Innovative Techniques in Minimally Invasive Cervical Spine Surgery

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PCF – Posterior Cervical Fusion

PCF not currently an ambulatory care procedure

Pearl diver – only 14% of all cervical fusions are done from a posterior approach.
  - many reasons…
  - Increased perioperative morbidity
  - Chronic myofascial pain
  - Length of stay is 4.5 days
Posterior Cervical Fusion
Choy et al 2016
data on 3401 patients with posterior fusion

- 30 day readmission rate 6.2%
- of which, 17% infection
- reoperation rate 4.9%
Tissue-Sparing Technique

Standard open approach for posterior fusion with lateral mass fixation.

Tissue-sparing posterior approach using intervertebral cages in the facet joints.
Minimally Disruptive

Traditional Open Posterior Cervical Fusion
Minimal Access PCF
Medial to Lateral Technique Guides Away from Canal

Vertebral Artery Protected by Pedicle

Nerve Exits in Bottom of Foramen
Technology Overview

Posterior Cervical Fusion w/ Intervertebral Fusion Device & Bone Graft

Unique Approach to Cervical Fusion
- Tissue Sparing Technique
- Indirect Decompression
- Stabilization & Fusion
Indirect Decompression

10.0mm Pre-Op

13.2mm Post-Op

Rigid Fixation

93% Fusion Rate @ 1 Year

98% Fusion Rate @ 2 Years

Implants packed with bone to promote fusion
Foraminal Stenosis & Osteophytes
Cervical intervertebral disc space narrowing & size of intervertebral foramina.

Lu J, Ebraheim NA, Huntoon M, Haman SP

<table>
<thead>
<tr>
<th>Reduction in Intervertebral Disc Space</th>
<th>Reduction in Foraminal Area</th>
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<tbody>
<tr>
<td>1 mm</td>
<td>20%–30%</td>
</tr>
<tr>
<td>2 mm</td>
<td>30%–40%</td>
</tr>
<tr>
<td>3 mm</td>
<td>35%–45%</td>
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</table>

“1-, 2-, and 3-mm narrowing of the intervertebral disc space corresponded to foraminal area reductions of 20%–30%, 30%–40%, and 35%–45%, respectively.”
“Modest distraction of the facets… …can increase foraminal height and area and therefore indirectly decompress the exiting nerve roots.”

Effect of machined interfacet allograft spacers on cervical foraminal height and area - Laboratory investigation

Lee A. Tan, M.D.,1 Carter S. Gerard, M.D.,1 Paul A. Anderson, M.D.,2 and Vincent C. Traynelis, M.D.1 1 Department of Neurosurgery, Rush University Medical Center, Chicago, Illinois; and 2 Department of Orthopedics & Rehabilitation, University of Wisconsin, Madison, Wisconsin
Fusion

93% Bridging Bone at 1 Year
98% Bridging Bone at 2 Years
Percutaneous posterior cervical fusion with the DTRAX Facet System for single-level radiculopathy: results in 60 patients

McCormack BM1, Bundoc RC, Ver MR, Ignacio JM, Berven SH, Eyster EF.

Clinical Faculty, Department of Neurosurgery, University of California San Francisco Medical Center, San Francisco, CA, USA

Symptom Improvement

Significant Improvement in VAS: Neck & Arm

Visual Analogue Scale (VAS): Neck

Visual Analogue Scale (VAS): Arm
Comparable Improvement to ACDF & TDR

Clinical improvement similar to ACDF and CDA (Gold Standards)

Neck Disability Index (NDI)

NDI (Percentage): Comparable to ACDF & CDA
Tissue-Sparing Technique
Use Cases

- Stand alone for radiculopathy
- Posterior fixation for circumferential fusions
- Symptomatic non-union after ACDF
- Adjacent level disease
- Laminectomy & Fusion
Patient Selection: Example 1

49 y.o. Male, Radiating Arm Pain, Radio Announcer
Patient Selection: Example 1

- Positive Spurling Test on Physical Exam
- Positive EMG for C6 radiculopathy.
- MRI showed severe foraminal narrowing from disc-osteophyte complex at C5-6.
Patient Selection: Example 1

- Cervical Fusion with DTRAX performed at C5-C6
- 2 week follow up – relief of radicular symptoms.
- At 6 month follow up – no pain medication, pain reported 0-1
35 year old male with 50% numbness, 50% pain
2-level ACDF C5-C7 in 2013
Progressive return of symptoms after 8 months.
Patient Selection: Example 2

- Immediate resolution of symptoms and return to work.
Patient Selection: Example 3

- 58 y.o. female neck and arm pain
- Osteoporosis
- Smoker: ½ pack per day (down from 2 ppd)
- Prior non union s/p lumbar fusion
Patient Selection: Example 3
Adjacent Level Example 4

- 46 yo female 11 years s/p successful C5-6 ACDF
- Neck and radiating right shoulder and arm pain
- Failed 6 months of conservative care
Adjacent Level Example 4

- No significant instability with flexion/extension
Adjacent Level Example 4

- MRI shows right C4-5 foraminal stenosis
Adjacent Level Example 4

- CT shows C4-5 right facet arthritis & foraminal stenosis
Adjacent Level Example 4

- Post-op AP, lateral X-rays
Bilateral posterior cervical cages provide biomechanical stability: assessment of stand-alone single-level fusion and as supplemental fixation for anterior cervical discectomy and fusion.

“The biomechanical effectiveness of bilateral posterior cages in limiting cervical segmental motion is comparable to single-level plated ACDF.”

<table>
<thead>
<tr>
<th>ROM in Degrees (sd)</th>
<th>ACDF C6-C7</th>
<th>PCF C5-C6</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexion-Extension</td>
<td>2.5 (0.8)</td>
<td>2.5 (1.3)</td>
<td>0.911</td>
</tr>
<tr>
<td>Lateral Bending</td>
<td>1.6 (0.7)</td>
<td>0.4 (0.3)</td>
<td>0.000</td>
</tr>
<tr>
<td>Axial Rotation</td>
<td>1.7 (0.4)</td>
<td>1.1 (1.7)</td>
<td>0.370</td>
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</table>
Supplementation of single- and multilevel ACDF with posterior cervical cages provided a significant increase in stability and therefore may be a potential, minimally disruptive option for supplemental fixation for improving ACDF fusion rates.

<table>
<thead>
<tr>
<th></th>
<th>ACDF C6-C7</th>
<th>ACDF + PCF C6-C7</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexion-Extension</td>
<td>2.5 (0.8)</td>
<td>0.6 (0.3)</td>
<td>0.002</td>
</tr>
<tr>
<td>Lateral Bending</td>
<td>1.6 (0.7)</td>
<td>0.1 (0.4)</td>
<td>0.005</td>
</tr>
<tr>
<td>Axial Rotation</td>
<td>1.7 (0.4)</td>
<td>0.2 (0.3)</td>
<td>0.000</td>
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Biomechanical evaluation of DTRAX® posterior cervical cage stabilization with and without lateral mass fixation

LMS vs PCF with Cage (1-Level)

LMS allowed less motion in flexion/extension than PCF with Cage (p<0.05)
LMS and PCF with Cage are comparable in lateral bending (p>0.05)
PCF with Cage allowed less motion in axial rotation than LMS (p<0.05)

<table>
<thead>
<tr>
<th></th>
<th>Intact</th>
<th>LMS C5-C6</th>
<th>PCF C5-C6</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexion-Extension</td>
<td>11.5 (3.5)</td>
<td>1.6 (0.7)</td>
<td>3.4 (1.8)†</td>
<td>0.032</td>
</tr>
<tr>
<td>Lateral Bending</td>
<td>10.0 (2.1)</td>
<td>0.7 (0.3)</td>
<td>0.7 (0.5)†</td>
<td>1.000</td>
</tr>
<tr>
<td>Axial Rotation</td>
<td>8.5 (2.1)</td>
<td>1.2 (0.4)</td>
<td>0.8 (0.5)†</td>
<td>0.020</td>
</tr>
</tbody>
</table>

† Significance from intact at p<0.05
Questions?
Thank You