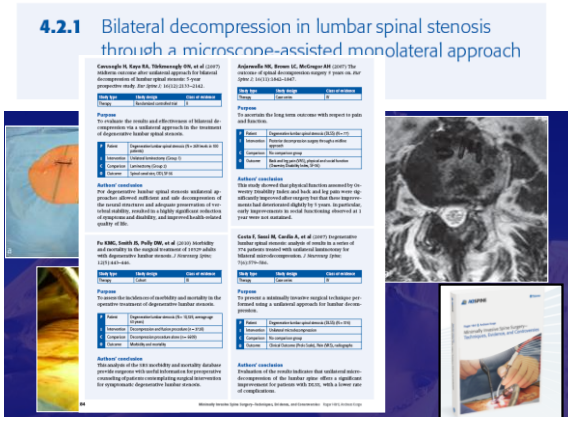




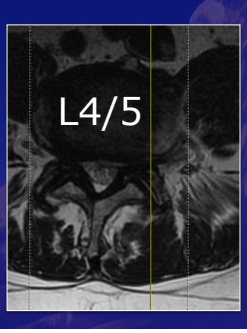


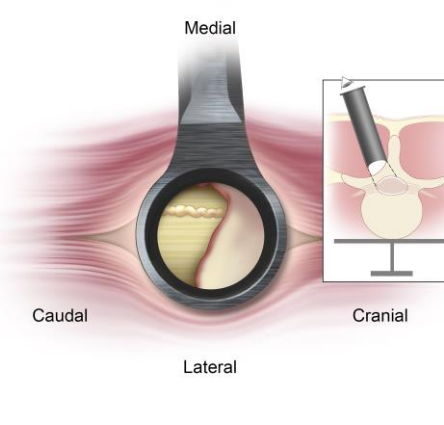
MIS Tubular Laminectomy (Laminotomy)

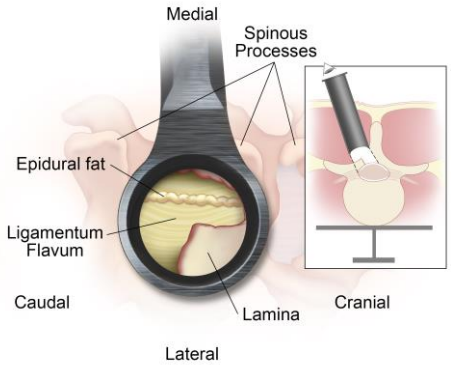
- **Class III evidence**
  - **Faster recovery**
    - **Mobility**
    - **Return to work**
  - **Improved perioperative clinical outcomes**
    - **EBL, LOS**
  - **Equivalent patient reported long term outcomes**
  - **Decreased hospital cost/societal cost**

Contralateral Decompression

81 y/o M with left L4 radiculopathy



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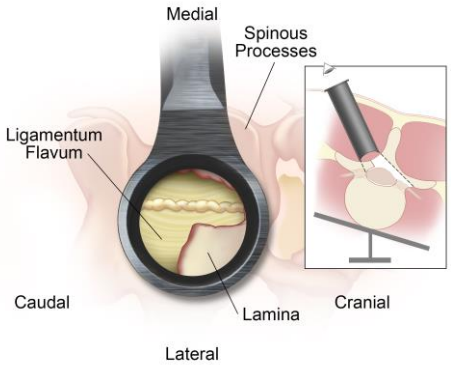
Epidural fat
Ligamentum Flavum
Caudal
Lamina
Cranial
Lateral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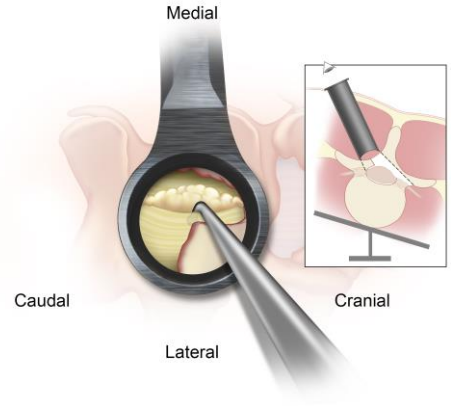
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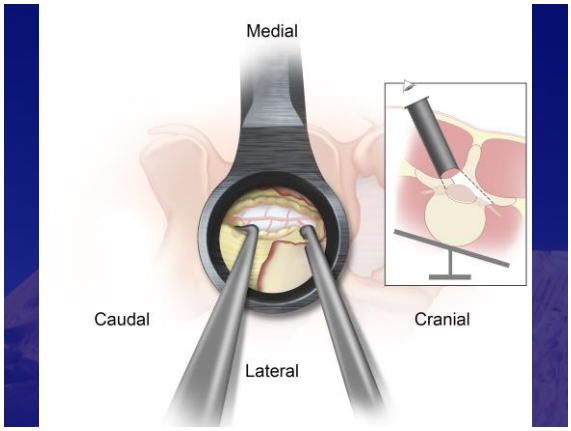
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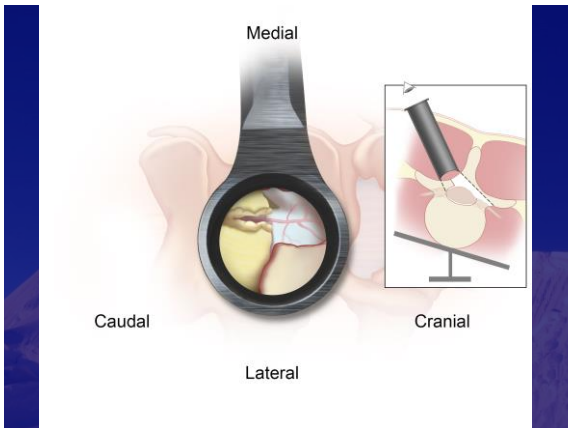
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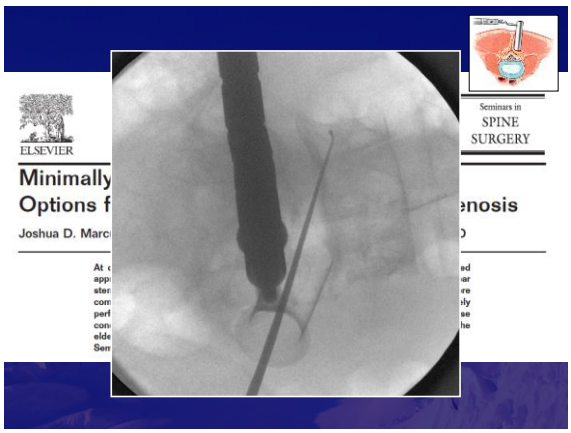
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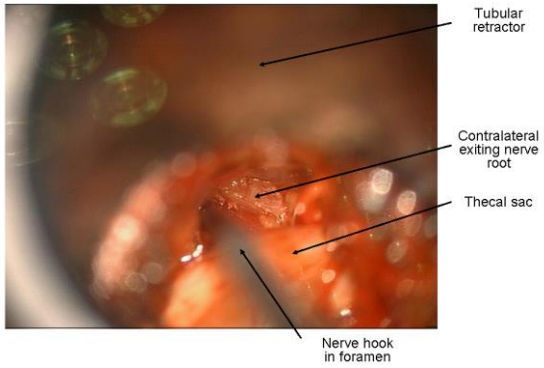
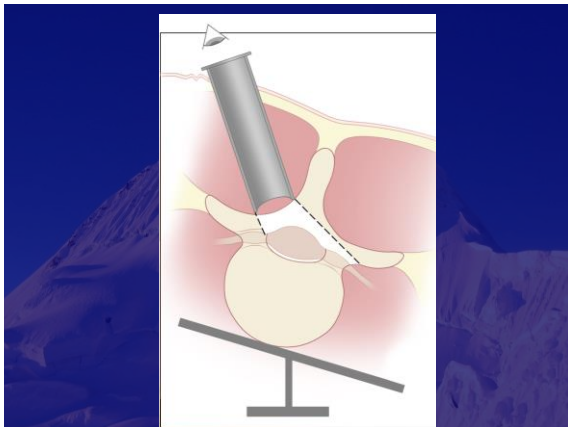
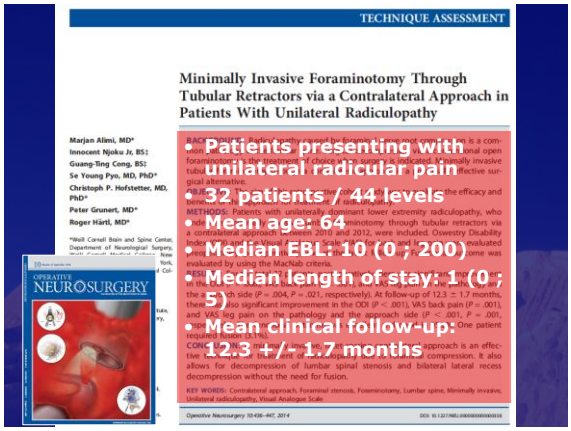






- **Patients presenting with unilateral radicular pain**
- **32 patients / 44 levels**
- **Mean age: 64**
- **Median EBL: 10 (0 ; 200)**
- **Median length of stay: 1 (0 ; 5)**
- **Mean clinical follow-up: 12.3 +/- 1.7 months**

Clinical outcome

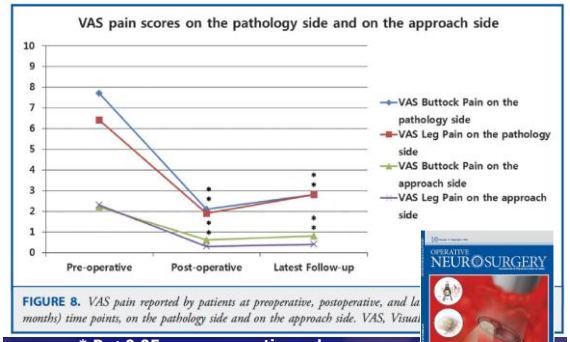


FIGURE 8. *VAS pain reported by patients at preoperative, postoperative, and la*
months) time points, on the pathology side and on the approach side. VAS, Visua

*** P < 0.05 vs. preoperative value**

Next Steps

Journal of Clinical Neuroscience 22 (2015) 730–734

Contents lists available at ScienceDirect

Journal of Clinical Neuroscience

journal homepage: www.elsevier.com/locate/jocn

Clinical Study

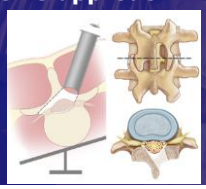
Endoscopic lumbar foraminotomy

Alexander I. Evins[a], Matei A. Banu[a], Innocent Njoku Jr.[a], Eric H. Elowitz[a], Roger Härtl[a], Antonio Bernado[a], Christoph P. Hofstetter[b,*]

[a]Department of Neurological Surgery, Weill Cornell Medical College, New York Presbyterian Hospital, New York, NY, USA
[b]Department of Neurological Surgery, University of Washington Medical Center, Seattle, WA, USA

1. Principle

- **Contralateral decompression:**
  - **You can perform a bilateral decompression and a contralateral foraminotomy through a unilateral minimally invasive approach**

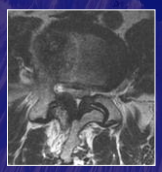


2. Principle

- **Minimalize Instability:**
  - **Minimally invasive spinal decompression can reduce iatrogenic instability and reduce the need for instrumentation and fusion**

Decompression or Decompression / Fusion ?

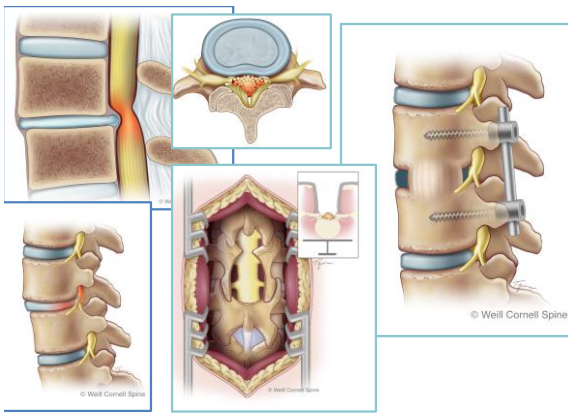
60 y/o F with stenosis & Grade I Spondylolisthesis

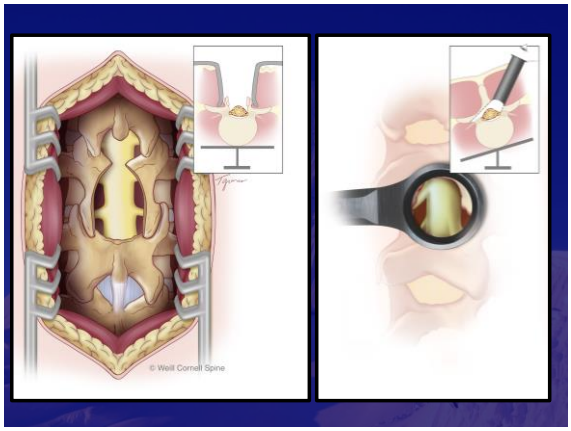


Also more recent: Kornblum, et.al. Spine 2008

J Neurosurg: Spine 2:679–683, 2005

Guidelines for the performance of fusion procedures for degenerative disease of the lumbar spine.
Part 9: fusion in patients with stenosis and spondylolisthesis

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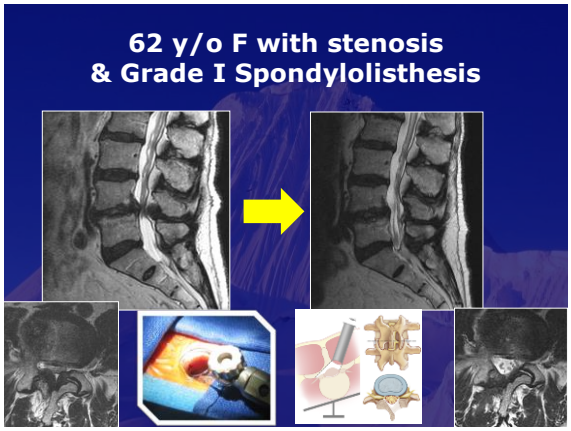
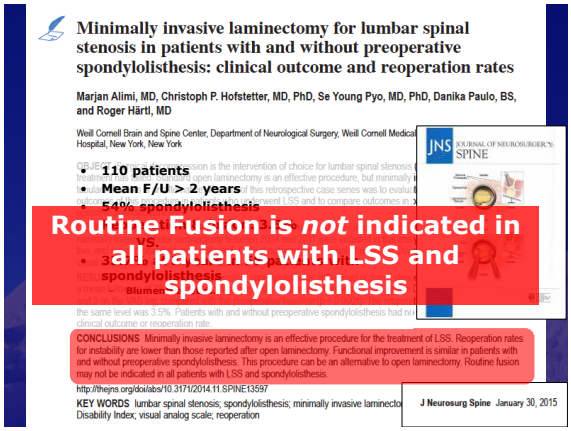
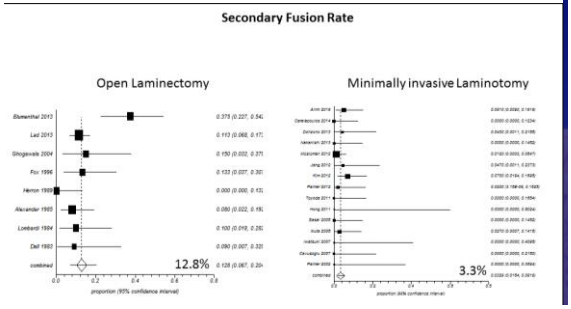

62 y/o F with stenosis
& Grade I Spondylolisthesis


Minimally invasive laminectomy for lumbar spinal stenosis in patients with and without preoperative spondylolisthesis: clinical outcome and reoperation rates
Marjan Alimi, MD, Christoph P. Hofstetter, MD, PhD, Se Young Pyo, MD, PhD, Danika Paulo, BS, and Roger Härtl, MD
Weill Cornell Brain and Spine Center, Department of Neurological Surgery, Weill Cornell Medical
Hospital, New York, New York
• 110 patients
• Mean F/U > 2 years
• 54% spondylolisthesis
Routine Fusion is not indicated in all patients with LSS and spondylolisthesis
JNS JOURNAL OF NEUROSURGERY: SPINE
CONCLUSIONS Minimally invasive laminectomy is an effective procedure for the treatment of LSS. Reoperation rates for instability are lower than those reported after open laminectomy. Functional improvement is similar in patients with and without preoperative spondylolisthesis. This procedure can be an alternative to open laminectomy. Routine fusion may not be indicated in all patients with LSS and spondylolisthesis.
http://thejns.org/doi/abs/10.3171/2014.11.SPINE13597
KEY WORDS lumbar spinal stenosis; spondylolisthesis; minimally invasive laminecto
Disability Index; visual analog scale; reoperation
J Neurosurg Spine January 30, 2015

Lumbar spinal stenosis associated with degenerative lumbar spondylolisthesis: A systematic review and meta-analysis of secondary fusion rates following open vs. minimally invasive decompression



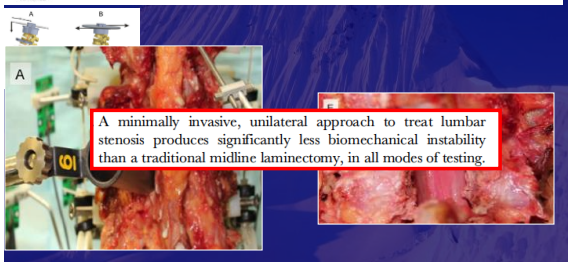
OPEN ACCESS Freely available online

PLOS ONE

Biomechanical Effects of a Unilateral Approach to Minimally Invasive Lumbar Decompression

Zachary A. Smith[1], Georgios A. Vastardis[2,3], Gerard Carandang[2,3], Robert M. Havey[2,3], Sean Hannon[2,3], Nader Dahdaleh[1], Leonard I. Voronov[2,3], Richard G. Fessler[1], Avinash G. Patwardhan[2,3]

1 Northwestern Feinberg School of Medicine, Department of Neurological Surgery, Northwestern University, Chicago, Illinois, United States of America, 2 Loyola University Stritch School of Medicine, Department of Orthopaedic Surgery, Maywood, Illinois, United States of America, 3 Edward Hines Jr. VA Hospital, Hines, Illinois, United States of America



H.M. Mayer · F. Heider

Wirbelsäulenzentrum, Schön Klinik München – Harlaching, München

Selektive, mikrochirurgische „Cross-over"-Dekompression mehrsegmentaler lumbaler Spinalstenosen

Die „Slalom"-Technik

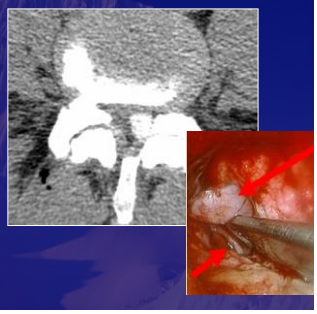
MIS = "Minimally Invasive Spine Surgery"

...or...

"Minimal Instrumentation Surgery"

Case Example: Spinal stenosis and facet joint cyst

- 65 y/o M with leg pain and neurogenic claudication
- Failed PT and epidural steroid injections

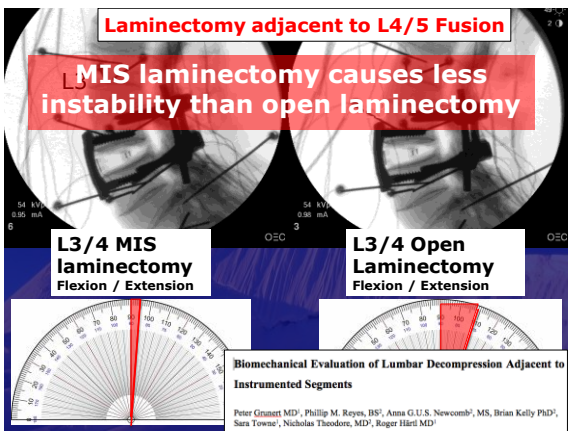


"Tubology" Approach Pearls

- *Foraminal stenosis with radiculopathy*
  - **Contralateral approach**
- *Central stenosis with neurogenic claudication*
  - **Right-sided approach for right-handed surgeon**
  - **Left-sided approach for left-handed surgeon**
  - **1-2 levels: one incision**
  - **3-4 levels: "slalom" technique**
- *Lateral recess stenosis*
  - **approach as above**
- *Unilateral disc herniation*
  - **ipsilateral approach**
- *Synovial cyst*
  - **Contralateral approach**

Laminectomy adjacent to L4/5 Fusion

MIS laminectomy causes less instability than open laminectomy



MIS decompression instead of fusion…

1. Lumbar spinal stenosis with stable spondylolisthesis
2. Unilateral foraminal stenosis
3. Lumbar stenosis adjacent to a level that requires fusion

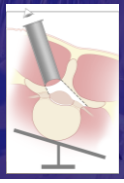
MIS = "Minimally Invasive Spine Surgery"

…or…

"Minimal Instrumentation Surgery"

1. Principle

- Contralateral decompression:
  - You can perform a bilateral decompression and a contralateral foraminotomy through a unilateral minimally invasive approach



2. Principle

- **Minimalize Instability:**
  - **Minimally invasive spinal decompression can reduce iatrogenic instability and reduce the need for instrumentation and fusion**

3. Principle

- **Indirect decompression:**
  - **Minimally invasive spinal surgery allows *indirect* decompression of central and foraminal stenosis in selected patients**

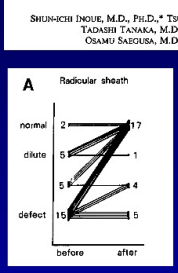
Indirect Decompression

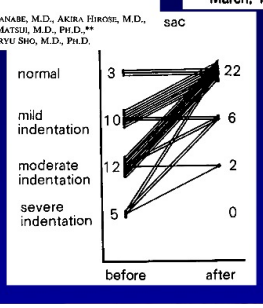
Anterior Discectomy and Interbody Fusion for Lumbar Disc Herniation

A Review of 350 Cases

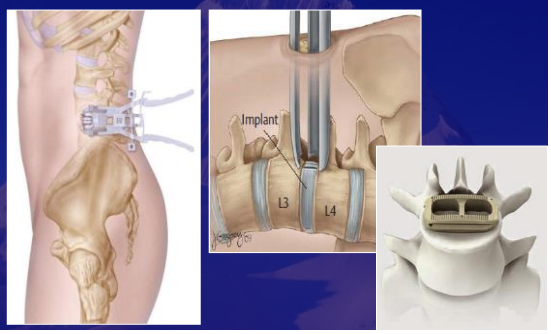
SHUN-ICHI INOUE, M.D., PH.D.,* TSUNEO WATANABE, M.D., AKIRA HIROSE, M.D., TADASHI TANAKA, M.D., NOBUO MATSUI, M.D., PH.D.,** OSAMU SAEGUSA, M.D., AND EKIRYU SHO, M.D., PH.D.

Number 183
March, 1984

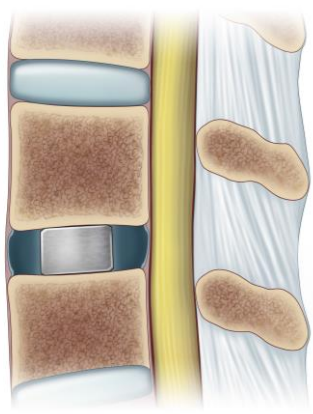




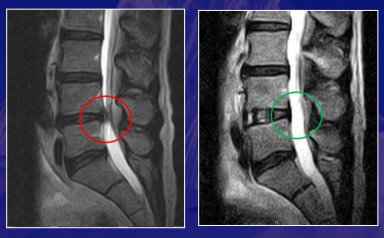
Lateral access / Transpsoas Surgery / ELIF / XLIF



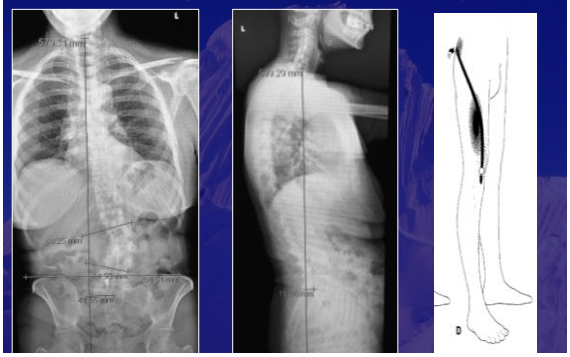
Indirect Decompression



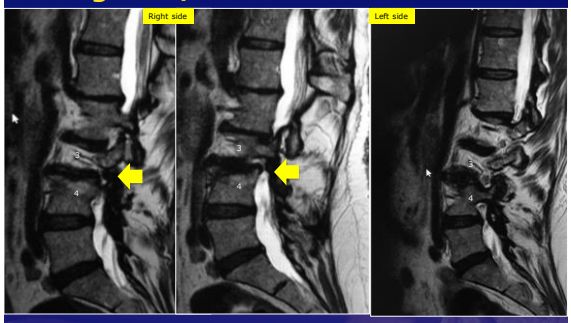
Indirect Decompression



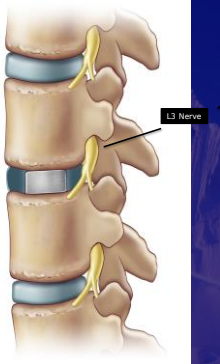
67 y/o Male with right L3/4 radicular pain, minimal back pain



Right L3/L4 Foraminal Stenosis



Indirect Decompression

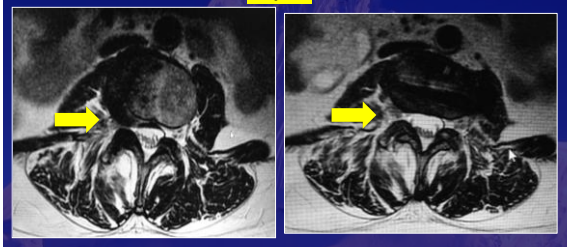


15 months postoperative

15 months postoperative

Pre *vs.* 15 months postoperative

L3/L4



Eur Spine J (2015) 24 (Suppl 3):S346–S352
DOI 10.1007/s00586-015-3940-z

CrossMark

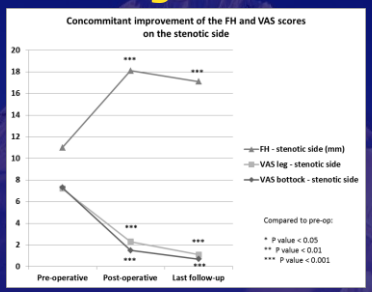
ORIGINAL ARTICLE

Extreme lateral interbody fusion for unilateral symptomatic vertical foraminal stenosis

Marjan Alimi[1] · Christoph P. Hofstetter[1] · Apostolos J. Tsiouris[2] · Eric Elowitz[1] · Roger Härtl[1]

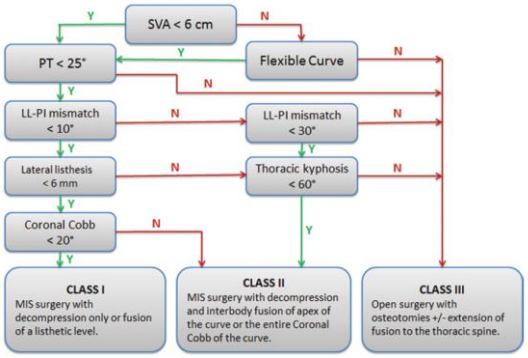
- **23 patients with unilateral leg pain and forminal stenosis**
- **1 year follow – up**
- **Single-level XLIF is an effective procedure for unilateral foraminal stenosis & radiculopathy**

Foraminal Height and Leg Pain



LIMITATIONs of MIS

Neurosurg Focus 36 (5):E6, 2014



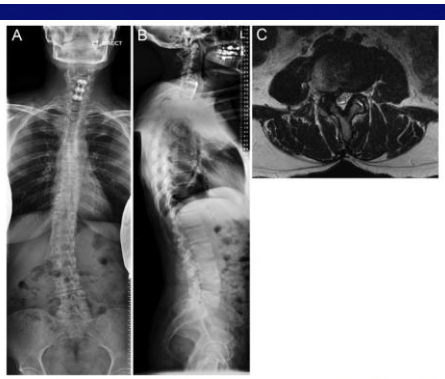


Fig. 2. MISDEF Class I. Anteroposterior (A) and lateral (B) radiographs and axial T2-weighted MR image (C) obtained in a patient with significant leg pain but no back pain. The SVA was less than 6 cm and the LL-PI mismatch was 7°.

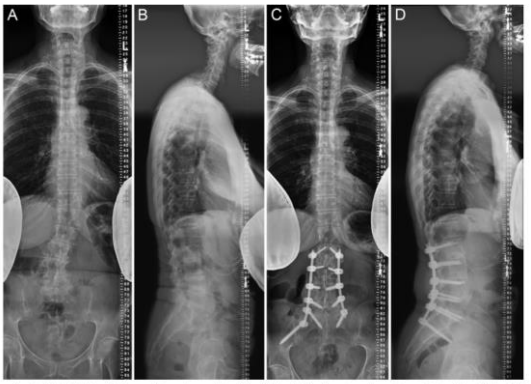


Fig. 3. MISDEF Class II. Preoperative anteroposterior **(A)** and lateral **(B)** and postoperative anteroposterior **(C)** and lateral **(D)** radiographs obtained in a patient with low-back and leg pain. The SVA was less than 6 cm, and the LL-PI mismatch equaled 13° preoperatively correcting to 3° postoperatively.

Fig. 4. MISDEF Class III. Anteroposterior **(left)** and lateral **(right)** radiographs obtained in a patient with low-back pain and an inability to stand upright. The SVA was greater than 6 cm, the LL-PI mismatch was 25°, and the PT was 25°.

Intraoperative 3D CT Navigation

"TOTAL" Navigation

We eliminate fluoroscopy in 70% of our cases

- ✓ **Skin incision**
- ✓ **Screw size and planning (no K-wires)**
- ✓ **Screw placement**
- ✓ **Tubular retractor placement**
- ✓ **Decompression**
- ✓ **Cage placement**
- ✓ **Rod measurement**
- ✓ **Final CT check**
- **Other indications → localization**
  - **Cervical forminotomies**
  - **Spinal tumor**
  - **Thoracic disc herniations**

MIS Spine: Where are we?

- **"Targeted MIS" based on** *clinical presentation* **and** *radiology findings*
  - **Treat pathology**
  - **Minimize overtreatment**
  - **"Surgical Strike"** *vs.* **"Carpet Bombing"**
- **MIS technique principles**
  - **Contralateral decompression**
  - **Minimize iatrogenic instability**
  - **Indirect decompression**
- **Minimize fusion need**
- **"Total Navigation"**

It's a team sport:

Weill Cornell Spine Center

http://weillcornellbrainandspine.org/spine

Weill Cornell Medicine

- **Care**: Clinical Excellence
- **Discover**: Research
- **Teach**: Education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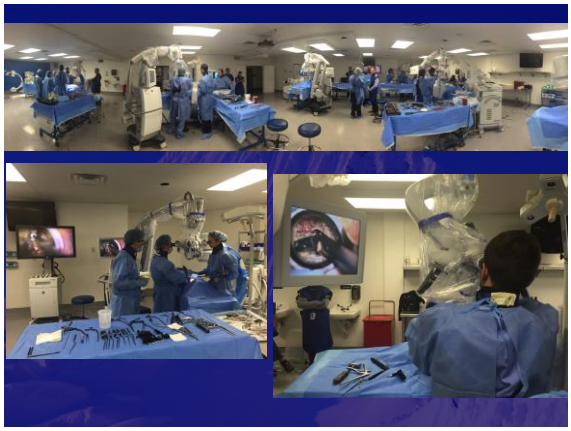



November 29-December 1, 2012
6th Minimally Invasive Spinal Surgery and Navigation
3-Day Symposium and Hands-On Lab
Location:
Course Directors:
REGISTER ONLINE TODAY
MIS course December 2016
Hands-on Symposium
Check "cornellneurosurgery.org" this fall

Types of back pain

- Neurogenic claudication
  - Lumbar stenosis
- Radicular pain
  - Lateral recess
  - Disc herniation
  - Foraminal stenosis
- Mechanical back pain
  - Instability
  - Facets
  - imbalance

Minimally Invasive Thoracic Decompressions

Larry T. Khoo, MD

The Spine Clinic of Los Angeles
At Good Samaritan Hospital
An Affiliate of the University of Southern California

DISCLOSURES OF CONFLICT

Major: Zimmer, Globus, Spineguard, Medacta

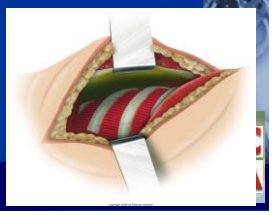
Minor: Aesculap, Mallincrodt

Case Presentation Surgical Technique

- 58 yo RH physician
- Sudden onset of thoracic pain
- No history of trauma
- 6 wk history of progressive gait sx
- Bladder incontinence
- Rt sided trunk / leg numbness
- 3+ DTR, ataxia, dec rectal tone
- 8/10 mid thoracic pain

Ventrolateral Approaches

- Advantages
  - Ventrolateral exposure of disc space and ventral spinal canal
  - Midline, densely calcified discs and intradural fragments
  - Ventral dural repairs and reconstruction
  - Multiple discs

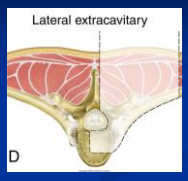


Thoracotomy - Disadvantages

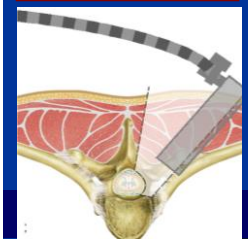
- Approach morbidity of 14% in large multicenter study (Spine 1995), n=770
  - *Post thoracotomy syndrome*
  - *Abdominal relaxation*
  - *Poor cosmesis & rib defomity*
- High overall morbidity (24%):
  - *wound infection, radiculopathy, aortic laceration, Horner´s syndrome, pleural effusion, pneumothorax, hemothorax, chylothorax, brachial plexus injury, lung herniation, renal failure, pneumocephalus and chronic pain*

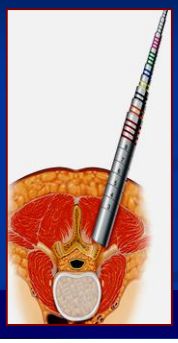
Minimally Invasive Extracavitary Thoracic Discectomy and Fusion (MI-ECTDF)

- Provides good angle of decompression
- Decreased Neural Retraction
- Combine with minimally invasive technologies and principles

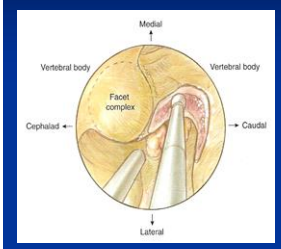


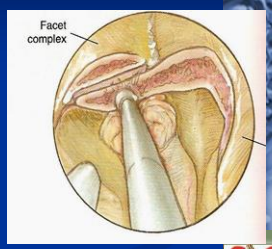
Oblique docking of the portal on lateral facet



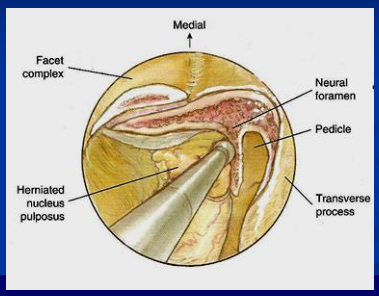


Drilling of Lateral Facet Complex

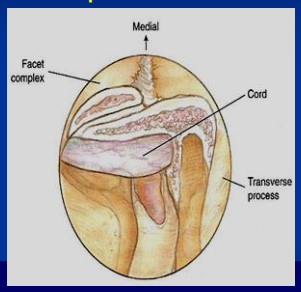




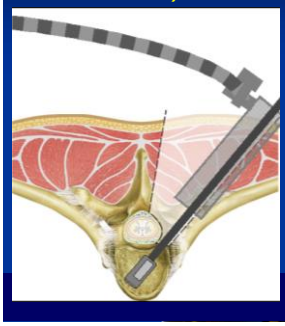
Skeletonize the superior aspect of the pedicle & transverse process



Discectomy with minimal retraction of the spinal cord



Insertion of Soft PLIF material, followed by interbody cage (to prevent pain and recurrence)



Postop Course

- OR time 2 hours
- EBL 25cc
- Full motor recovery
- Residual mild rt numbness
- Bladder issues resolved
- 24 month followup
- No further back pain

Journal of Neurosurgery Spine: Jan 2011

Minimally invasive extracavitary approach for thoracic discectomy and interbody fusion: 1-year clinical and radiographic outcomes in 13 patients compared with a cohort of traditional anterior transthoracic approaches

Clinical article

Larry T. Khoo, M.D.,[1] Zachary A. Smith, M.D.,[1] Farbod Asgarzadie, M.D.,[1] Yorgios Barlas, M.D.,[2] Sean S. Armin, M.D.,[2] Vartan Tashjian, M.D.,[3] and Baron Zarate, M.D.[4]

[1]Department of Neurological Surgery, University of California, Los Angeles, California; [2]Department of Neurological Surgery, General Hospital of Nikea, Athens, Greece; [3]Department of Neurosurgery, Loma Linda University, Loma Linda, California; and [4]Department of Spinal Surgery, Institucion Nacional de Rehabilitation, Mexico City, Mexico

Object. Open transthoracic approaches, considered the standard in treating thoracic disc herniation (TDH), are associated with significant comorbidities. The authors describe a minimally invasive lateral extracavitary tubular approach for discectomy and fusion (MIECTDF) to treat TDH.

Methods. In 13 patients (5 men, 8 women; mean age 51.8 years) with myelopathy and 15 noncalcified TDHs, the authors achieved a far-lateral trajectory by dilating percutaneously to a 20-mm working portal docked at the transverse process–facet junction, which then provided a corridor for a near-total discectomy, bilateral laminotomies, and interbody arthrodesis requiring minimal cord retraction. A cohort of 11 demographically comparable patients treated via transthoracic approaches was used as control.

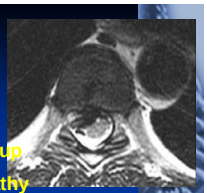
Results. Preoperative Frankel grades were B in 1 patient, C in 4, D in 5, and E in 3, whereas at mean of 10 months, 11 had Grade E function and 2 had Grade D function. Mean surgical metrics were operating room time 93.75 minutes, blood loss 33 ml, and hospital stay 3.1 days. Complications included 4 transient paresthesias, 1 CSF leak, 1 abdominal wall weakness, and 3 nonwound infections. One-year follow-up MR imaging revealed full decompression in all cases and no cage migration. Mean visual analog scales scores preoperative, at 6 weeks, 3 months, and 1 year were 5.6, 4.5, 3.2, and 1.2, respectively. No differences existed in preoperative clinical and radiographic profile of the study and control groups. Compared with controls, the MIECTDF group achieved superior scores in all metrics ($p < 0.01$) except for equivalent 1-year neurological outcomes.

Conclusions. Compared with transthoracic procedures, MIECTDF effectively decompressed the spinal canal, yielding identical 1-year radiographic and clinical outcomes to those seen in controls, while producing superior clinical scores in the interim. Thus, MIECTDF is the authors' treatment of choice for TDH.

(DOI: 10.3171/2010.10.SPINE09456)

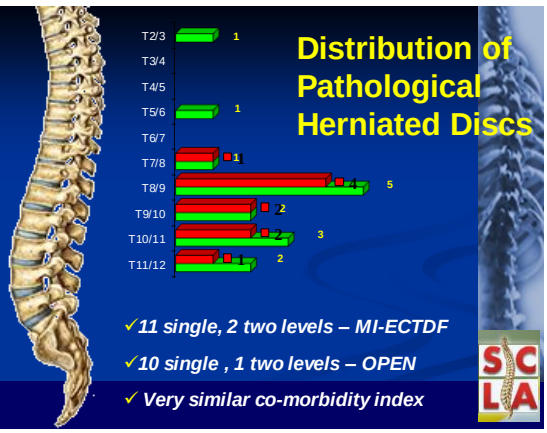
Key Words • **minimally invasive surgery** • **thoracic discectomy** • **extracavitary approach** • **transthoracic approach** • **interbody fusion**

Patients & Methods



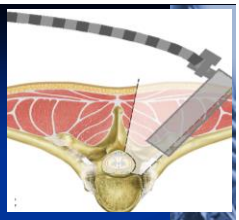
- Prospective, non-randomized study
- Class II / III study,Single surgical group
- All with cord compression / myelopathy
- Mean duration sx- 4.2 months
- Total of 24 patients, 1 year f/u
- Two arms:
  - ✓11 – Open mini-thoracotomy (52.5y, 5 men, 6 women)
  - ✓13 – Min Invasive EC-TDF (51.8 y, 4 men, 9 women)

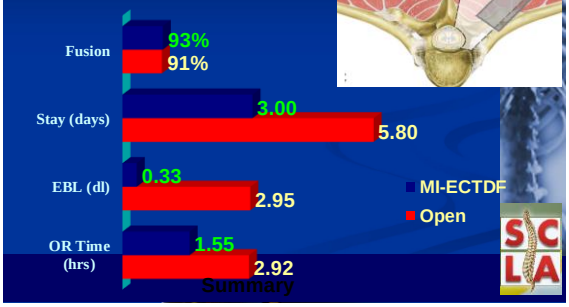
Distribution of Pathological Herniated Discs



- ✓*11 single, 2 two levels – MI-ECTDF*
- ✓*10 single , 1 two levels – OPEN*
- ✓ *Very similar co-morbidity index*

Operative data





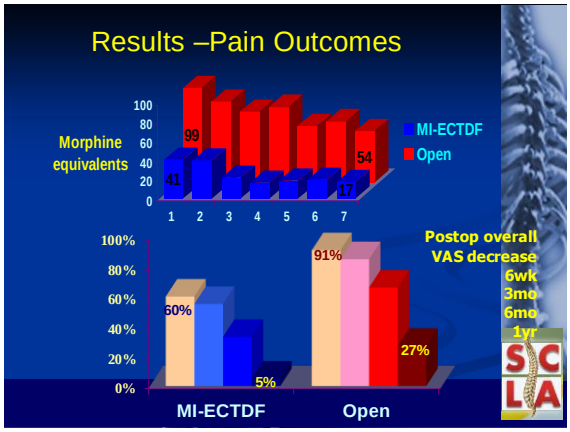
Complications

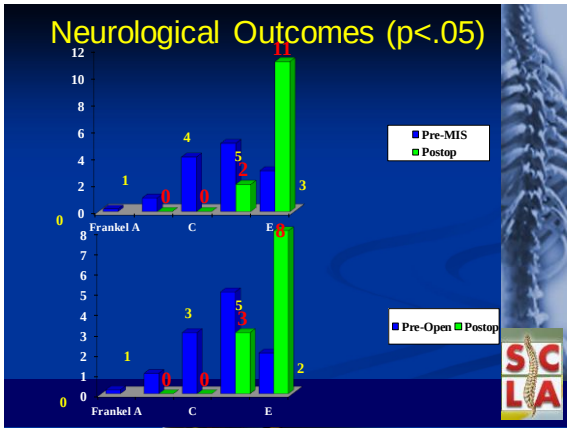
	MI-ECTDF	*Open*
✓ CSF leaks	1	3
✓ Radicular Numbness	1	9
✓ Trunk wall weakness	1	6
✓ Trunk wall hyperesth	1	4
✓ Wound Infection	1	3

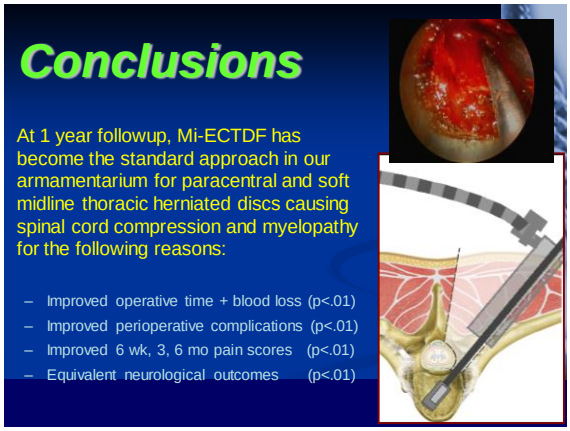
Peri-operative Course

(4.2x risk ratio, p<.01)

	MI-ECTDF	*Open*
✓ Chest Tube Drainage	0	11 (1.5d)
✓ Early Wound Infection	0	2
✓ Pts in ICU postop	0	7 (1.25d)
✓ Transfusion	0	4
✓ Pneumonia	0	3
✓ Urinary Tract Infect	1	4
✓ DVT	1	3
✓ Cardiac Events	1	2
✓ Hematoma	0	1
✓ Prolonged Ileus	0	2


Results –Pain Outcomes
Morphine equivalents
100
80
60
40
20
0
1 2 3 4 5 6 7
99
41
54
17
MI-ECTDF
Open
100%
80%
60%
40%
20%
0%
60%
5%
91%
27%
MI-ECTDF
Open
Postop overall VAS decrease
6wk
3mo
6mo
1yr
SCLA


Neurological Outcomes (p<.05)
12
10
8
6
4
2
0
1
0
4
2
5
11
3
Pre-MIS
Postop
Frankel A
C
E
0
8
7
6
5
4
3
2
1
0
1
0
3
3
5
8
2
Pre-Open
Postop
Frankel A
C
E
SCLA

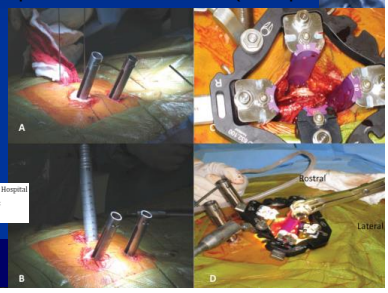

Conclusions
At 1 year followup, Mi-ECTDF has become the standard approach in our armamentarium for paracentral and soft midline thoracic herniated discs causing spinal cord compression and myelopathy for the following reasons:
– Improved operative time + blood loss (p<.01)
– Improved perioperative complications (p<.01)
– Improved 6 wk, 3, 6 mo pain scores (p<.01)
– Equivalent neurological outcomes (p<.01)

MIS Posterior Thoracic Extracavitary Corpectomies

Minimally invasive lateral extracavitary corpectomy – Cadaveric evaluation model and report of three clinical cases

Zachary A. Smith, M.D.[1], Zhenzhou Li, M.D.[2], Nan-Fu Chen, M.D.[1], Dan Raphael, PA-C[1], Larry T. Khoo M.D.[1]

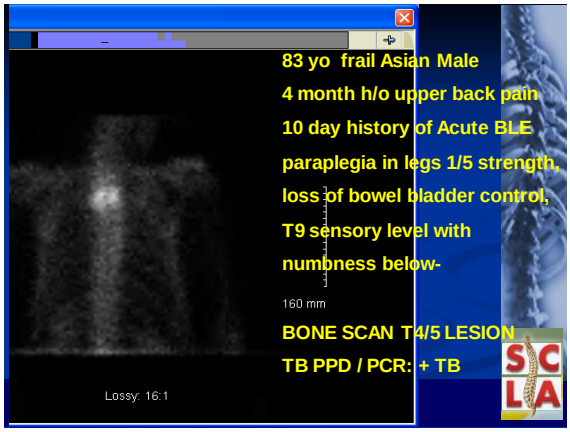
J Neurosurgery Spine: December 2011 (accepted pending)

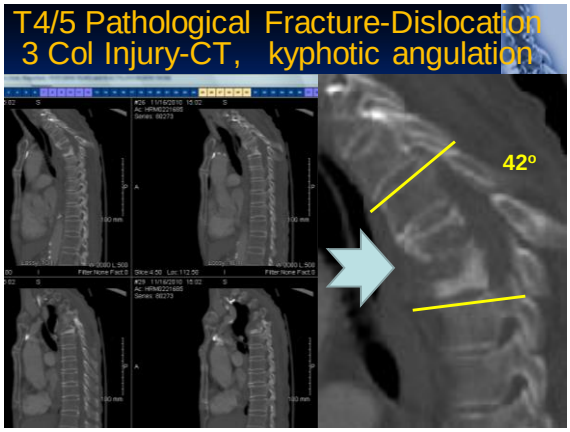


1- The Spine Clinic of Los Angeles; Good Samaritan Hospital
An affiliate of the University of Southern California;
Los Angeles, CA 90017

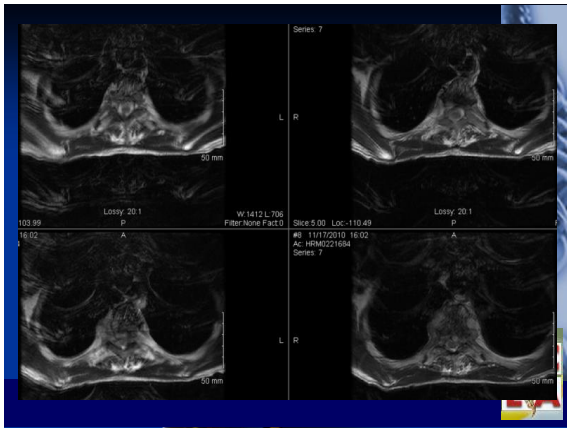
Table 1 : Radiographic Measurements in 6 Cadavers

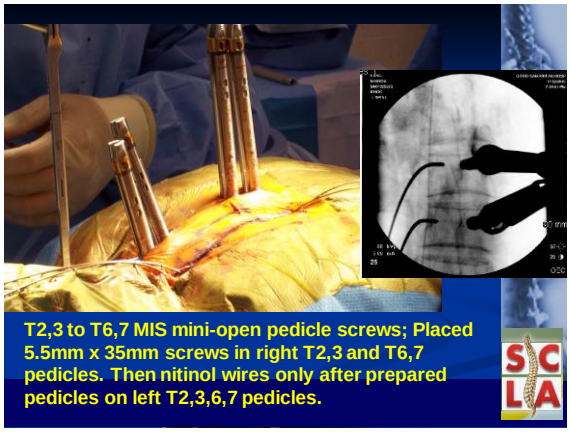
	Corpectomy Level	Anterior Vertebral Height		Posterior Vertebral Height		Cobb Angle	
Patient No.		*Pre-op*	*Post-op*	*Pre-op*	*Post-op*	*Pre-op*	*Post-op*
Patient 1	T8	2.67 cm	3.03 cm	2.93 cm	3.56 cm	30 deg	20 deg
Patient 2	T8	2.30 cm	3.17 cm	2.71 cm	3.23 cm	29 deg	18 deg
Patient 3	T8	2.91 cm	3.38 cm	3.05 cm	3.21 cm	11 deg	1 deg
Patient 4	T12	3.05 cm	3.76 cm	3.28 cm	4.97 cm	16 deg	8 deg
Patient 5	T12	3.76 cm	4.03 cm	3.79 cm	4.17 cm	7 deg	3 deg
Patient 6	T12	2.97 cm	3.14 cm	3.00 cm	3.32 cm	10 deg	8 deg
Mean		**2.94 cm**	**3.41 cm**	**3.13 cm**	**3.74 cm**	**17.2 deg**	**9.7 deg**


83 yo frail Asian Male
4 month h/o upper back pain
10 day history of Acute BLE paraplegia in legs 1/5 strength, loss of bowel bladder control, T9 sensory level with numbness below-
160 mm
BONE SCAN T4/5 LESION
TB PPD / PCR: + TB
Lossy: 16:1
SCLA

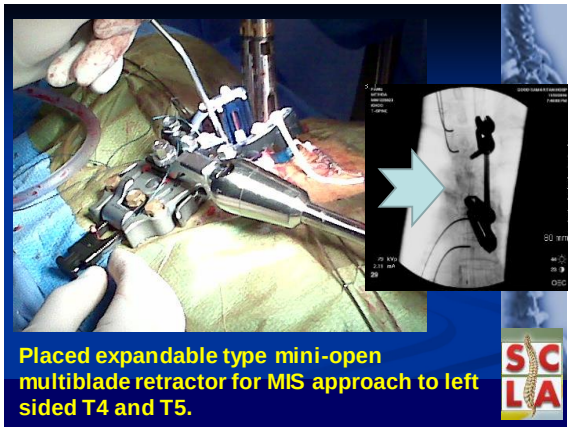

T4/5 Pathological Fracture-Dislocation
3 Col Injury-CT, kyphotic angulation
42º


CA

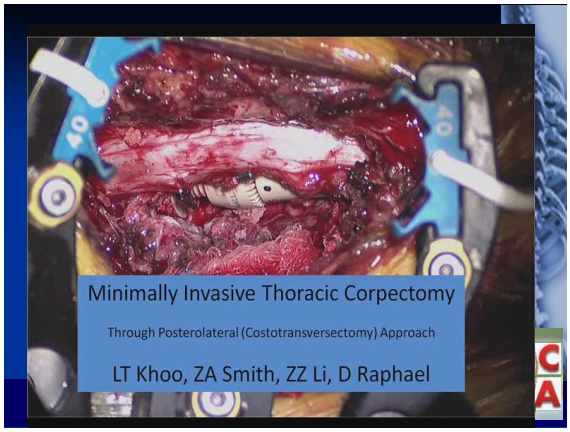


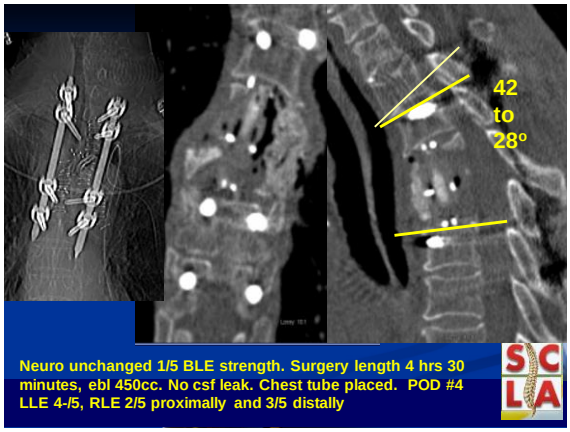


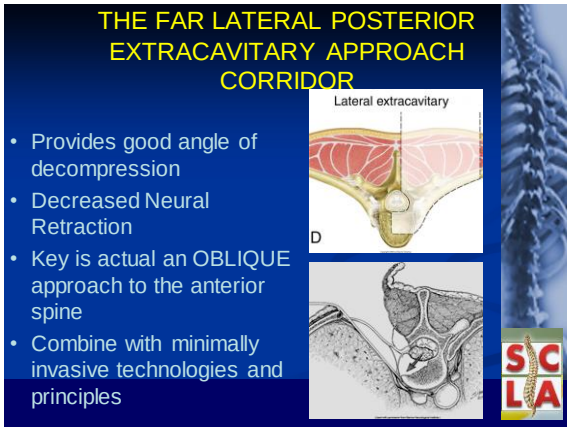
T2,3 to T6,7 MIS mini-open pedicle screws; Placed 5.5mm x 35mm screws in right T2,3 and T6,7 pedicles. Then nitinol wires only after prepared pedicles on left T2,3,6,7 pedicles.



Placed expandable type mini-open multiblade retractor for MIS approach to left sided T4 and T5.


Minimally Invasive Thoracic Corpectomy
Through Posterolateral (Costotransversectomy) Approach
LT Khoo, ZA Smith, ZZ Li, D Raphael


42
to
28°
Neuro unchanged 1/5 BLE strength. Surgery length 4 hrs 30 minutes, ebl 450cc. No csf leak. Chest tube placed. POD #4
LLE 4-/5, RLE 2/5 proximally and 3/5 distally


THE FAR LATERAL POSTERIOR EXTRACAVITARY APPROACH CORRIDOR
• Provides good angle of decompression
• Decreased Neural Retraction
• Key is actual an OBLIQUE approach to the anterior spine
• Combine with minimally invasive technologies and principles
Lateral extracavitary
D

THANK YOU

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At Good Samaritan Hospital
An Affiliate of the University of Southern California

Indications and Techniques for Minimally Invasive Cervical Laminoforaminotomy using a Tubular Retractor

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Professor of Neurosurgery, Orthopaedic Surgery, & Biomedical Engineering
Semmes-Murphey Clinic & University of Tennessee Health Science Center, Memphis

Disclosures

- Consultant to Medtronic
- Royalties from Medtronic
- BOD member and stockholder for BioD, Discgenics, & TrueVision
- Ownership (stock) in Medtronic, NuVasive, and SpineWave

History

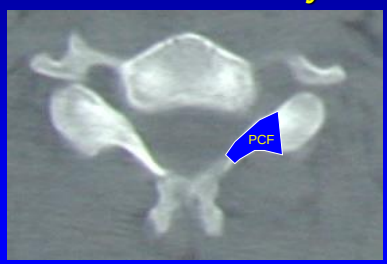
Historically, surgery for cervical radiculopathy was posterior.

- Stookey B. Compression of the spinal cord due to ventral extradural cervical chordomas: diagnosis and surgical treatment. Arch Neurol Psychiat 1928; 20: 279-291
- Semmes RE. Diagnosis of ruptured intervertebral disk without contrast myelography and comment on recent experience with modified hemilaminectomy for their removal. Yale J Biol & Med 1939; 11: 433-435.

Posterior Cervical Discectomy
Indications

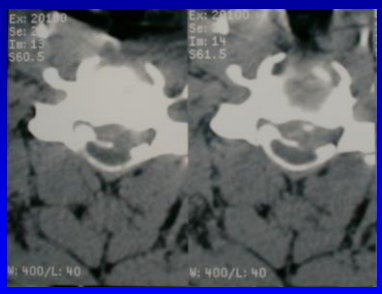
- Cervical radiculopathy recalcitrant to nonoperative management
- Disc herniation, osteophyte, or foraminal stenosis producing nerve root compression that correlates with the patient's clinical presentation
- No evidence of instability

Posterior Cervical Foraminotomy



Posterior Cervical Discectomy
Contra-indications

- Central compressive lesion (disc and/or osteophyte)
- Ventral spinal cord compression
- Cervical spine instability
- Significant mechanical neck pain



Advantages: Posterior vs. Anterior

- Maintain functional motion segment
  - Minimize adjacent level disc degeneration
- Excellent visualization of nerve root
- Avoid certain anterior complications
  - Recurrent laryngeal nerve injury, Horner's syndrome, esophageal injury, carotid injury, graft-related complications
- Avoid post-op neck immobilization

Disadvantages: Posterior vs. Anterior

- Post-op incisional neck pain
- Unable to address central disc/osteophyte
  - Pre-op MRI or CT-myelogram to exclude
- Need for neural retraction
  - Can minimize
- Positioning a bit more cumbersome
- Risk of instability?
- Risk of recurrence?

Instability After Posterior Cervical Discectomy/Foraminotomy

- Rare
- Chen BH et al. Comparison of biomechanical response to surgical procedures used for cervical radiculopathy: Posterior keyhole foraminotomy vs. anterior foraminotomy and discectomy vs. anterior discectomy with fusion. J Spinal Disorders 2001; 14(1): 17-20
  - "minor" increase in motion over normal spine

Recurrent HNP After Posterior Cervical Discectomy/Foraminotomy

- Rare
- 1/2032 patients in Collias' and Roberts' series (.05%)
  - Collias JC, Roberts MP. Posterior surgical approaches for cervical disk herniation and spondylotic myelopathy. In:Schmidek HH, ed. *Operative Neurosurgical Techniques: Indications, Methods, and Results*, Philadelphia: W.B. Saunders, 2000: 2016-2028.

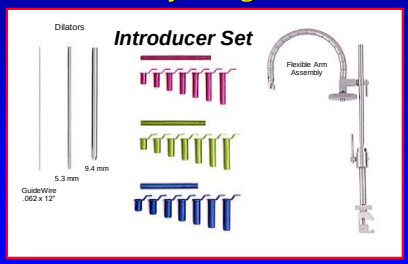
Results

- Murphey F, Simmons J, Brunson B. Ruptured cervical discs: 1939 to 1972. Clin Neurosurg 1973; 20: 9-17.
  - Hemilaminectomy & discectomy, prone
  - 648 patients,96% good/excellent results
  - 1% recurrence rate
- "The results of this operation are better than those of any other operation in neurosurgery"

Minimally Invasive Posterior Cervical Discectomy/Foraminotomy

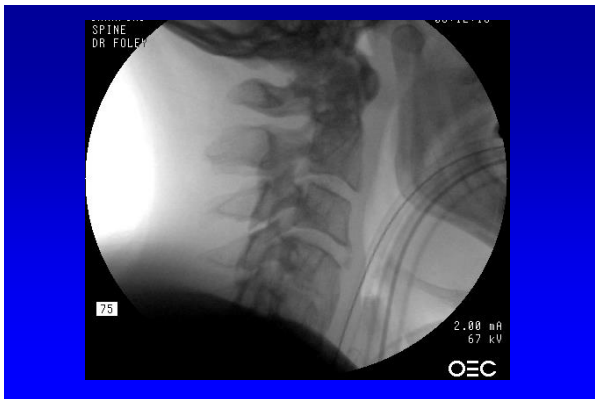
- Extension of the "classical" open technique
- Operation is identical except for approach
- Minimally invasive approach via tubular retractor minimizes post-op pain
- Can be routinely performed on an outpatient basis

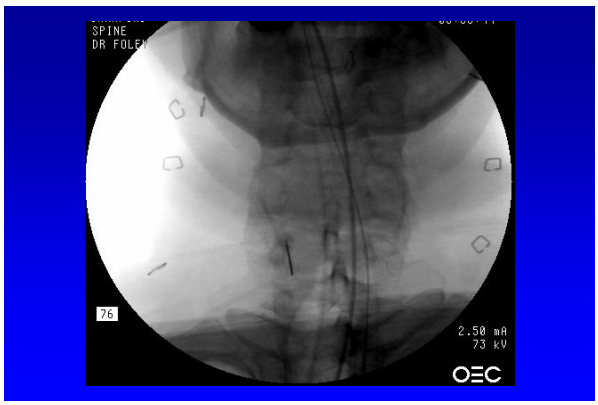
Minimally Invasive Microdiscectomy Surgical Technique

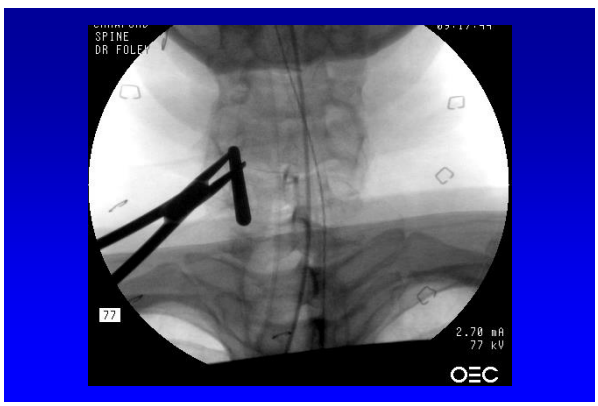


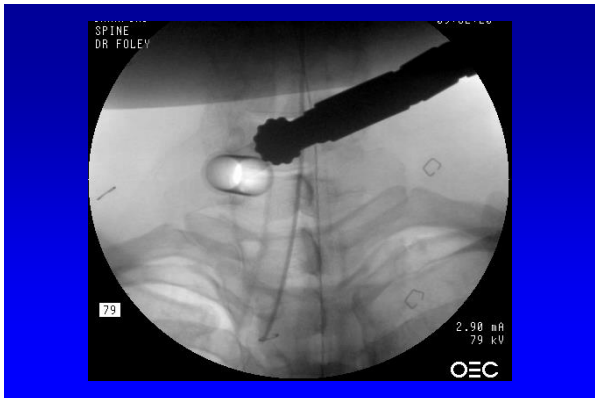
Minimally Invasive Posterior Cervical Discectomy

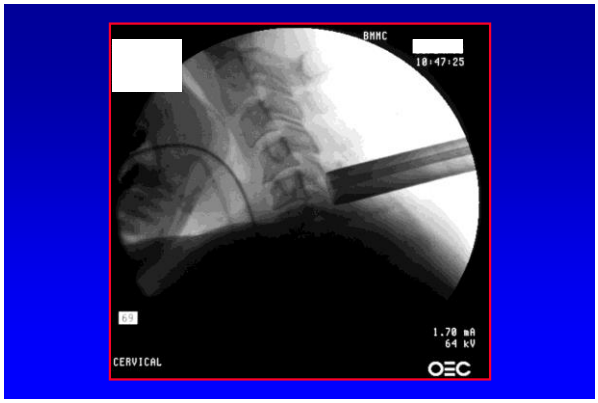
- Prone or sitting position
  - Reverse Trendelenberg if prone
- Fluoroscopic localization—use AP if shoulders block lateral view
- Incision 1.5 cm lateral to midline
- NO K-WIRE! Perforate fascia with sharp iris scissors, spread fascia bluntly with Metzenbaum's
- 14mm or 16mm diameter tube

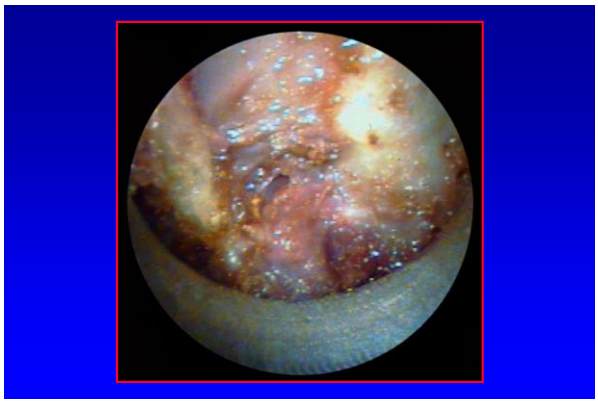

SPINE
DR FOLEY
75
2.00 mA
67 kV
OEC

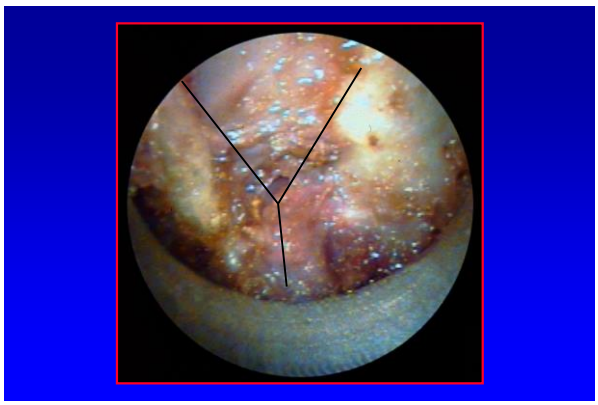

SPINE
DR FOLEY
76
2.50 mA
73 kV
OEC

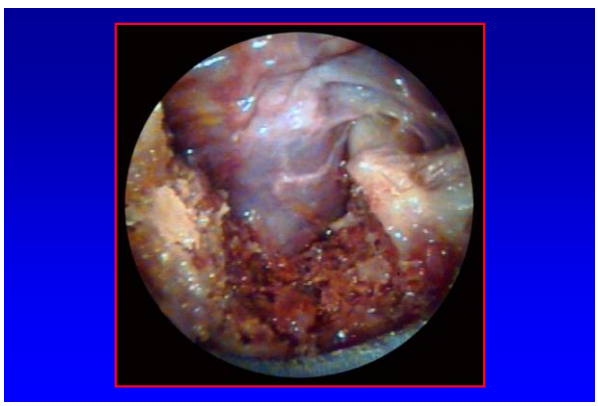

SPINE
DR FOLEY
77
2.70 mA
77 kV
OEC

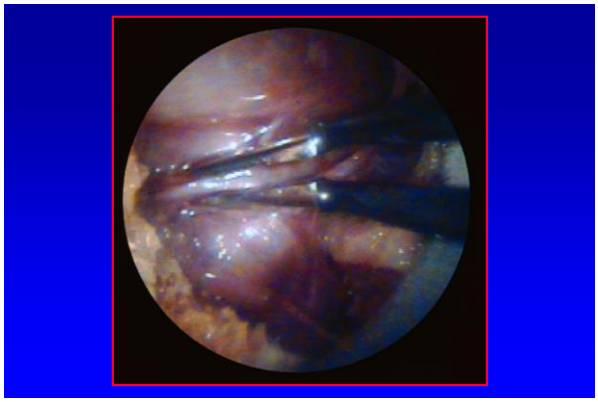

SPINE
DR FOLEY
79
2.90 mA
79 kV
OEC

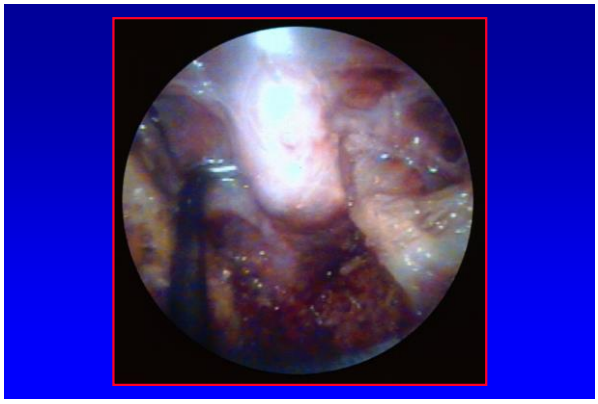

BMMC
10:47:25
64
1.70 mA
64 kV
CERVICAL
OEC











Tubular Retractor: Minimally Invasive Posterior Cervical Discectomy Results

- 100 consecutive patients with cervical radiculopathy
- Decompression via tubular retractor (MED)
- D/C 3 hours post-surgery
- Mean F/U 14.8 months
- 91 excellent, 6 good, 2 fair, 1 poor (re-op at 18 months)
- Return to work and/or full baseline activity 1 day to 4 weeks (mean 1.9 weeks) post-op

Adamson TE, J Neurosurg (Spine) 95:51-57, 2001

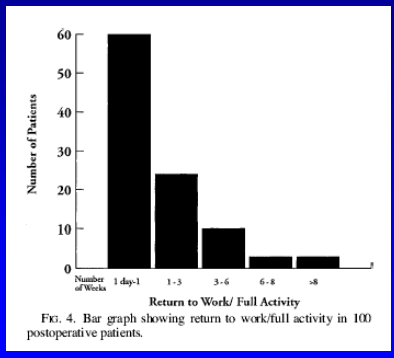


FIG. 4. Bar graph showing return to work/full activity in 100 postoperative patients.

Tubular Retractor: Minimally Invasive Posterior Cervical Discectomy Results

- 222 consecutive patients with cervical radiculopathy, mean F/U 26 months
- Decompression via tubular retractor, prone position
- Mean surgery time 63 minutes, mean EBL 71 cc
- 188 excellent, 22 good, 9 fair, 3 poor (all re-op with ACDF)
- LOS data for 191 patients - same day (167) or overnight (24)
- Complications: 1 infection, 2 dural tears (Duragen/Tisseel)

Hilton DL, Spine Journal 7:154-158, 2007

Conclusions

- Minimally invasive posterior cervical discectomy/foraminotomy using a tubular retractor is a safe and effective procedure
- Minimally invasive approach allows for routine outpatient surgery and quicker RTW/activity than the conventional open procedure