Fenestration Misalignment with F/EVAR Leads to Bad Outcomes
Prevention & Treatment

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Disclosure
none


**Table 4. Procedural details and 30-Day/In-hospital post-operative clinical outcomes**

<table>
<thead>
<tr>
<th></th>
<th>Atomic Data</th>
<th>Standard Deviation</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab 1</td>
<td>100 ± 5</td>
<td>70 ± 4</td>
<td>0.02</td>
</tr>
<tr>
<td>Lab 2</td>
<td>80 ± 4</td>
<td>60 ± 3</td>
<td>0.04</td>
</tr>
</tbody>
</table>

**Total Procedural Time (min)**
- Lab 1: 262 ± 15
- Lab 2: 351 ± 25

**Mean Fluoroscopy Time (min)**
- Lab 1: 85 ± 6
- Lab 2: 106 ± 8

**Mean Contrast Volume (ml)**
- Lab 1: 193 ± 13
- Lab 2: 239 ± 20

**Hospital Length of Stay (days)**
- Lab 1: 5 ± 0.5
- Lab 2: 10 ± 1.5

<table>
<thead>
<tr>
<th></th>
<th>Type 1</th>
<th>Type 2</th>
<th>Type 3</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Endoleaks</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>&gt; 0.5</td>
</tr>
<tr>
<td>No. of Endoleaks</td>
<td>0 (0)</td>
<td>4 (14)</td>
<td>3 (10)</td>
<td>&gt; 0.5</td>
</tr>
<tr>
<td>No. of Endoleaks</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>4 (11)</td>
<td>&gt; 0.5</td>
</tr>
</tbody>
</table>

**30-day Complications**
- Atrial Fibrillation: 1 (3) vs 2 (6) > 0.5
- Paraplegia: 1 (3) vs 4 (11) > 0.3
- Myocardial Infarction: 2 (7) vs 2 (6) > 0.5
- Ischemic Colitis: 0 (0) vs 4 (11) > 0.1
- Renal Failure: 0 (0) vs 1 (3) > 0.5
- Death: 0 (0) vs 4 (11) > 0.1

**No. of Endoleaks**
- Type 1: 0 (0)
- Type 2: 4 (14)
- Type 3: 2 (6)

**Intraoperative Target Vessel Cannulation Failure**
- 0 (0) vs 4 (11) > 0.1

**Intraoperative Target Vessel Complication**
- 1 (1) vs 8 (8) > 0.4

**End-organ Ischemia and/or Death**
- 1 (3) vs 11 (31) > 0.008

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**WHAT CAN A SURGEON DO TO MINIMIZE DEVICE ROTATION?**

1. To develop a mechanically realistic aortoiliac bench top model
2. To validate quantitative anatomical markers which have been observed clinically
3. To evaluate the effect of operator technique on stent graft rotation

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**Flexible models**
- Molds are 3D printed in PLA at a resolution of 0.2 mm
- Polyvinyl alcohol cryogel is then cast using a 15% solution with 4 freeze thaw cycles
- Effective rigidity is controlled by altering the thickness of the model walls

**Idealized models**
- Helically structured to have a constant torsion
  - Torsion specified by altering the pitch and radius of the helix

**Patient specific models**
- Segmented from pre-operative CT angiograms

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**Experimental Apparatus**

**Introduction**

**Methods**

**Results**

**Conclusions**

- Torsion and rigidity/calcification combined are direct causes of intraoperative stent graft rotation.
- In-vivo correction of orientation significantly increases the observed rotation.
  - If clinically safe, fully remove the device, adjust the orientation and reinsert the device.

**Table 4-1.** Measured rotational errors during ZFEN deployment in patient-specific aortoiliac phantoms, compared with the expected intraoperative rotation during patient deployment.

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>Model</th>
<th>Intraoperative Rotation (°)</th>
<th>Absolute Error (°)</th>
<th>Iliac Torsion (mm⁻¹)</th>
<th>Iliac Calcium Volume (mm³)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>2.3</td>
<td>10.2</td>
<td>2.3</td>
<td>1.2</td>
<td>1322</td>
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<tr>
<td>2</td>
<td>17</td>
<td>20</td>
<td>3</td>
<td>3.1</td>
<td>1052</td>
</tr>
<tr>
<td>3</td>
<td>14</td>
<td>25</td>
<td>4</td>
<td>3.2</td>
<td>1264</td>
</tr>
</tbody>
</table>

**Figure 4-4.** Evaluation of the effect of operator insertion technique in rigid idealized models at varying levels of torsion. **Straight**: No correction of device orientation during insertion. **Multiple**: Insert the device, note orientation; fully remove the device, correct the orientation accordingly; and reinsert. **Corrected**: Gradually correct the orientation of the device as needed during insertion.