retina implant

look and you will see

Restoring vision with subretinal implants

Dr. Timo Lebold

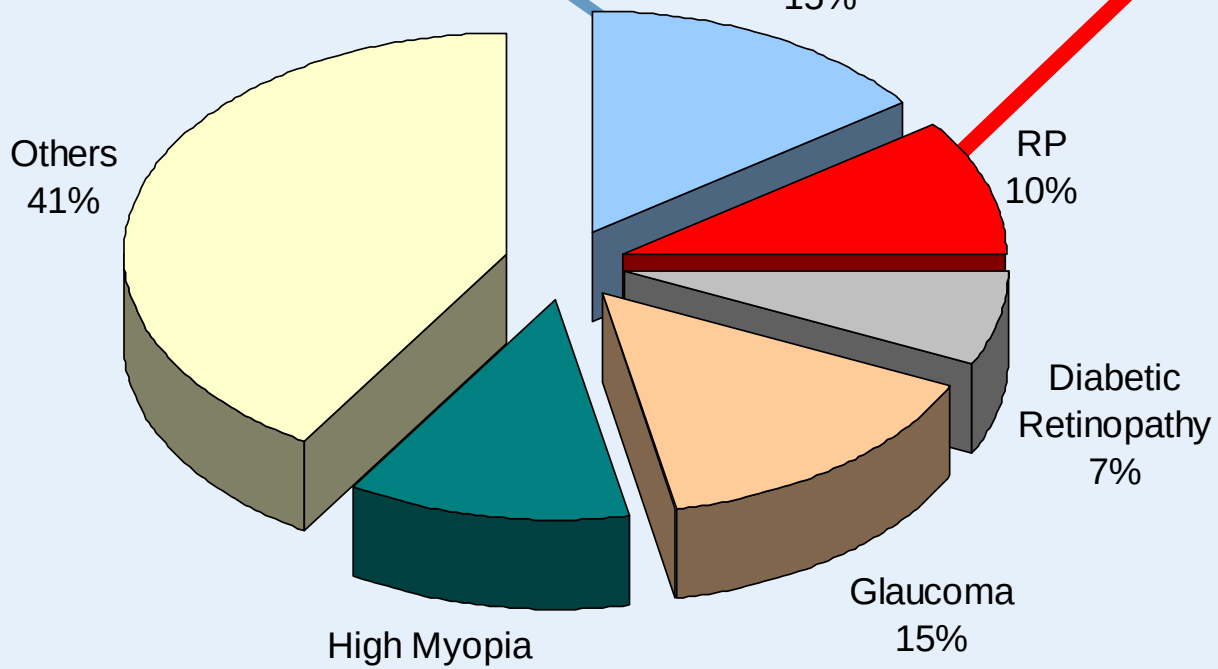
Retina Implant AG, Reutlingen, Germany

Causes for Blindness

retina implant

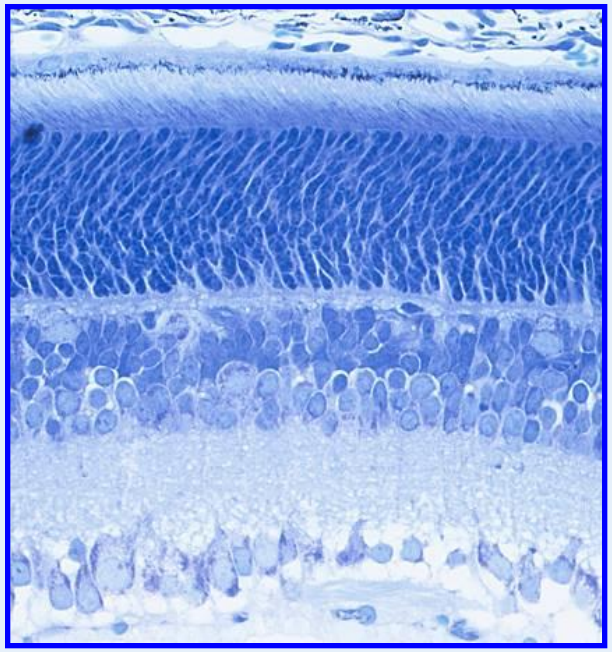
approx. 5000 AMD-incidences/year in Germany (2008: 4 Mio. AMD patients in total)

30.000-40.000 RP patients in Germany (1 out of 3000 – 7000)

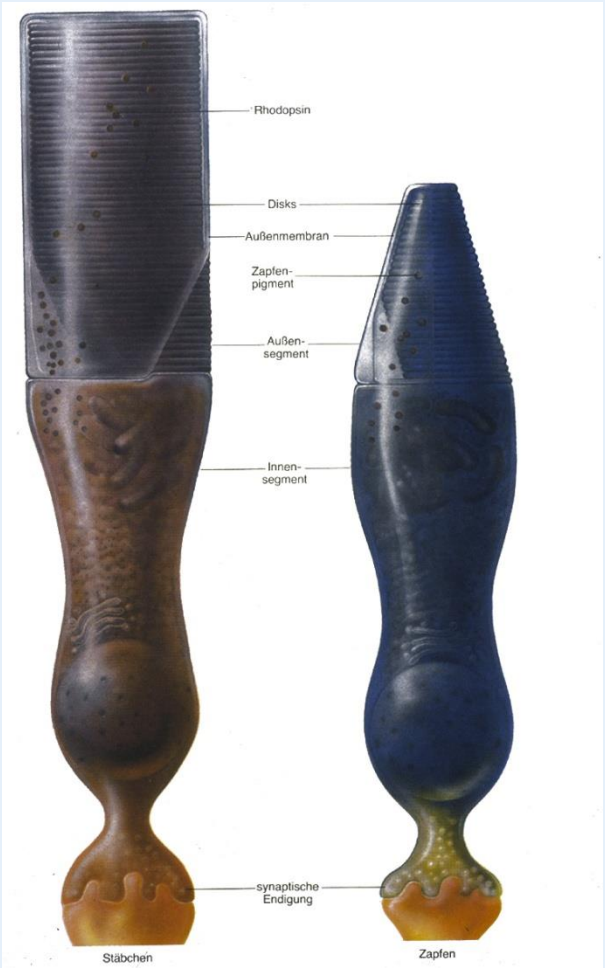


Rods

High sensitivity
Low spatial resolution
No colour discrimination.

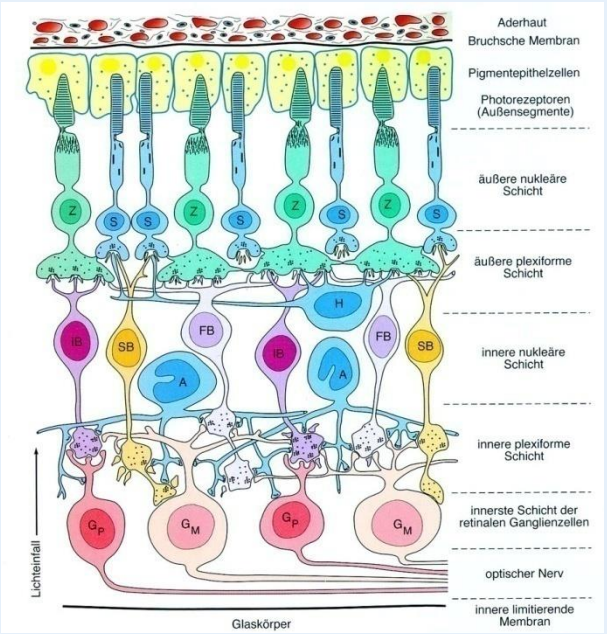


The Retina



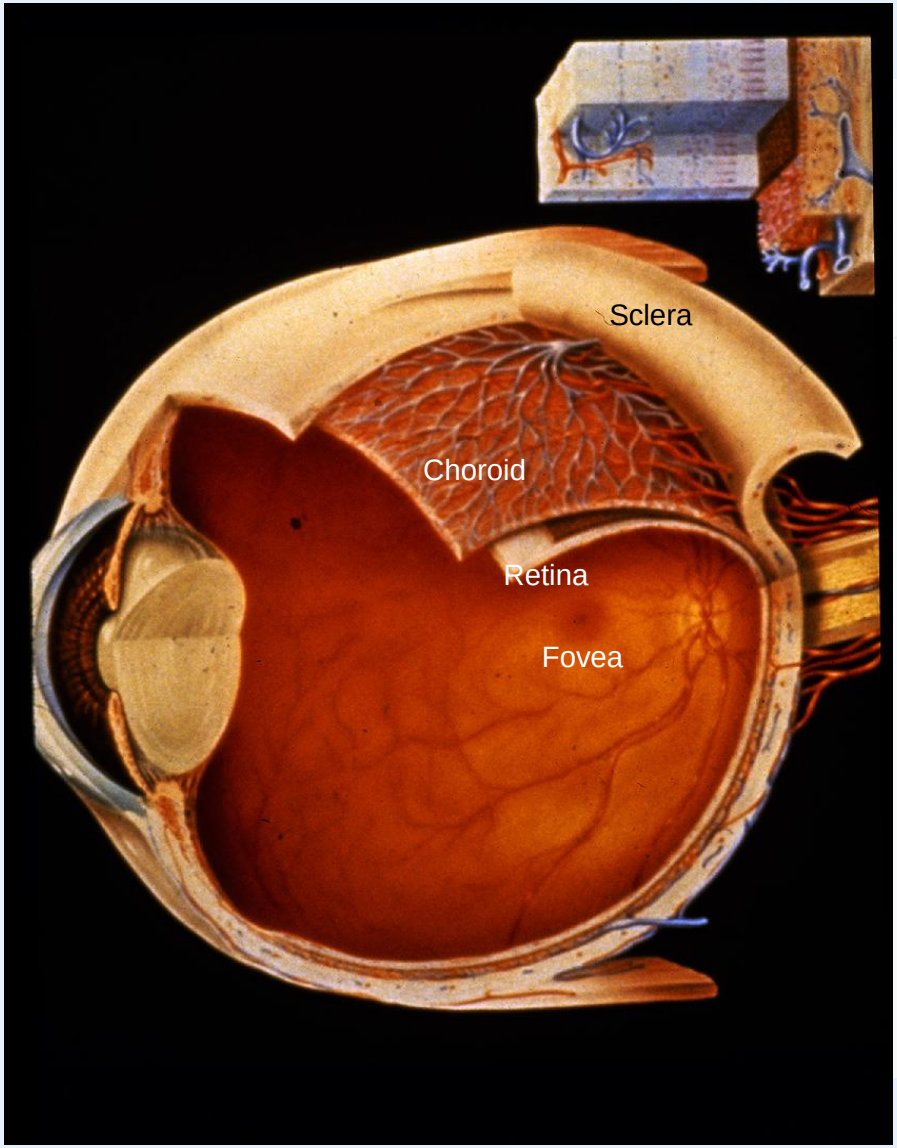
Cones

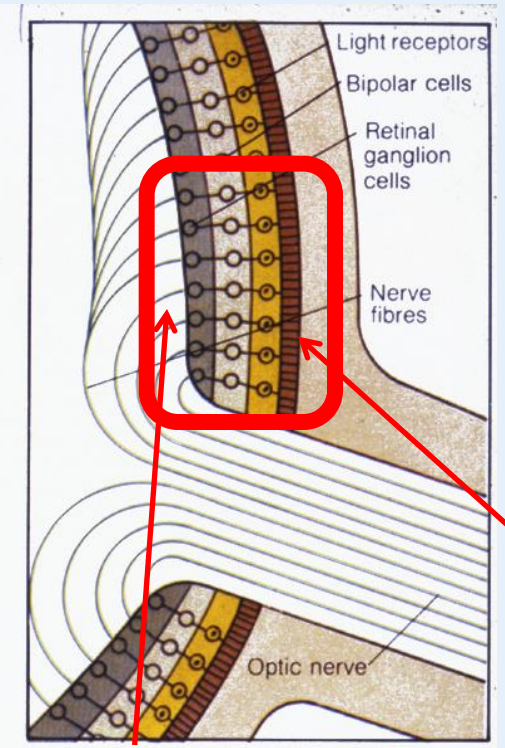
Low sensitivity
High spatial resolution
Colour discrimination



The Principles of Retinal Implants

retina implant



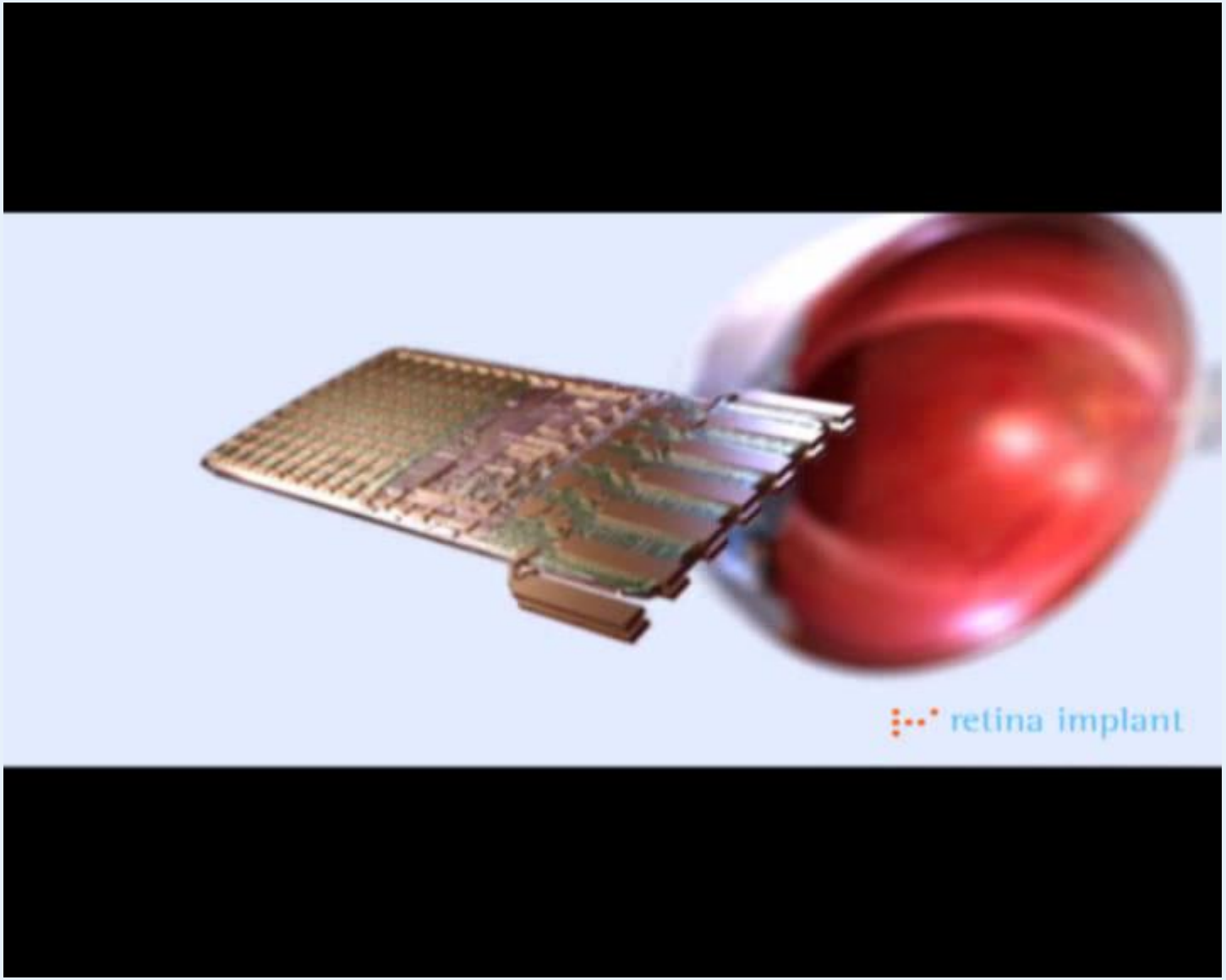


SUB
Light sensor under the retina

EPI
Light sensor Outside body

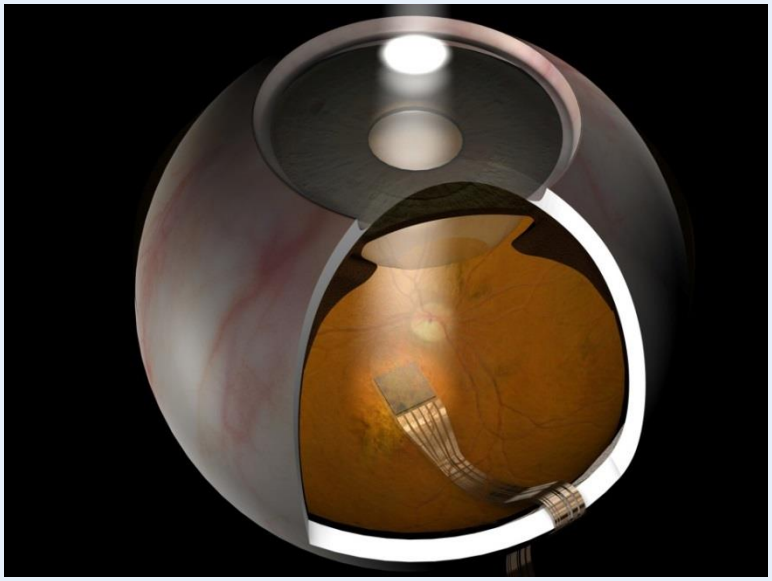
Concept for a Subretinal Implant

retina implant



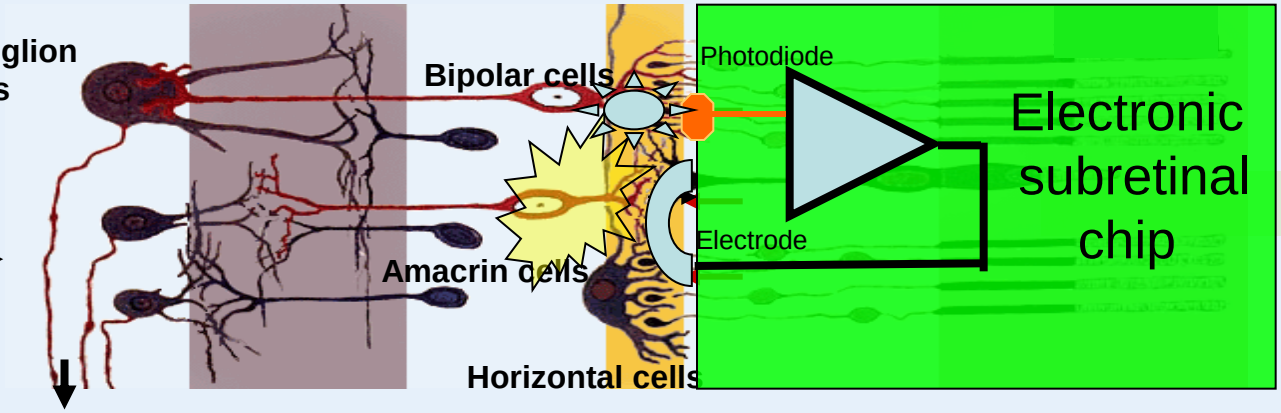
Why a subretinal approach?

- 1500 Photodiodes and electrodes connect to the retinotopic correct localization
- Remaining retinal network can be utilized
- Fixation of the chip is easier
- Natural eye movements



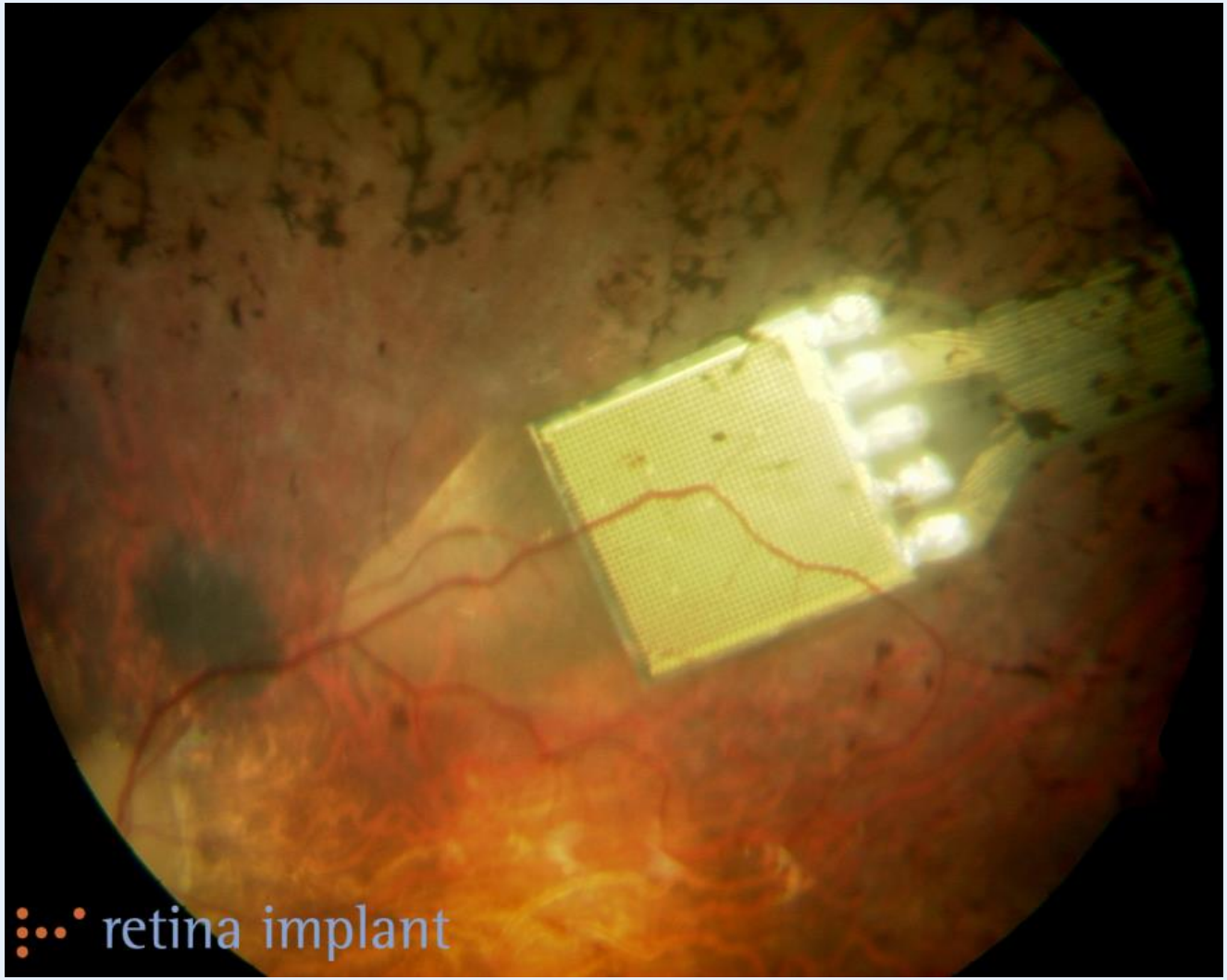
Universitäts-Augenklinik Tübingen

Light



The Subretinal Chip inside the Eye

retina implant



The Tübingen Approach for a Subretinal Implant

retina implant

SUBRET-Project (funded by the German government) (1996-2003)
Retina Implant AG (founded in 2003): 10 years – 30 mio. €

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ims chips

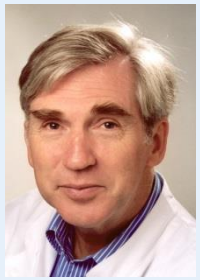
Chipdesign & -Manufacturing

Bundesministerium für Bildung und Forschung

Baden-Württemberg
Wir können alles. Außer Hochdeutsch.

Projektleitung, Diagnostik, Humanimplantation:
University Eye Hospital Tübingen

UNIVERSITÄT REGENSBURG
KLINIKUM



Surgical technologies

UNIVERSITÄT HOHENHEIM

Animal experiments

multichannel systems

Power supply

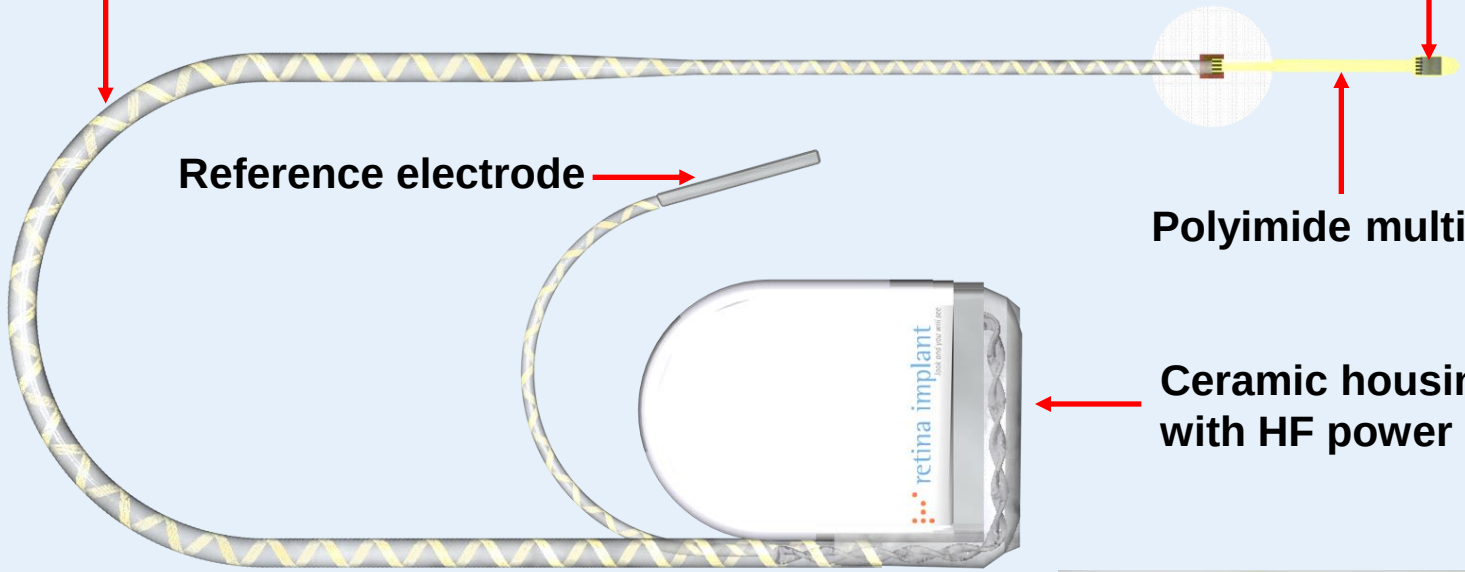
NMI

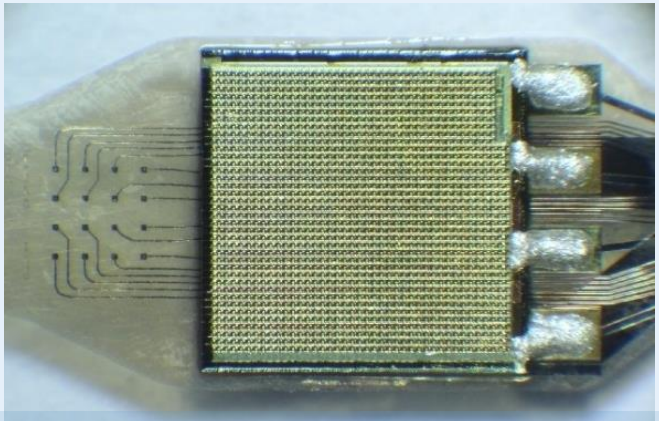
In-vitro tests,
thin film coatings,
flexible substrates

Retina Implant AG

Overview of the subretinal implant

retina implant





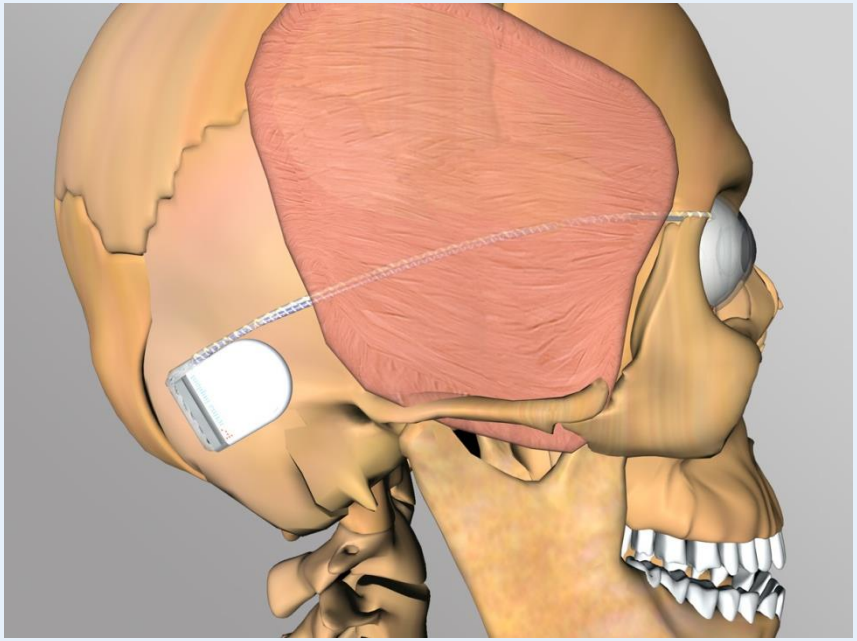
Microchip: 3 x 3 mm, 70µm thickness, 1.500 pixels.

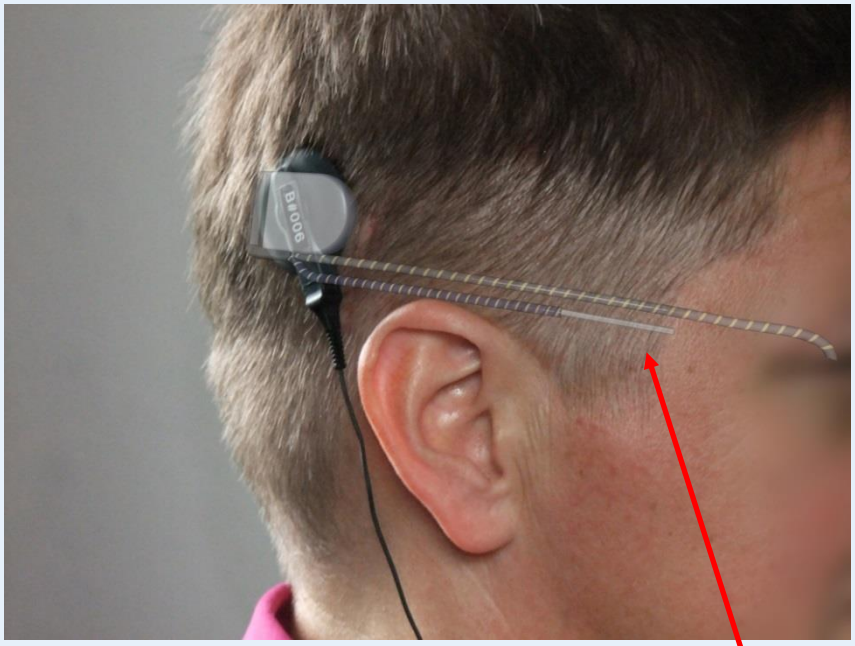
MCS Multichannel Systems GmbH

External Supply Unit

The implanted power supply

retina implant



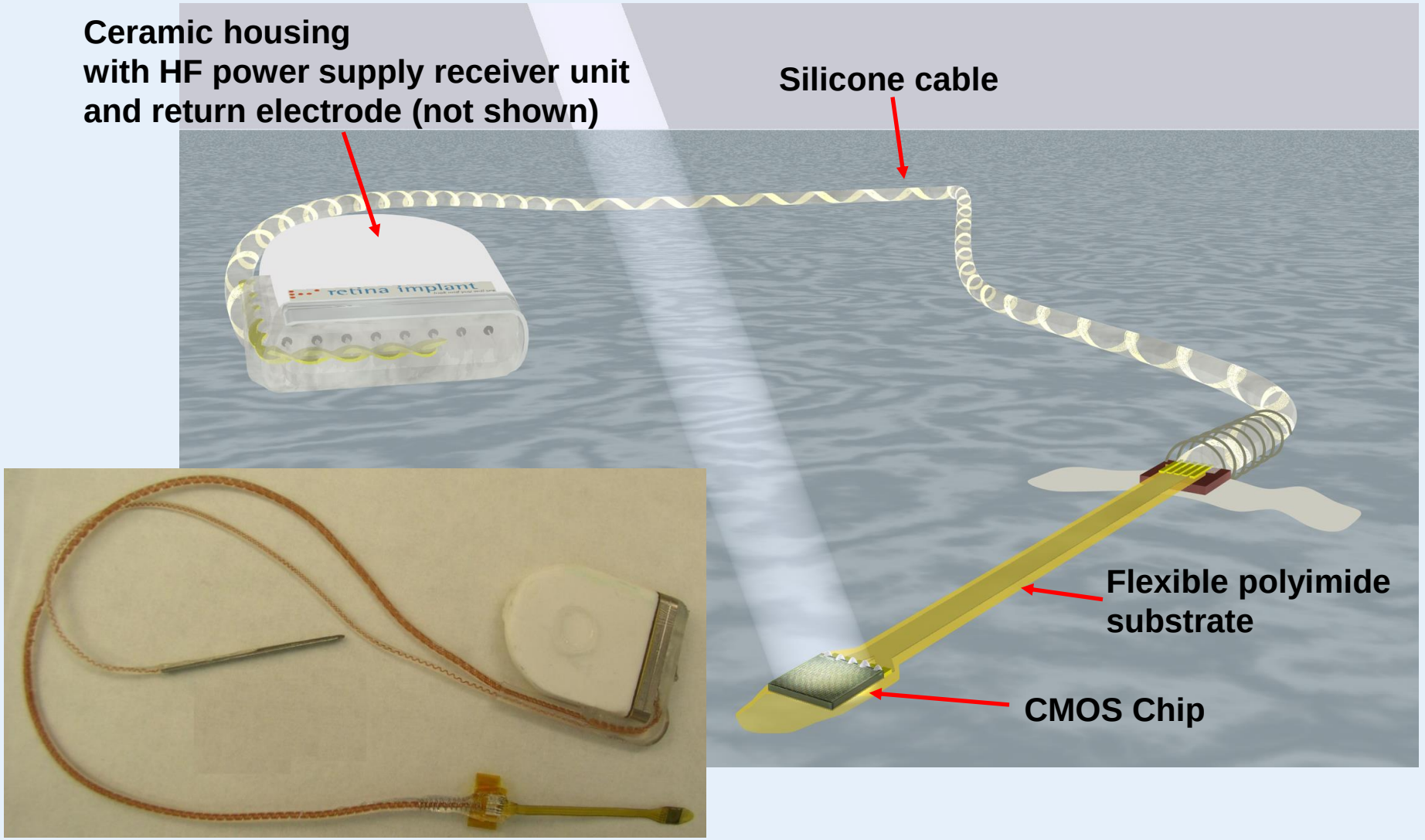


Return electrode

- ✓ Only handheld device external, all key components implanted and thus invisible.
- ✓ Chip (1500 pixels) automatically follows eye movements.
- ✓ Utilization of the remaining network of nerves.

Challenge: Long-term stability

retina implant



Challenges: Long-term stability

retina implant

„Aktive Implantate: das ist so schwierig, wie einen Flachbildschirm in Seewasser zu werfen, und zu verlangen, dass er 10 Jahre lang ununterbrochen läuft…“

Presentation ZVEI Frankfurt Nov.2009

Challenges: Long-term stability

retina implant

„Aktive Implantate: das ist so schwierig, wie einen Flachbildschirm in Seewasser zu werfen, und zu verlangen, dass er 10 Jahre lang ununterbrochen läuft…“

Presentation ZVEI Frankfurt Nov.2009

Cebit, Hannover, 2012

Notified Bodies (TÜV, FDA etc.):
10 year lifetime target
Not achievable for novel products and technologies.

Challenges: Long-term stability

retina implant

Polyimide foil substrate

[redacted]

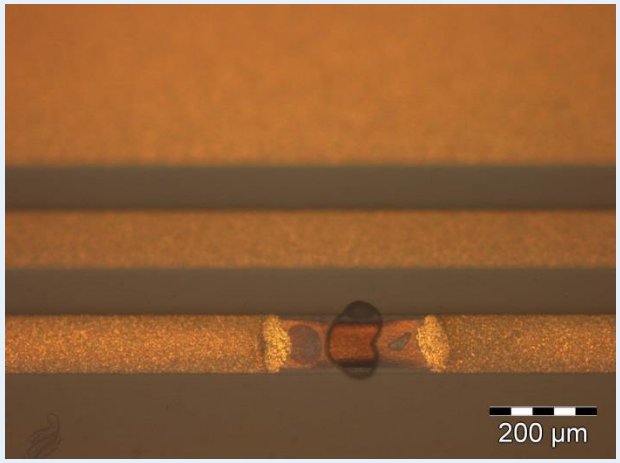
- [redacted]
- Different lengths available due to variations in eye size: 30, 35, 40, 45, 50mm
- Gold leads (sputtered or galvanized)

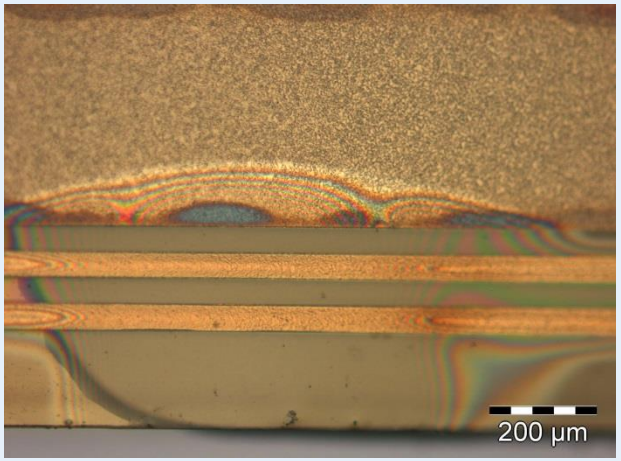
[redacted]

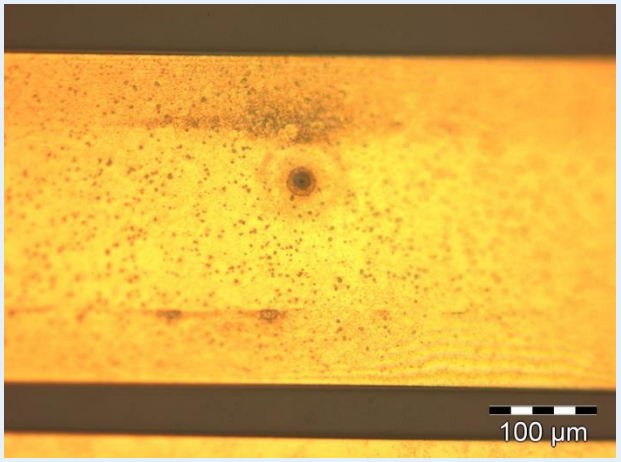
Challenges: Long-term stability

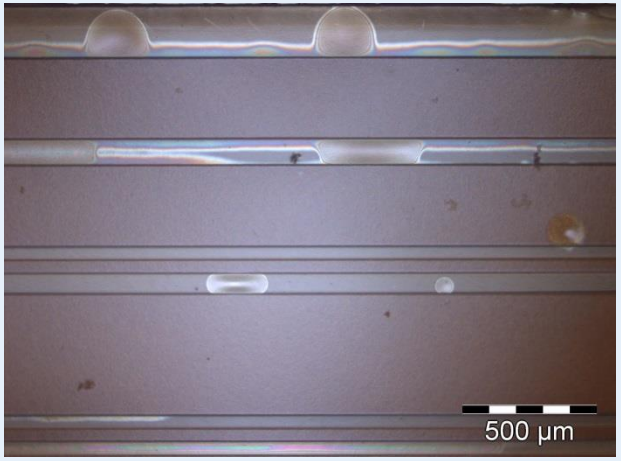
retina implant

Typical failure patterns for foil substrates









pinholes

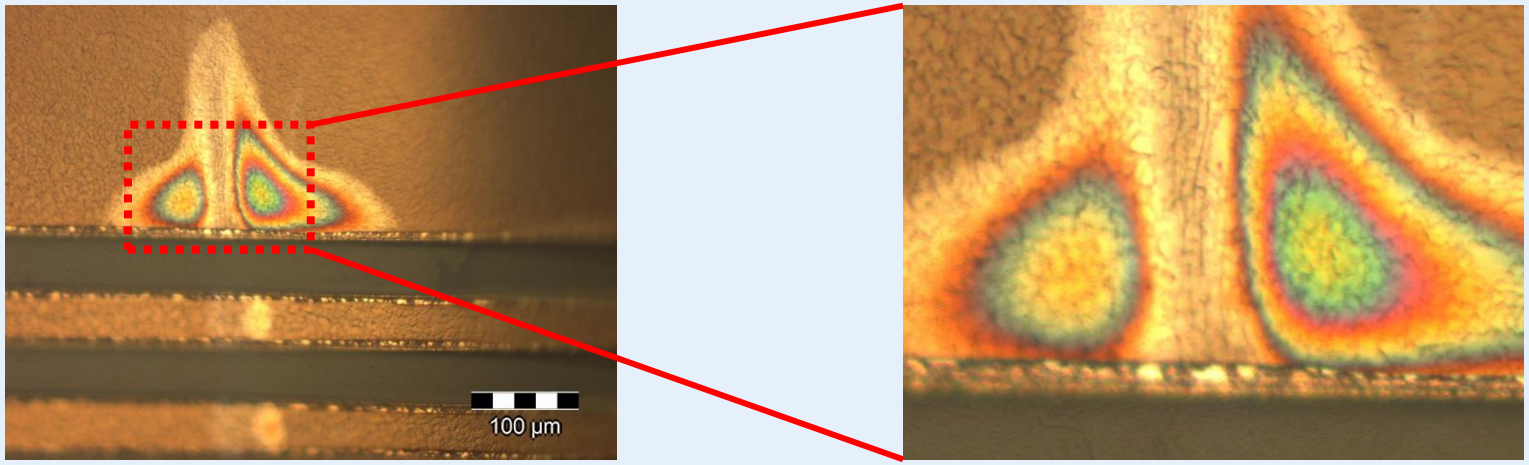
delaminations

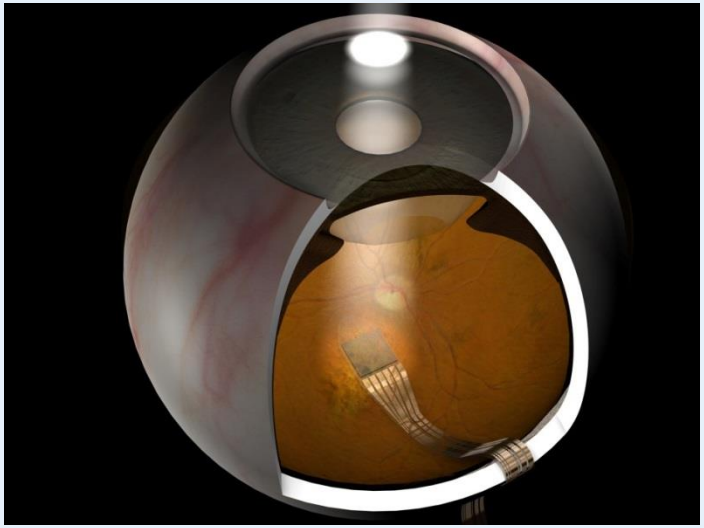
Challenges: Long-term stability

retina implant

Mechanical Strain

Low Bending diameters: 270 µm (stainless steel wire)





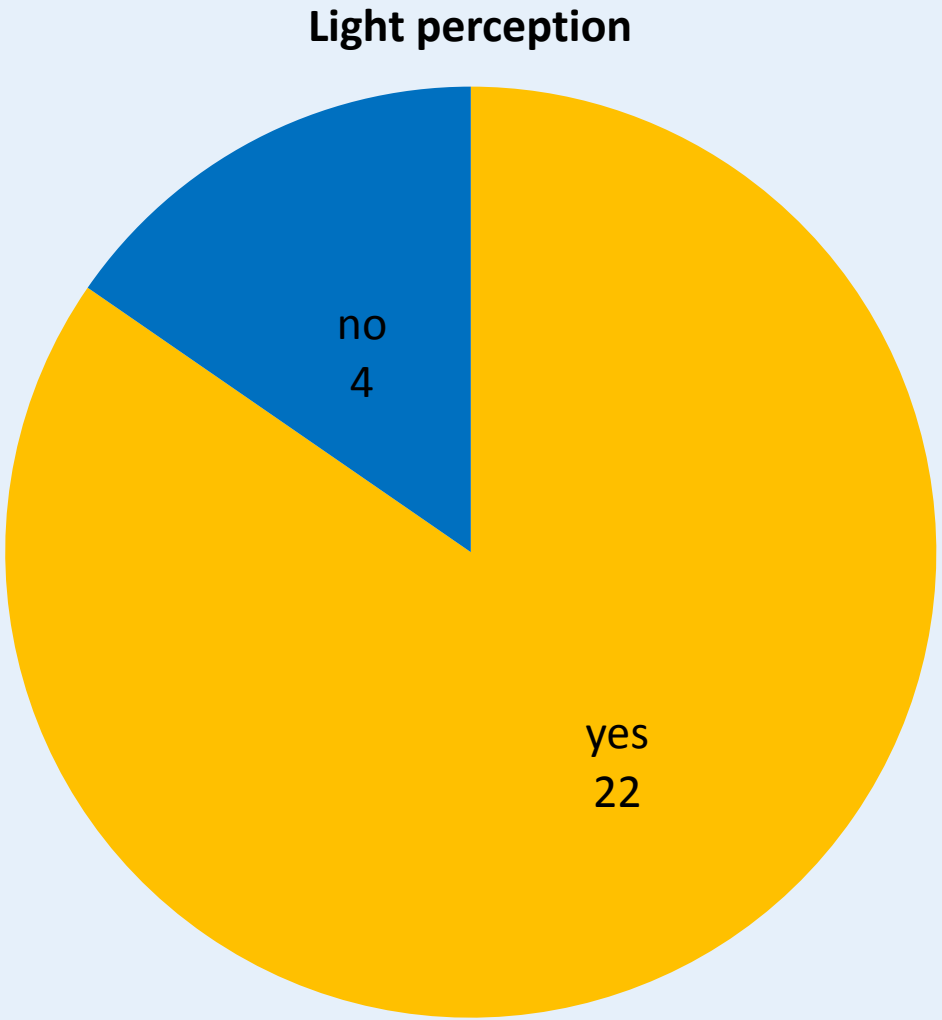
Challenges: Long-term stability

retina implant

Mechanical Strain

Visual Results: Basic Function

retina implant



No perception:

TU-01 optic nerve problem

BU-01 retinal swelling after repositioning

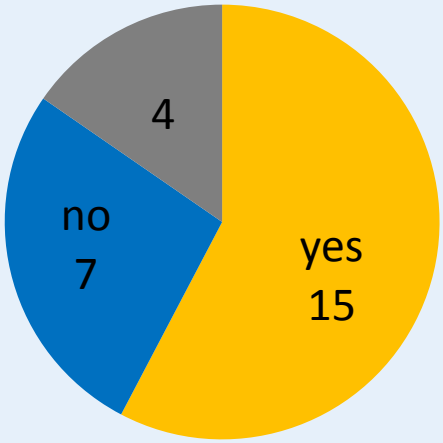
HK-02 vascular problems

SI-01 technical problem

Visual Results: Basic Function (II)

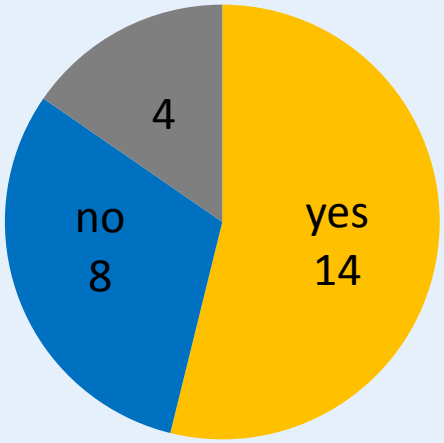
retina implant

Light source Localization



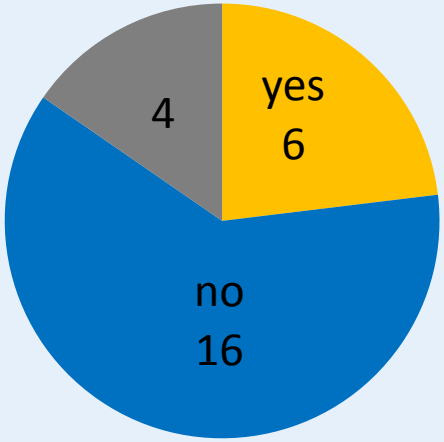
median
0,33 cpd

Grating acuity

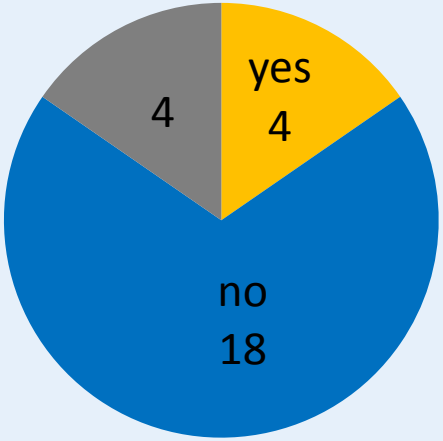


0,33	TU-05
0,3	TU-07
0,3	TU-08
3,3	TU-09
0,5	TU-10
1	TU-12
1	TU-15
0,33	LO-01
0,1	LO-07
0,33	OX-02
0,33	OX-03
1	OX-04
0,33	OX-05
1	OX-06

Motion perception



Landolt C-rings

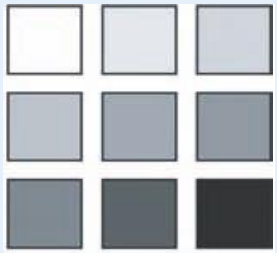


0,01	TU-07
0,037	TU-09
0,01	OX-06
0,033	HK-01

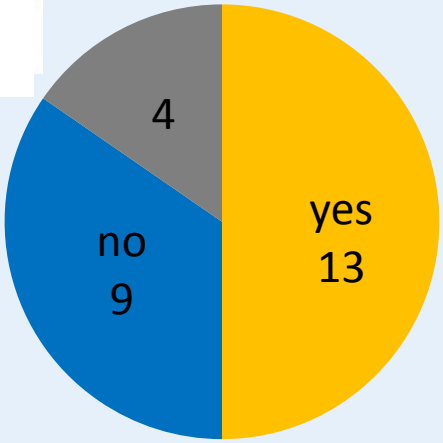
median
0,0215

Visual Results: Special Recognition tasks

retina implant

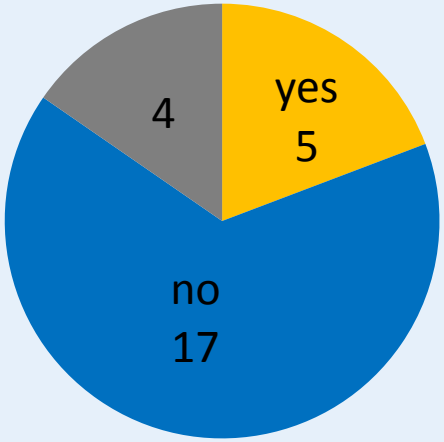


Greyscales



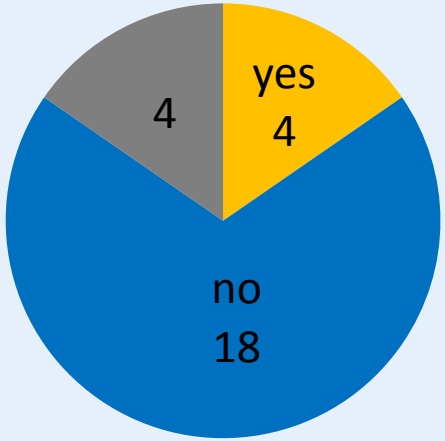
3	TU-08
4	TU-10
3	TU-12
5	TU-14
1	TU-15
2	LO-01
3	OX-01
5	OX-02
4	OX-03
4	OX-04
4	OX-05
6	OX-06
6	HK-01

Clock



9	TU-02
11	TU-09
11	TU-12
7	OX-05
10	OX-06

Letters



7 of 12	TU-02
5 of 8	TU-08
12 of 12	TU-09
3 of 4	LO-07
(2 of 3	TU-10)

T V I L H U C L T V I H

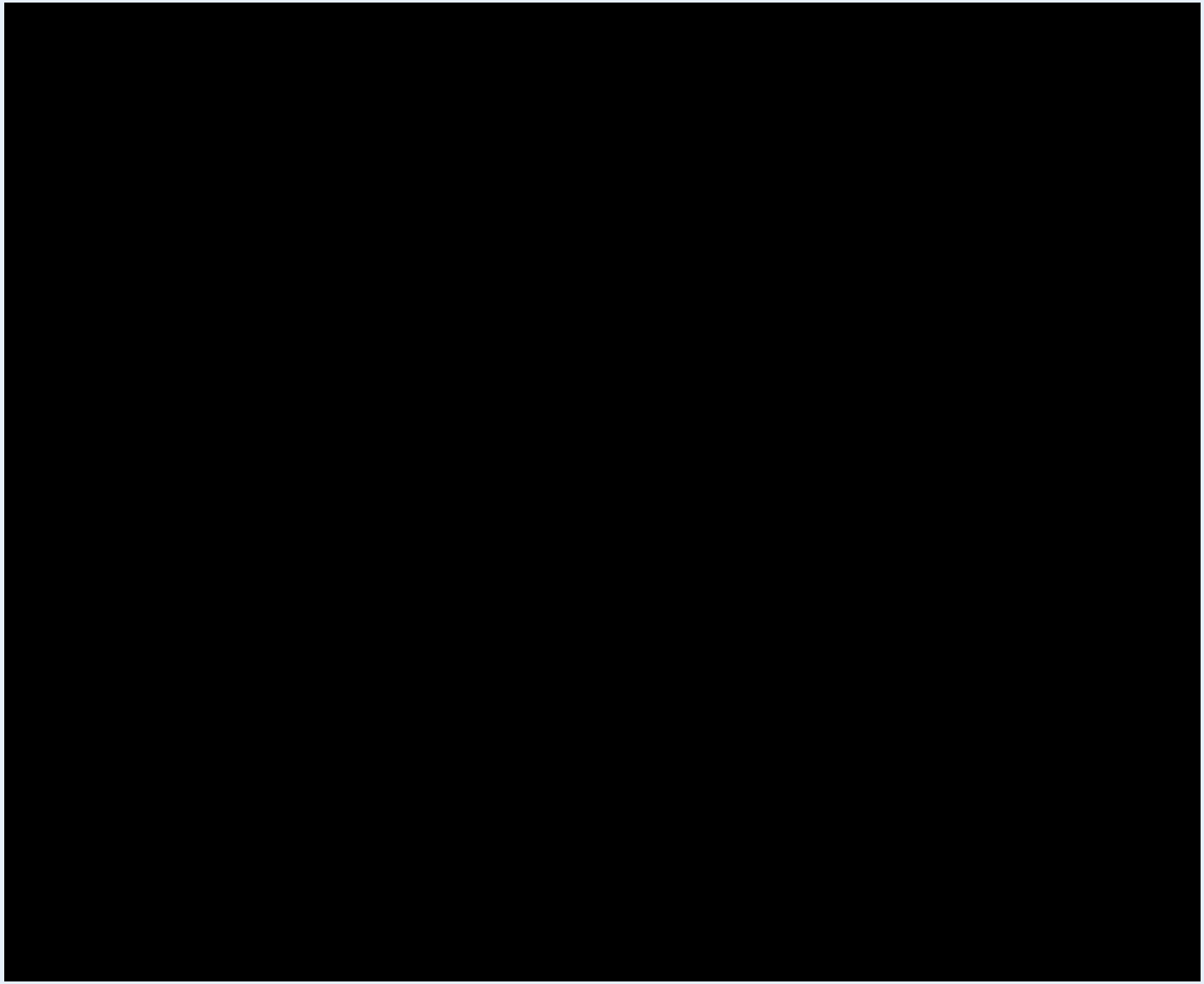
Patients‘ Self Reporting

retina implant

People	shape of head; face: eye part, mouth shape, teeth; glasses; bracelet; characteristics of dresses; heads of colleagues during work group meeting; darkhair vs. blond hair; rim of glasses; people sitting on chairs in the garden; person bending to his laptop; silhouette of a visitor on the couch; moving heads ("bananas"); ground daughter in white baby-dress; shoulders silhouette; face as a triangular flash; white scarf around the neck;	**8**
Houses	windows; house outlines; white papersheet hanging on the door; door knob; silhouette of Tübingen town-hall; locate doors or door frames; walls; chimney margins; locating egdes of steps; size of the windows; curtain stripes	**10**
Streets	white pile on the street; street lamps showing the direction of the street; fireworks; shop sighs in darknes lit up (not reading); lines of the pavements; landmarks; arches of a viaduct;	**5**
Cars	car reflexions; car lights at night moving; bus lights; telling 2 bus companies; sitting in the car at nicght: car lights as "fireflies";	**4**
Nature	sunflower stalk in the graden; parasol in the garden; horizon; river on the horizon (sun reflexion); blooming flowers in the garden; goose swimming in the pond; outline of the dogs; dogs wagging the tail; could walk around a garden table and sit down; moon	**4**
Reading	Signs on the street (lighting): ADAC, VAPIANO	**1**
Own body	own fingers in front of the TV screen; own hand; head silhouette in the mirror; own striped jacket in the mirror	**3**
Near / At home	Frame of a picture with texture of the image; lamp-post; fluorescent tubes; kitchen objects such as plates, etc. in good contrast; washing basin; trash can; clock on the wall (not reading hours); square-shaped carpet in the next room; frame of the TV; cup handle; small bottles; red vs. white wine; dark vs. milk chocolate; noodels vs. beef; objects on the working desk (staples, phone, etc.); glass and cutlery on the table; picking up hot steam while cooking;	**9**

Recognizing objects

retina implant



Recognizing
Numbers on Dice
retina implant
Original Source:
ARD, Sendung mit der Maus - aired 22.04.2012

Watching a
Car pass by
retina implant

Recognizing letters

Simulation of the visual perception

retina implant

Recognizing
Facial Features
retina implant
Original Source:
ARD, Sendung mit der Maus - aired 22.04.2012

Thank you very much for your attention.