Clinical evaluation of the swirling flow stent: the MIMICS experience

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Faculty Disclosure

Thomas Zeller, MD

For the 12 months preceding this presentation, I disclose the following types of financial relationships:

• **Honoraria received from:** Abbott Vascular, Bard Peripheral Vascular, Veryan, Biotronik, Boston Scientific Corp., Cook Medical, Cordis Corp., Gore & Associates, Medtronic, Spectranetics, Straub Medical, TriReme

• **Consulted for:** Abbott Vascular, Bard Peripheral Vascular, Boston Scientific Corp., Cook Medical, Gore & Associates, Medtronic, Spectranetics

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MIMICS Clinical Program

Feasibility Study
N=10
1 site

MIMICS
Randomized Controlled vs. straight stent
N=50
8 sites
24-month follow-up
CE Mark

MIMICS-2
Prospective, multinational evaluation of safety and primary patency at 12 months
N=271
47 sites
36-month follow-up
IDE Study (US, Japan, Germany)

MIMICS-3D
Prospective, observational evaluation within real-world clinical population
N=500+
25 sites
36-month follow-up

European Post-market Surveillance Registry

MIMICS et seq
Investigator-initiated and retrospective studies evaluating safety, efficacy and performance

Targets of interest:
- popliteal
- calcified lesions
- DCB combination

Post-market Studies
Mimics Randomized Control Trial

Lead-in Phase I
N=10

Randomised Phase II
N=76

BioMimics 3D
N=50
- Death (1); withdrawn consent (3); lost to follow-up (2)
- Withdrawn consent (1); no re-consent to 24 month protocol (2)

Follow-up: 12 Months
N=44/44

Follow-up: 24-Months
N=41/41

Control stent
N=26
- Lost to follow-up (1); missed 12-m visit (1)

Follow-up: 12 Months
N=24/25

Follow-up 24 Months
N=22/22

24/26 Control Stents were CR Bard LifeStent
*N=24/26 LifeStent (CR Bard)
### Mimics RCT

#### Assessment Schedule

<table>
<thead>
<tr>
<th>Assessment Schedule</th>
<th>Screening</th>
<th>Index Procedure</th>
<th>Discharge</th>
<th>30 days</th>
<th>6 months</th>
<th>12 months</th>
<th>24 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freedom from MAE</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Angiography</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>X-ray</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duplex U/S Volumetric</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Duplex U/S Swirling Flow</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Rutherford</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>ABI/TBI</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Walking Impairment Q</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
### Mimics RCT: Subject Demographics

<table>
<thead>
<tr>
<th></th>
<th>BioMimics 3D (N=50)</th>
<th>Control stent (N=26)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td>Mean ± SD (N)</td>
<td>68 ± 10.4</td>
<td>67 ± 8.9</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td>Male</td>
<td>66%</td>
<td>65%</td>
</tr>
<tr>
<td><strong>Risk Factors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes Type II</td>
<td>26%</td>
<td>42%</td>
<td>0.16</td>
</tr>
<tr>
<td>Insulin-dependent</td>
<td>14%</td>
<td>19%</td>
<td>1.00</td>
</tr>
<tr>
<td>Hypertension</td>
<td>88%</td>
<td>85%</td>
<td>0.73</td>
</tr>
<tr>
<td>Smoking Current</td>
<td>42%</td>
<td>50%</td>
<td>0.63</td>
</tr>
<tr>
<td><strong>Medical History</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carotid artery disease</td>
<td>10%</td>
<td>8%</td>
<td>1.00</td>
</tr>
<tr>
<td>Iliac disease</td>
<td>18%</td>
<td>15%</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Previous Interventions</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Previous PTA</td>
<td>16%</td>
<td>12%</td>
<td>0.74</td>
</tr>
<tr>
<td>Previous Stent</td>
<td>2%</td>
<td>8%</td>
<td>0.27</td>
</tr>
<tr>
<td><strong>Rutherford Category</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>6% (3/50)</td>
<td>4% (1/26)</td>
<td>1.00</td>
</tr>
<tr>
<td>2</td>
<td>14% (7/50)</td>
<td>4% (1/26)</td>
<td>0.74</td>
</tr>
<tr>
<td>3</td>
<td>74% (37/50)</td>
<td>88% (23/26)</td>
<td>0.27</td>
</tr>
<tr>
<td>4</td>
<td>6% (3/50)</td>
<td>4% (1/26)</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Ankle brachial Index</strong></td>
<td>Mean ± SD (N)</td>
<td>0.60 ±0.23 (N=45)</td>
<td>0.59 ± 0.17</td>
</tr>
</tbody>
</table>
# Mimics Study: Lesion Characteristics

<table>
<thead>
<tr>
<th></th>
<th>BioMimics 3D (N=50)</th>
<th>Control stent (N=26)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lesion Location</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SFA</td>
<td>92%</td>
<td>77%</td>
<td>0.08</td>
</tr>
<tr>
<td>SFA/Popliteal</td>
<td>6%</td>
<td>12%</td>
<td>0.41</td>
</tr>
<tr>
<td>Popliteal</td>
<td>2%</td>
<td>12%</td>
<td>0.11</td>
</tr>
<tr>
<td><strong>TASC II</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>42%</td>
<td>42%</td>
<td>1.00</td>
</tr>
<tr>
<td>B</td>
<td>56%</td>
<td>58%</td>
<td>1.00</td>
</tr>
<tr>
<td>C</td>
<td>2%</td>
<td>0%</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Lesion Length</strong></td>
<td>mm</td>
<td>66 ± 29</td>
<td>63 ± 28</td>
</tr>
<tr>
<td><strong>Stent Length</strong></td>
<td>mm</td>
<td>99 ± 30</td>
<td>88 ± 22</td>
</tr>
<tr>
<td><strong>Occlusion</strong></td>
<td>Total</td>
<td>44%</td>
<td>46%</td>
</tr>
<tr>
<td><strong>Calcification</strong></td>
<td>Moderate to Severe</td>
<td>52%</td>
<td>58%</td>
</tr>
</tbody>
</table>

## Comparison with Other Studies

<table>
<thead>
<tr>
<th></th>
<th>Superb</th>
<th>Zilver PTX</th>
<th>Durability II</th>
<th>Mimics</th>
<th>IN.PACT</th>
<th>LEVANT 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Occlusions</td>
<td>25%</td>
<td>30%</td>
<td>48%</td>
<td>44%</td>
<td>25.8%</td>
<td>20.6%</td>
</tr>
<tr>
<td>Calcium (severe)</td>
<td>44%</td>
<td>37%</td>
<td>43%</td>
<td>42%</td>
<td>8%</td>
<td>17.6%</td>
</tr>
</tbody>
</table>
Mimics RCT: Primary Patency

Kaplan Meier Estimate of Survival from Loss of Patency
(defined as PSVR >2.0, or where angiography reveals >50% diameter stenosis; or adjudicated clinically driven TLR)

Log rank test
P = 0.05

Cumulative Survival

Months

BioMimics
3D
Control
Stent

80%
71%
55%
72%
Mimics Study: TLR

Kaplan Meier Estimate of Survival from CDTLR
(Clinically-driven TLR determined through Event Adjudication)

What is the value of the longer term benefit?
- Improved patency improves clinical outcomes in claudicants.
- Incremental health economic benefits.
Mimics Study: Longer Term Benefit

12-Month Landmark Analysis: all subjects in study at landmark
(Clinically-driven TLR determined through Event Adjudication)

Log rank test
\( P = 0.03 \)

Cumulative Survival

12-24 Months

BioMimics 3D
Control Stent
TLR: Contemporary Comparisons

Freedom from Clinically-Driven TLR
(KM Survival Estimates)

<table>
<thead>
<tr>
<th>12 Months</th>
<th>24 Months</th>
</tr>
</thead>
<tbody>
<tr>
<td>95%</td>
<td>95%</td>
</tr>
<tr>
<td>90%</td>
<td>90%</td>
</tr>
<tr>
<td>85%</td>
<td>85%</td>
</tr>
<tr>
<td>80%</td>
<td>80%</td>
</tr>
<tr>
<td>75%</td>
<td>75%</td>
</tr>
<tr>
<td>70%</td>
<td>70%</td>
</tr>
</tbody>
</table>

BioMimics 3D
Zilver PTX
Supera
Smart
Lifestent
Everflex

Change in CDTLR from 12 to 24 months

- Everflex (DURABILITY II) 11%
- LifeStent (RESILIENT) 9%
- Smart (STROLL) 6%
- Supera (SUPERB) 5%
- Zilver PTX (ZILVER PTX) 4%

1 Cordis SMART Stent; STROLL Study, 1-year: G. Ansel, LINC 2013; 2-year: W. Gray ISET 2013
2 Bard LifeStent; RESILIENT Study, J. Mustapha, LINC 2012
3 Covidien EverFlex Stent: DURABILITY II Study, K. Rocha-Singh, VIVA 2013
5 Cook Zilver PTX Stent: ZILVER PTX Study, M. Dake, LINC 2012
X-ray images show a BioMimics 3D stent in a femoropopliteal location in a patient with knee bent at 90°. The second image confirms that curvature is sustained over time.

Curvature evident on 2 view X-rays (e.g. AP & Lateral) can be combined to reveal the actual geometry of the BioMimics 3D stented segment and predict wall shear stress.
Mimics Study: Real-World Curvature

If lesion is heavily calcified, is curvature of the stented segment attenuated?

- Curvature and freedom from loss of primary patency are **independent** of calcification
MIMICS I Study

Case 2
MIMICS-2 IDE Study  Enrolment Completed Oct-2016

Evaluation of Safety and Effectiveness of BioMimics 3D in Femoropopliteal Intervention

• Primary Endpoints:
  • **Safety**: composite of death, any major amputation performed on the index limb or clinically-driven target lesion revascularisation (CDTLR) through 30 days
  • **Effectiveness**: 12-month Primary Patency

• IDE Study extended to Japan through FDA/PMDA Harmonization by Doing Initiative

• 47 investigational sites: 35 US; 6 Germany; 6 Japan

**Study Principal Investigators**

Professor Timothy M. Sullivan, M.D  
Minneapolis, MN, USA

Professor Thomas Zeller, MD  
Bad Krozingen, Germany

Professor Masato Nakamura, MD  
Tokyo, Japan

• Independent core labs: ultrasound; angiography
• Independent clinical event adjudication

• 3-year follow-up
MIMICS-3D Registry

Enrolment Ongoing

Prospective, multicentre observational study to evaluate BioMimics 3D in peripheral arterial disease

- PrimaryEndpoints:
  - **Safety**: composite of death, any major amputation performed on the index limb or clinically-driven target lesion revascularisation (CDTLR) through 30 days
  - **Effectiveness**: 12-month Primary Patency

- Post-market surveillance study
- 25 investigational sites in Europe

**Study Principal Investigator**
Michael Lichtenberg MD Arnsberg, Germany

- Independent clinical event adjudication
- 3-year follow-up
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