Implantable Miniaturized Telescope (IMT) for Low-Vision

Eli Peli\textsuperscript{1,2}, Gideon Dotan\textsuperscript{2}, Eli Aharoni\textsuperscript{2}, Alon Sadeh\textsuperscript{2} and Isaac Lipshitz\textsuperscript{2}

\textsuperscript{1}-The Schepens Eye Research Institute, Harvard Medical School, Boston MA, USA

\textsuperscript{2}-VisionCare, Inc., Yehud, Israel
Age-Related Macular Degeneration

- About 5% of western world population is >75y/o.
- The western population is “getting older”.
- About 30% of people >75y suffer AMD.

No effective treatment for a large population.
Concept of IMT™

- Miniature telescope fully implanted in the eye.
- Implant only in one eye (monocular).
- Enables distance & near vision (with spectacles).
IMT™ Visual Functions Principle: Bi-Ocular Multiplexing

- Central vision using the *operated eye* (through the IMT™).

- Peripheral vision using the *fellow eye*. 
**IMT™ Dimensions**

**Size**
- Fits the lenticular capsule ("bag").
- Optical cylinder Size:  
  - Length (ant.-post.): 4.6mm.
  - Diameter: 3.0mm.
- Corneal endothelium - Safety distance - 2mm.

**Weight**
- IMT™ weight in aqueous - 45mg (equal to 4 IOL’s).
- Supportable by the “bag” and the iris.
<table>
<thead>
<tr>
<th>Object Distance</th>
<th>Eyeglasses lens</th>
<th>Mag.</th>
</tr>
</thead>
<tbody>
<tr>
<td>50cm</td>
<td>Dist. Rx</td>
<td>3X</td>
</tr>
<tr>
<td>30cm</td>
<td>Rx +1.5 D</td>
<td>5X</td>
</tr>
<tr>
<td>25cm</td>
<td>Rx +2.2 D</td>
<td>6X</td>
</tr>
<tr>
<td>20cm</td>
<td>Rx +3.2 D</td>
<td>7.5X</td>
</tr>
</tbody>
</table>
Patient Selection Criteria

- Bilateral stable “dry” type AMD
- OR
  Disciform AMD in the eye planned for operation.
- No other eye disease (except for cataract).
- Visual acuity not better than 20/80 (6/24), and not worse than 20/400 (6/120) in either eye.
Patient Selection Criteria (cont.)

- Visual acuity as similar as possible in both eyes.
- **Improved** V.A. with external telescope in planned eye, **better** than fellow eye B.C.V.A.
- The patient shows interest and understands the need for visual rehabilitation.
Surgical Techniques

- **Limbal Approach**
  - Limbal incision - 10mm (140°-160 °).

- **Scleral Tunnel**
  - Tunnel location: 3-4mm posterior to limbus.
  - 10mm incision - wide and long “tunnel”.
  - Short healing period, no astigmatism.
Pre-and Post-Op Care

Teamwork of Ophthalmologists & Low-Vision Experts

- Patient selection and evaluation
- Medical / Surgical treatment.
- Refraction, astigmatism correction and suture removal.
- Low-Vision Rehabilitation.
European Clinical Trial

- Total 46 patients (9 blind eyes, safety only)
- Follow-up
  - 2 months - 31 patients
  - 3 months - 21 patients
  - 6 months - 20 patients
  - 12 months - 11 patients
- Distance VA, Near VA, ADL (Activities of Daily Living)
Clinical Trial Results

Visual Acuity

■ Distance Visual Acuity:
   At 6 months improved in 86% of patients.
   mean improvement 2.1×

■ Near Visual Acuity:
   At 6 months improved in 95% of patients.
   mean improvement 1.8×

Improvements are statistically significant by Wilcoxon Signed Test (p<0.0005)
Activities of Daily Living

- Actual environment for tasks set up locally
- Subjective reporting of difficulty with task
- Rank as:
  - Impossible to do 0
  - Possible with great difficulty 1
  - Possible with some difficulty 2
  - Easily done 3
Clinical Trial Results
Subjective Reports
improved performance at 6 months

- Reading newspaper  90%
- Face recognition    80%
- Table orientation  70%
- Watching TV        90%

Improvements are statistically significant by Wilcoxon Signed Test (p<0.006)
Advantages of IMT™

- Enhanced central while maintaining peripheral vision
- No relative movements between eye / telescope.
- Natural scanning of visual field.
- No “escape” from adaptation.
- Patient comfort and cosmetic advantages.
Improved Image Stability and Orientation

- (a) A head rotation without optical device, VOR useful
- (b) With a head-mounted telescope (3.0X) the VOR generated eye rotation will not suffice ⇒ image motion, reduced visibility, and possibly motion sickness.
- (c) Telescope inside the eye restores natural VOR function.
Restoring Depth Perception Through Monocular Parallax

- Monocular nature of the device eliminates stereo vision.
- Monocular depth perception is significantly improved due to anterior position of the nodal point in front of the eye (similar to the eye of the Chameleon).
Problem

- AMD - leading cause of blindness.
- Numbers of AMD patients growing.
- No treatment for most patients.
Solution

- **IMT™ - Implantable Miniaturized Telescope.**
- Optical solution for AMD patients.
- Unique functional advantages.
- Cosmetically acceptable (invisible)