New Advances in Minimally Invasive Spine Surgery

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Disclosure

Consultant: Depuy Spine
Aesculap Spine
Biomet Spine
Grant Funding: AANS/CNS Joint Section

Why Minimally Invasive?

Surgical Obsolescence
The Morbidity of Open Surgery

The “Cost” of Surgery

Case Example

Minimally Invasive Lumbar Stenosis Decompression

66 year-old African American female w/ previous open L4/5 laminectomy surgery at outside hospital with 5 day hospitalization. Developed adjacent level L3/4 stenosis. Minimally invasive unilateral decompression performed followed by a one day hospitalization.
MIS TLIF

1. “Workhorse procedure
2. Most widely accepted MIS fusion procedure in the U.S.
3. Involves:
   1. Decompression
   2. Cage placement
   3. Pedicle screw fixation

Overcoming the Learning Curve

Difficulty & Complexity

- Microdisc
- Stenosis
- Perc screws
- TLIF

“Starter” Cases: MIS TLIF

Do MIS approaches allow us to operate on older, sicker, fatter people?

Population Trends

“80 is the new 60”

Oldest college grad.

Nola Ochs, 95
### MIS and the Compromised Patient

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<th>Number of Levels</th>
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#### 1. Adult Spinal Deformity
Case Example

An 84 year-old woman presents with intractable back and leg pain symptoms for two years. She had already failed to get relief from conservative measures and epidural injections and was able to stand for less than 5 minutes and ambulate less than 2 blocks. The back pain component was 85% and leg pain was 15%.
Dissection Through/Around the Psoas Muscle

Discectomy and Cage Placement
Rod De-Rotation

An 84 year-old woman presents with intractable Donaghue.

<table>
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<tr>
<th>Pt</th>
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<th>Sex</th>
<th>Levels Fused</th>
<th># Levels</th>
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Mean = 21 degree correction

Sagittal Correction

56 year-old female with symptoms of neurogenic claudication with minimal back pain.

MRI shows stenosis at the L3-5 levels. The patient underwent a two-level laminectomy.
8 months postop

Dynamic Views

AP  Flexion  Extension

Postoperative CT

Are there better methods?

70 year-old female with symptoms of severe unilateral leg pain and mechanically reproducible back pain.

Unilateral Mini-Open Exposure on the Concavity
Facet Joint Osteotomies

Spine Destabilized Dorsally

Three-level Osteotomy

Anterior Release via Posterolateral Approach

Anterior Height Restoration with Interbody Fusion

In situ Interbody Assembly
Percutaneous Pedicle Cannulation

Screw/Rod Placement & Final De-Rotation

Compression/Distraction

Unilateral Posterolateral Fusion & Closure

Standing X-Rays

Standing X-Rays
Summary

Illiosacral Screw Saddles

18 Hours Post-op

Beware of the Rigid Spine
2. Spinal Column Infections

Obturator outlet view
3. Complex Spinal Trauma

MIS in the Compromised Trauma Patient

Damage Control Spine Surgery

61 y/o male with AS; pedestrian struck by car; multiple fractures and floating spine…
Injury Severity Score = 23

Chest injury…

Intra-operative – Rod in Place

After Screw Extension Removal
T4 - L2 Decompression & Fusion

Haiti Earthquake
January 12, 2010
• ~ 200,000 killed
• ~ 10,000 amputees
• ~ 300 paraplegic and quadriplegic survivors

Week #2
SCI Patients: The Challenge
1. Mostly profoundly unstable (fracture-dislocations)
2. Patients losing neurologic function
3. Surgical fixation necessary (bracing inadequate)
4. Lack of specialized health personnel
   • PT/OT
   • Skin care
   • Bowel/bladder management
5. Transport and evacuation largely stifled
6. International interest waning
Case #1
Diet and Basic Nursing

Medishare Hospital

The Surgical/Technical Challenge
1. Lack of blood for transfusion
2. No suction
3. No specialized OR lighting or headlights
4. Minimal electrocautery
5. Instrument sterilization with ETOH
6. 100% infection rate
7. Pre-existing decubitus ulcers
8. Malnutrition

Is MIS a Solution?

Percutaneous spinal fixation
1. Reduced blood loss
2. Minimal need for direct visualization
3. Reduced number of surgical instruments
4. Incisions avoid midline areas of cutaneous breakdown
5. Lowered infection rates: our experience shows 1/456 (0.2%) in the U.S.
Gavril Ilizarov
Siberia (1950’s)
- External fixation
- Minimally invasive
- Low infection rates
- Soft tissue healing
- Periodic adjustment

AP Only Pedicle Cannulation

Posterior Percutaneous Surgery Setup

AP View
Pedicles in upper half of vertebral body.
Spinous Process Equidistant
Endplates parallel

Mark out Anatomy
0° L4
12° L5
20 mm

Pedicle Targeting
1/2
AP Only View Targeting

1. Minimizes need for fluoro drapes
2. Minimizes contamination from fluoro rotation
3. Minimizes fluoro “on” time in an old machine
4. Minimizes need for X-Ray tech work
5. No capability for “image guidance”
6. Single monitor on machine
15 patients treated to date
- All with thoracolumbar injuries
- 13 fracture dislocations, 2 burst fractures
- All treated with two-above-two-below constructs
- Operative time: 35 – 115 min
- No deaths, complications, or excessive blood loss

Results

1. Two weeks out: 1 infection (6%)
2. 1 lateral pedicle fracture
3. Neurologically:

<table>
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<th>B</th>
<th>C</th>
<th>D</th>
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What Effect Does MIS Surgery Have on Costs?
But are there real advantages?

To date, there have been no Class I data demonstrating the superiority of MIS over open fusion surgery.

….However, MIS Proponents Claim:

- Reduced blood loss
- Lower infection rates
- Less postoperative pain
- Shorter hospital stays
- Better outcomes
- Cost savings

MIS vs. open TLIF Charges:

University of Miami

- 74 patients treated over 14 months
- 59 1-level (75% MIS)
- 15 2-level (53% MIS)
- Patients underwent open surgery if neural symptoms were bilateral

MIS TLIF Charges – Miami Demographics and Outcome

MIS TLIF Charges - Miami

\[ P = 0.027 \]

\[ P = 0.071 \]
Can we generalize these results?

- Premier database®
- 2002-2009 data from 5.5 million discharges/year
- 20% of all inpatient admissions in the U.S.
- Lumbar interbody fusion (PLIF/TLIF) surgeries
- Surgery type classified by implant (percutaneous or standard pedicle screws)

<table>
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<tr>
<th>6,106 patients</th>
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<tr>
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<td>1804</td>
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<tr>
<td>2 – level</td>
<td>716</td>
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Cost Centers

<table>
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<tr>
<th>Cost Center</th>
<th>One-Level</th>
<th>Two-Level</th>
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<tbody>
<tr>
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<td>$350,000</td>
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<tr>
<td>Operating Room</td>
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<td>$20,000</td>
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<tr>
<td>Recovery &amp; Board</td>
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<td>$60,000</td>
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<tr>
<td>Other</td>
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Case Example

A 58 year-old man presents with intractable back pain, and leg pain due to neurogenic claudication. He has failed all conservative measures and elects to undergo surgery:

L4/5 Open TLIF
Added Costs

- Diagnostic imaging and lab tests
- Re-admission
- Surgery for I&D
- Home antibiotics
- Outpatient labs for Abx dosing and tracking infection
- Lost work/wages
- Potential for litigation

What about non-acute costs?

724 instrumented spine cases
29 became infected (4%)
Mean cost of surgery increased from $27,125.00 to $100,666.00 if they became infected

Multi-Center Study of the Safety and Durability of 2204 Cannulated Pedicle Screws Placed for Percutaneous Spinal Stabilization

- Retrospective Study at 9 institutions
- 456 patients / 2204 screws placed (mean of 4.8 screws/case)
- Indications, procedures, safety, durability of percutaneous pedicle screws (Viper Spine System)

Procedures
Complications

- Mean follow-up: 13.8 mos
- 1.4% Pedicle Breech/Fracture (31/2204)
- 0.6% Screw Revision (13/2204)
- 0.05% Screw loosening (1/2204)
- No screw or rod breakage
- 0.05% Superficial Infection (1/2204)

MIS & Costs

1. MIS lumbar interbody fusion is widely accepted as a treatment for a multiplicity of spinal disorders
2. MIS TLIF likely results in a finite but significant reduction in both acute hospital charges and costs?
3. These differences increase with the number of levels treated
4. Additional reductions in non-acute care costs are probably realized as well, but remain poorly quantitated.

Summary

1. MIS options for treating complex spinal pathologies have advanced significantly.
2. The benefits of reduced blood loss, cost savings, and lower infection rates are becoming well-proven.
3. However, the true advantages of MIS may be best realized in the challenging and compromised patient population.

! Thank You !