Spine Surgery
What The Future Holds

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Disclosures

• I have no idea what the future holds
• The contents of this talk represent my biased opinions

What Has Not Happened……Yet

• All spine surgery will be done minimally invasively
• The Perfect Arthroplasty
• Bone Morphogenetic Protein/Biologics
• Cure for SCI or medications to improve outcome
• Robotics in Spine Surgery
• Training the future
• Foolproof Image guidance

What Has Not Happened……Yet

• Optimal Deformity Treatment
SCI Pathophysiology

- **Early** - Minutes, Hours, Days
  - Vascular changes: loss of autoregulation/ischemia
  - Electrolyte disturbances
  - Accumulation of neurotransmitters
  - Inflammation
  - Reactive oxygen species
  - Immune Response/Cytokines
- **Late**
  - Apoptosis
  - Demyelination
  - Glial Scar Formation

**Biochemical Cascade**

- Minutes to hours: Ischemia, Excitotoxicity, Depolarization, Reactive Oxygen Species
- Hours to days: Inflammation and Edema
- Days to weeks: Immune Response, Genetic changes, Apoptosis, Glial scar (inhibitory molecules)
Biochemical Cascade

- Neuroprotection - ameliorate secondary injuries
- Neuroregenerative - remyelination, axonal and neural regeneration
- Stem cells aimed at regenerative pathways

Spinal Cord Injury

- I think the era of methylprednisolone has passed.
- Hypothermia
- Currently Riluzole is being investigated and holds some promise
- Stem cells—either endogenous or exogenous

Deformity

Multimodal Paradigms

- Neuroprotection - ameliorate secondary injuries
- Neuroregenerative - remyelination, axonal and neural regeneration
- Stem cells aimed at regenerative pathways
Revision Surgery

• Complication rates for revision spinal fusion are as high as 60%
• Surgery for correction of sagittal imbalance: 47% of patients have residual sagittal deformity

ASA Grade and Spine Surgery Outcomes

Good Fusions / Bad outcomes

• 30% of Lumbar Fusions have poor clinical outcomes
• Postfusion pain has been shown to be significantly related to:
  » Decreased Sacral Slope
  » Increased Pelvic Tilt
  » Decreased Lumbar Lordosis

• Yet, Consideration of Global Balance

Potter et al. Prevention and Management of Iatrogenic Flatback Deformity. JBJS (American) 2004

The Primary Determinant of Outcome in ADS is Sagittal Contour

Yet, Consideration of Global Balance

SaF-12 SRS-29 ODI p Value

SVA Moves Anteriorly <0.001
Presence of Lumbar Kyphosis <0.01

Good Fusions / Bad outcomes

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  » Increased Pelvic Tilt
  » Decreased Lumbar Lordosis


The pump bout (a) has well evelled ax x-ray spine and scolos 1a in positioning spine h ing DRF to been related to eects.
Degenerative Spinal Deformity

Advances in Fusion Rates, Circumferential Treatment, Minimizing Tissue Disruption, & Biomaterials:

Have not optimized outcomes.

Normal Limits

- PT should be < $\pi/2$
- SS should be > $\pi/2$
- LL = $\pi/2 + 10^\circ$

Deformity

- The enemy of good enough is perfect
- Has forced us to be aware of iatrogenic deformity
- We have created a new problem
Is there an Alternative to this?

Minimally Invasive Surgery

- Discectomies and TLIF are routinely performed in many centers.
- Techniques for deformity, XLIF, and endonasal techniques are gaining popularity.
- Literature demonstrates cost savings, but probably no difference in long-term outcomes.

MIS

- Skill set remains specialized.
- Will continue to have its role in spine surgery and will likely expand, but will not replace open techniques.

Argument for Disc Replacement

- Adjacent Segment Disease
- Maintenance of motion
- Relatively low success of fusion for treatment of multiple segments
- No graft site morbidity
- No possibility for disease transmission (Allograft)
- Decreased recuperation period / Early Discharge/Return to normal activities
- Precludes need for bracing requirements.
Review of Recent Literature

- Mixed results regarding adjacent segment disease
- No study shows ACDF better than ACDA
- Several studies claim ACDA better
- Data is not conclusive
- ACDA and ACDF are appropriate treatment in patients with specific indications

Clinical and Radiographic Analysis of an Artificial Cervical Disc: Seven Year Clinical and Radiographic Outcomes from a Prospective Randomized Controlled Clinical Trial

Vincent C. Traynelis
Praveen Mummaneni
Regis Haid
J. Kenneth Burkus

<table>
<thead>
<tr>
<th>Fusion (n=265)</th>
<th>Prestige ST (n=276)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary Surgery at Treated Level</td>
<td>No. of Patients Cumulative Rate %</td>
</tr>
<tr>
<td>Revision</td>
<td>11 (4.8)</td>
</tr>
<tr>
<td>Removal</td>
<td>8 (3.1)</td>
</tr>
<tr>
<td>Removal elective</td>
<td>9 (3.5)</td>
</tr>
<tr>
<td>Supplemental fixation</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Reoperation</td>
<td>4 (1.5)</td>
</tr>
<tr>
<td>Supplemental fixation - BOS</td>
<td>0 (0.0)</td>
</tr>
</tbody>
</table>

*The rows listed below secondary surgery at treated level indicate the total number of events per treatment.*
Adjacent Level Surgery

Arthroplasty

• Lumbar arthroplasty is dead and will remain so.
• Cervical arthroplasty

Biologics

• Continuous development in several areas
• Significant abuse potential
• Only 1 bone morphogenic protein on the market currently