The Intraocular Retinal Prosthesis Project

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Developing an Implantable Prosthesis

- Anatomy of the visual system in normal and RP individuals.
- Concept of the retinal prosthesis.
- Understanding how electric current drives the retina in blind RP and AMD individuals.
- Prosthesis technology development.
- Assess the efficacy and safety of the prosthetic device in animals.
- Human experiments.

Margalit et al, Survey Ophthalmol 2002
Diagram of the Human Visual System
Diagram of the Retinal Layers

- Internal Limiting Membrane
- Nerve Fiber Layer
- Ganglion Layer
- Inner Plexiform Layer
- Inner Nuclear Layer
- Outer Plexiform Layer
- Outer Nuclear Layer
- External Limiting Membrane
- Layer of A) Rods & B) Cones
- Pigmented Epithelium
- Choroid Capillaries
- Müller Cell
  - A) Horizontal Fibers
  - B) Honeycomb Meshwork
  - C) Radial Processes
  - D) Fiber Bundles

Retina
Morphometric Analysis of RP patients’ Retina
How The Idea of an Electronic Retinal Prosthesis Came About

- During the 18th century, scientists began to understand that electricity could elicit a response in biological tissues (Galvani 1791).
- The era of electronic implants was ushered in by both cardiac pacemakers (Glenn 1959) and cochlear implants (Djourno 1957).
- Electrically evoked response (EER) is recordable in some RP patients (Potts 1969).
Recording of ganglion cells from normal and RD mice

Light stimulation

Normal mouse

RD mouse

Suzuki et al, 2004
Recording of ganglion cells from normal and RD mice

Electrical stimulation

Normal mouse

RD mouse
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Cochlear Prosthesis Concept
Retinal Prosthesis Concept
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Animation of Electrode Insertion

Humayun et al, Arch Ophthal, Vis Res 1996, 1999
Twenty-One Electrodes Used in Human Experiments
### Summary of Results in the Human Experiments

<table>
<thead>
<tr>
<th>Subject</th>
<th>Diagnosis</th>
<th>Preop-Visual Acuity</th>
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Electronic Chip