Kinematic Response of Cervical Disc Arthroplasty in Different Hybrid Constructs

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- AGP: Consultant: Orthofix, Inc.
Premise of Cervical Disc Arthroplasty (CDA)

Restoration of:

- physiologic ROM and
- physiologic load-sharing at the treated level

Should lead to:

- longevity of the index-level, and
- mitigate the risk of ASD.
Key Design Features of M6-C

- **Compressible Core**
  - Compression mimics native disc
  - Allows 6-DOF
  - Allows anatomy to dictate segmental motion after CDA
  - More likely to achieve the goals of CDA

- **Fiber Annulus**
  - Built in resistance to motion
  - Mimics native disc anatomy
  - Restore stability to hypermobile segments
Background: Cervical Hybrid Constructs

- CDA adjacent to an ACDF maybe an attractive alternative to a multilevel ACDF:
  - a patient with a prior fusion at C6-C7 develops new radiculopathy and/or myelopathy at C5-C6.
- in the presence of two symptomatic adjacent cervical segments.

Courtesy: Jack Zigler, MD; TBI
2-level cervical fusion significantly increased motion at adjacent segments compared with hybrid

Hybrid had significant biomechanical advantages over 2-level fusion by reducing adjacent-level hypermobility and loads required to achieve a predetermined ROM
Hybrid Constructs – Previous Studies

- TDR placed adjacent to a two-level fusion is subjected to a more challenging biomechanical environment as compared to a stand-alone TDR.
Hybrid Constructs – Previous Studies

- Hybrid constructs potentially reduce mechanical stresses at adjacent segments when compared to a 2-level fusion.

Hybrid Constructs – M6C Disc

- There are no clinical or biomechanical data on hybrid constructs using the M6C cervical disc prosthesis.
Purpose

- How is M6C response affected by the presence of an ACDF proximal or distal to the prosthesis?
- Does the number of fused levels affect M6C performance?
Examples of different hybrid constructs:

- Proximal to ACDF
- Distal to ACDF
Specimens: Two equal groups of $N = 8$ each

### ROM from Intact FE runs

<table>
<thead>
<tr>
<th>Group 1</th>
<th>Age</th>
<th>Sex</th>
<th>C2-C3 ROM</th>
<th>C3-C4 ROM</th>
<th>C4-C5 ROM</th>
<th>C5-C6 ROM</th>
<th>C6-C7 ROM</th>
<th>C7-T1 ROM</th>
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</thead>
<tbody>
<tr>
<td>Mean</td>
<td>47.4</td>
<td>4M/4F</td>
<td>7.9</td>
<td>13.5</td>
<td>14.7</td>
<td>11.4</td>
<td>9.3</td>
<td>7.2</td>
</tr>
<tr>
<td>Std Dev</td>
<td>13.7</td>
<td></td>
<td>1.9</td>
<td>2.6</td>
<td>2.3</td>
<td>2.7</td>
<td>4.1</td>
<td>2.8</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Group 2</th>
<th></th>
<th></th>
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<td>7.6</td>
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<td>12.4</td>
<td>12.7</td>
<td>10.2</td>
<td>6.9</td>
</tr>
<tr>
<td>Std Dev</td>
<td>14.2</td>
<td></td>
<td>2.6</td>
<td>2.6</td>
<td>3.3</td>
<td>3.6</td>
<td>4.6</td>
<td>3.7</td>
</tr>
</tbody>
</table>

T-test group diffs, $p =$

<p>| | | | | | | | | |</p>
<table>
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<tbody>
<tr>
<td></td>
<td>1.00</td>
<td>0.84</td>
<td>0.01</td>
<td>0.13</td>
<td>0.40</td>
<td>0.67</td>
<td>0.86</td>
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</table>
Motion Response of M6C in Different Hybrid Constructs

Proximal to 1- vs 2-level fusion:
Number of fused levels (1- vs. 2-level) did not affect M6C motion
Motion Response of M6C in Different Hybrid Constructs

Distal to 1- vs 2-level fusion:
Number of fused levels (1- vs. 2-level) did not affect M6C motion
Motion Response of M6C in Different Hybrid Constructs

Proximal versus Distal to 1-level fusion:
Location relative to 1-level ACDF did not affect M6C motion.
Motion Response of M6C in Different Hybrid Constructs

Proximal versus Distal to 2-level fusion:
Location relative to 2-level ACDF did not affect M6C motion
### Summary: Range of Motion of M6C in Different Hybrid Constructs

<table>
<thead>
<tr>
<th></th>
<th>CDA Proximal to ACDF</th>
<th>CDA Distal to ACDF</th>
<th>P-value</th>
<th>All by Levels in ACDF</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-Level ACDF</td>
<td>11.4° ± 4.3° (N=8)</td>
<td>10.1° ± 5.1° (N=8)</td>
<td>P = 0.60</td>
<td>10.8° ± 4.6° (N=16)</td>
</tr>
<tr>
<td>2-Level ACDF</td>
<td>10.5° ± 3.8° (N=8)</td>
<td>10.2° ± 4.7° (N=8)</td>
<td>P = 0.89</td>
<td>10.3° ± 4.1° (N=16)</td>
</tr>
<tr>
<td>P-value</td>
<td>P = 0.47</td>
<td>P = 0.94</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All by Location</td>
<td>10.9° ± 3.9° (N=16)</td>
<td>10.2° ± 4.7° (N=16)</td>
<td></td>
<td>10.6° ± 4.3° (N=32)</td>
</tr>
</tbody>
</table>

- Proximal vs. distal to ACDF did not affect M6C motion.
- Number of fused levels (1- vs. 2-level) did not affect M6C motion.
Conclusions

Hybrid constructs using the M6-C appear to be a reasonable alternative treatment option with:

- Biomechanics better than 2-level or 3-level ACDF
- Proximal vs. distal to ACDF did not affect M6C motion.
- Number of fused levels (1-level vs. 2-level) did not affect M6C motion
- Suggest that disc arthroplasty performed adjacent to a 1- or 2-level cervical fusion is likely to maintain the same degree of motion as a primary arthroplasty.
- These results provide a cadaveric basis for future *in vivo* studies to validate these results.

*Thank you!*