



JOHNS HOPKINS
M E D I C I N E

JOHNS HOPKINS HEALTH SYSTEM

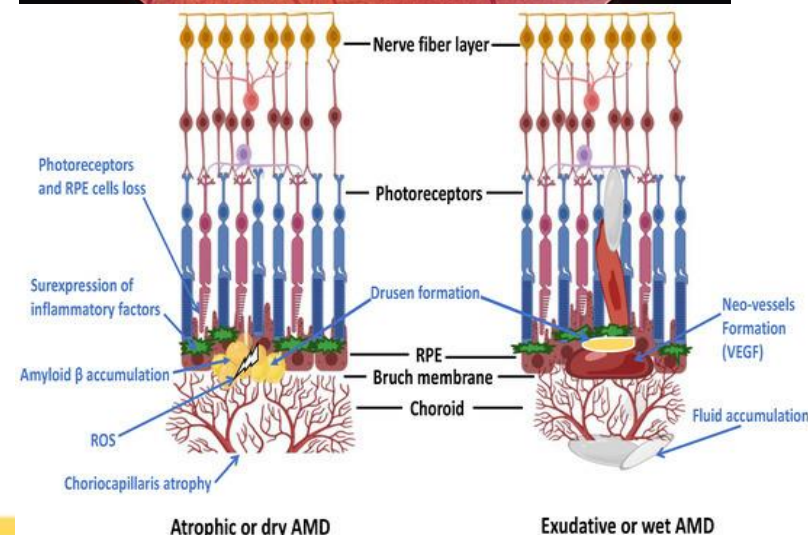
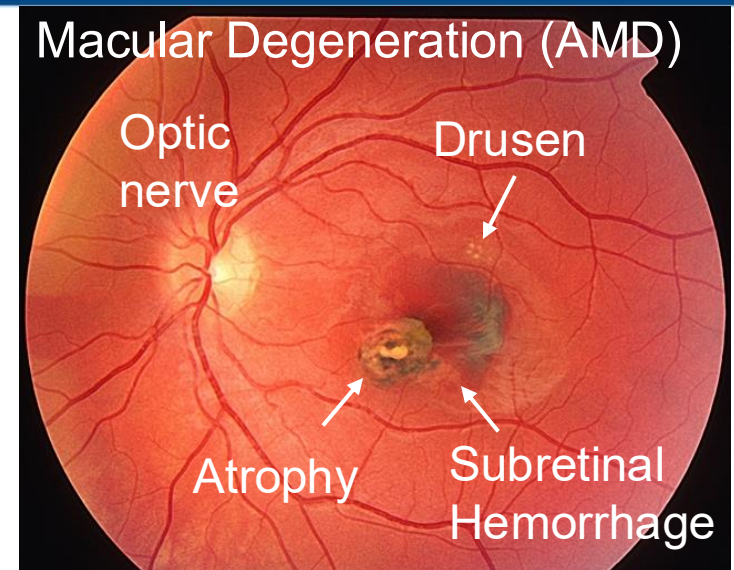
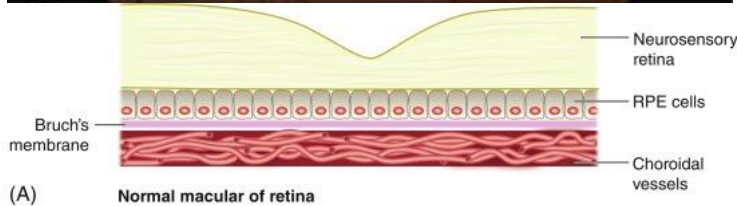
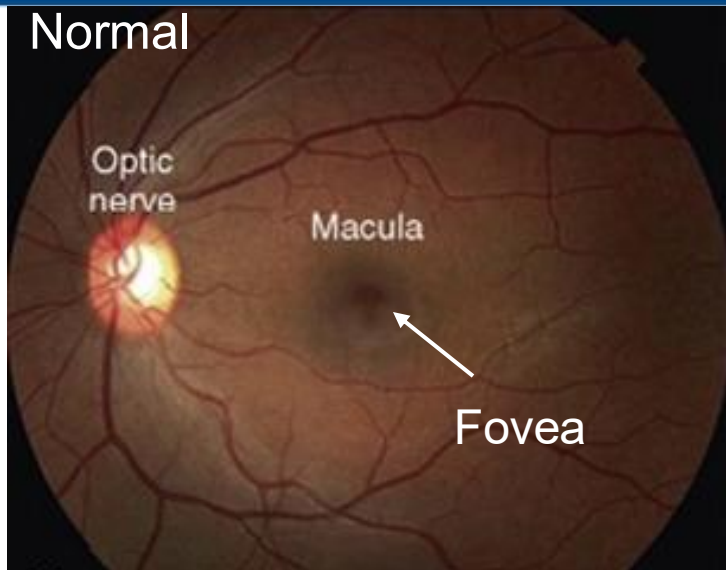
Silicon Nanoneedles: A Breakthrough Platform for Controlled, Sustained Macular Degeneration Treatment

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Financial disclosures

- **CH Lee and YM Paulus are inventors on a UM-Purdue Univ. patent application on silicon nanoneedles**
- **All other authors have no relevant financial disclosures.**

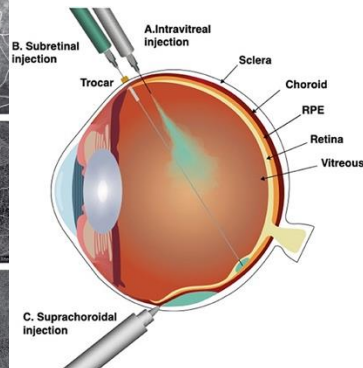
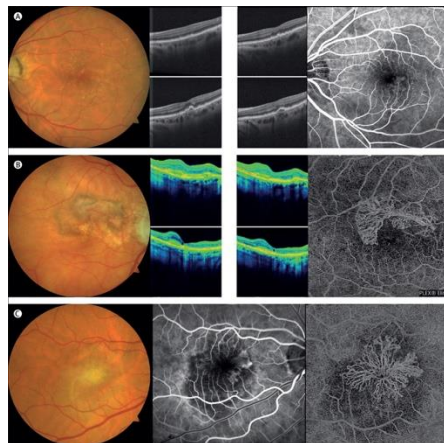
Age-related Macular Degeneration



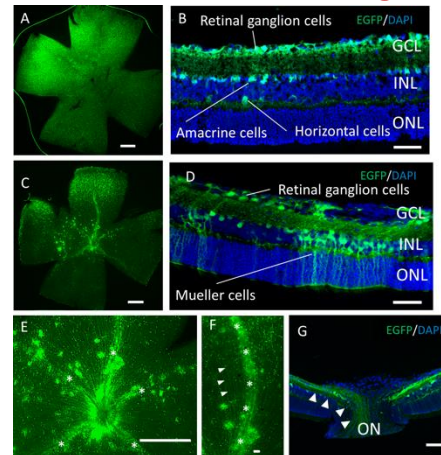
- AMD is the leading cause of vision impairment and blindness.
- Advanced (wet) AMD characterized by the formation of choroidal neovascularization from choroid layer, break through Bruch's membrane into the retina/subretinal space.

AMD Treatment

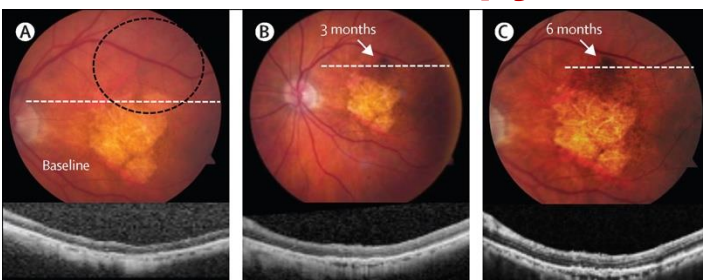
□ Anti VEGF



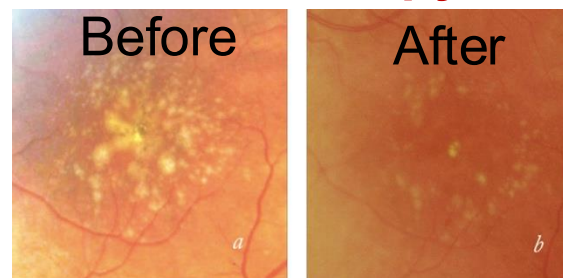
□ Gene Therapy



□ Stem Cell Therapy



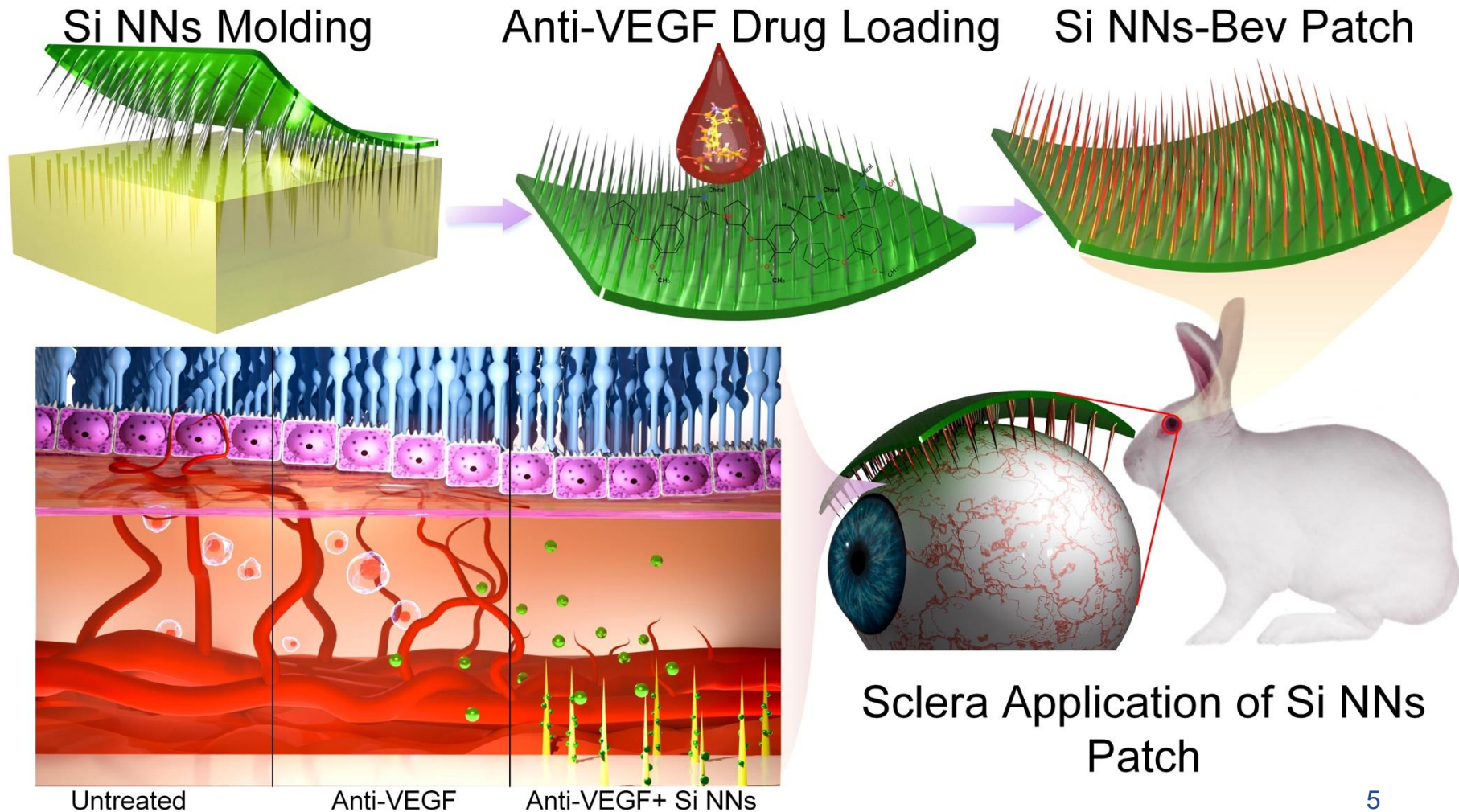
□ Laser Therapy



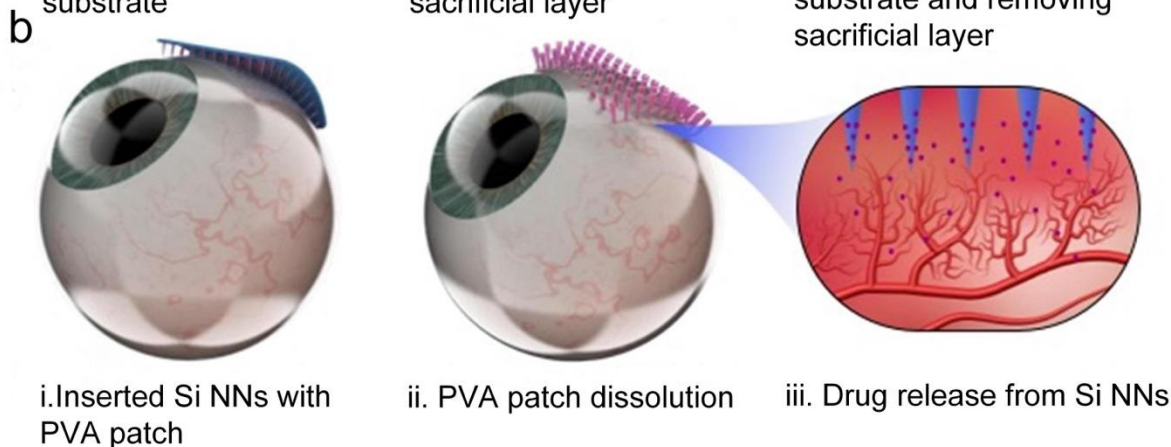
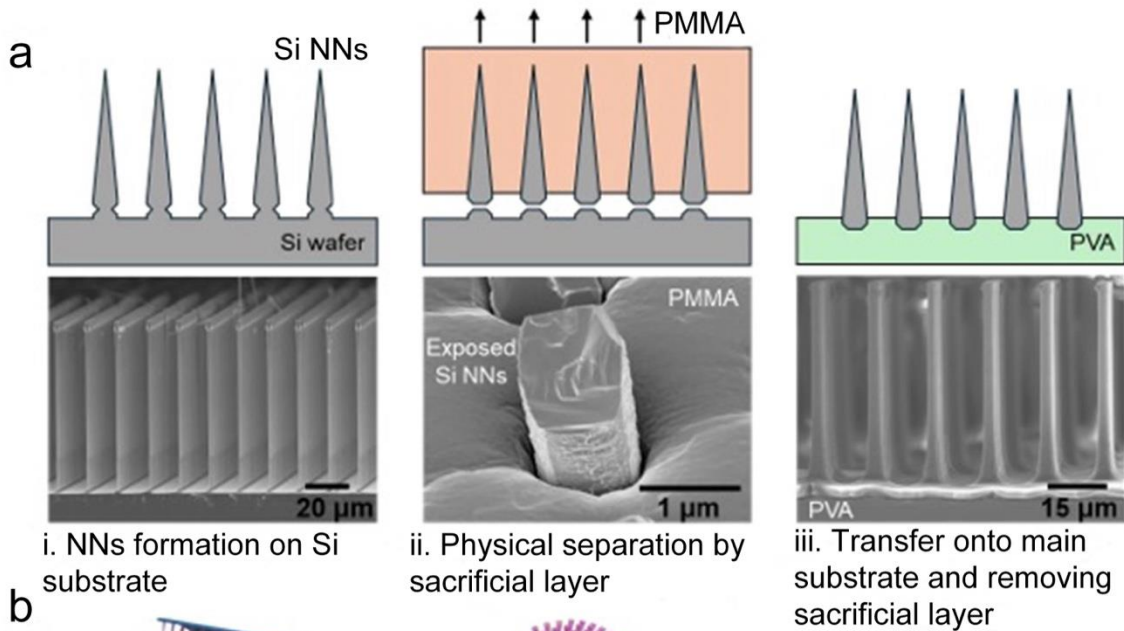
□ Limitations:

- Frequent dosing required
- Intraocular inflammation
- Still in clinical trials, immune reaction to viral vectors
- Risk of tumor formation
- Integration challenges
- High cost and complexity

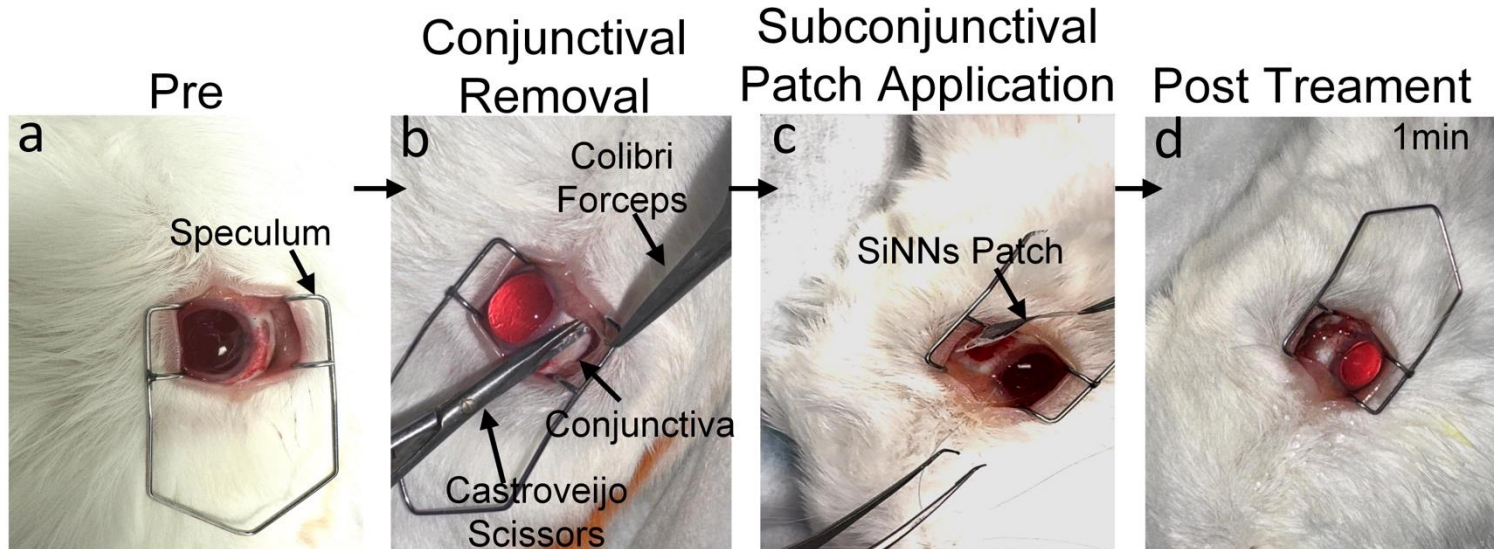
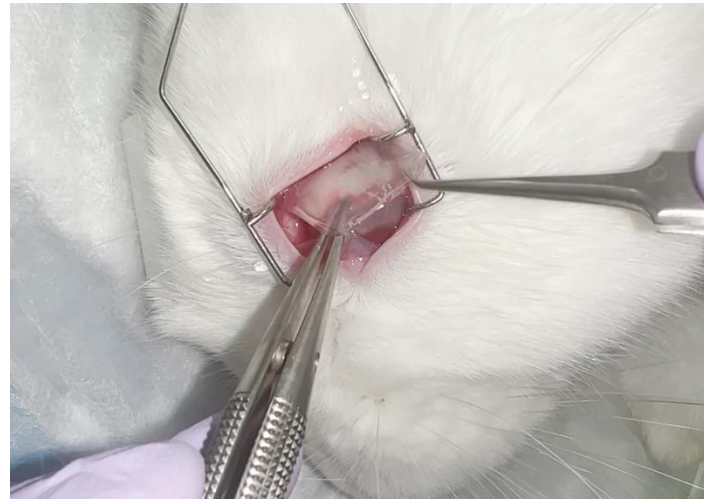
Silicon Nanoneedles for Treatment of AMD



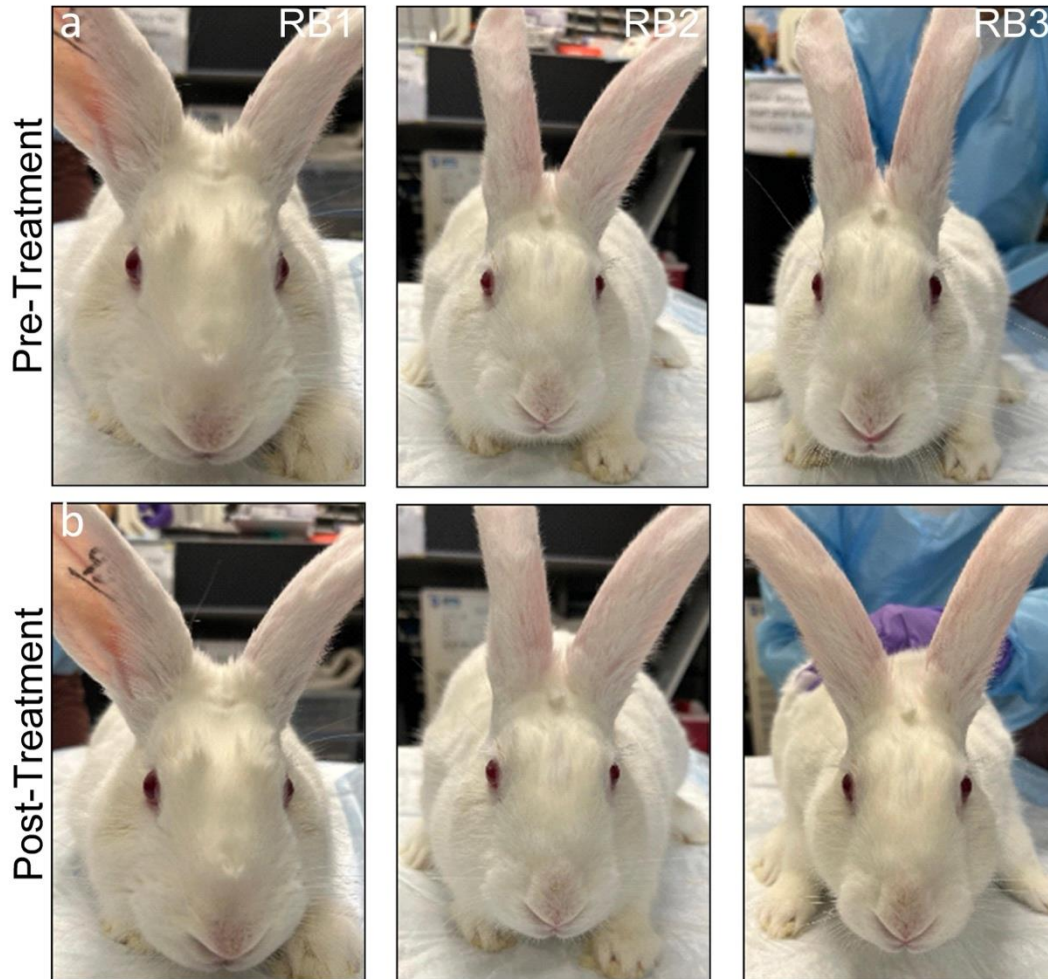
Si NNs Fabrication and Application in The Retina



SiNNs Application in Rabbits

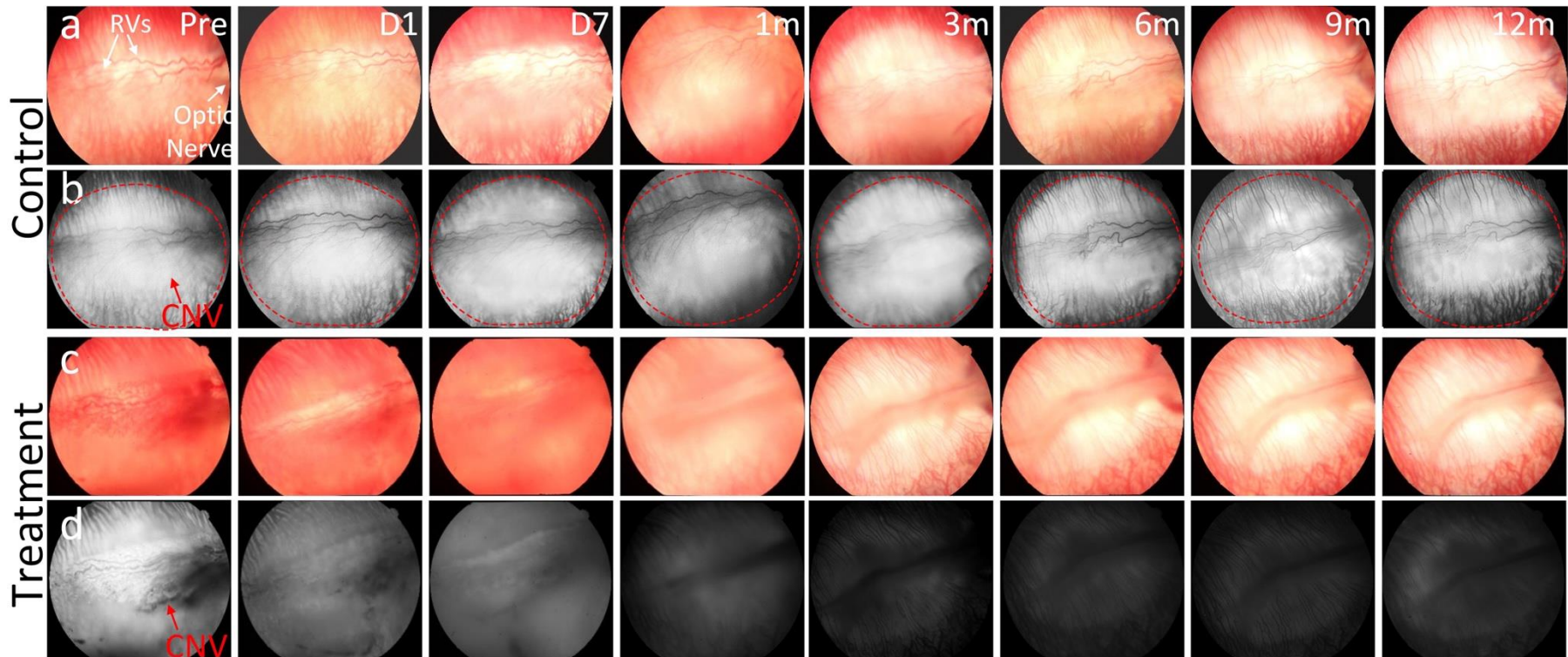


Grimace Scale Analysis



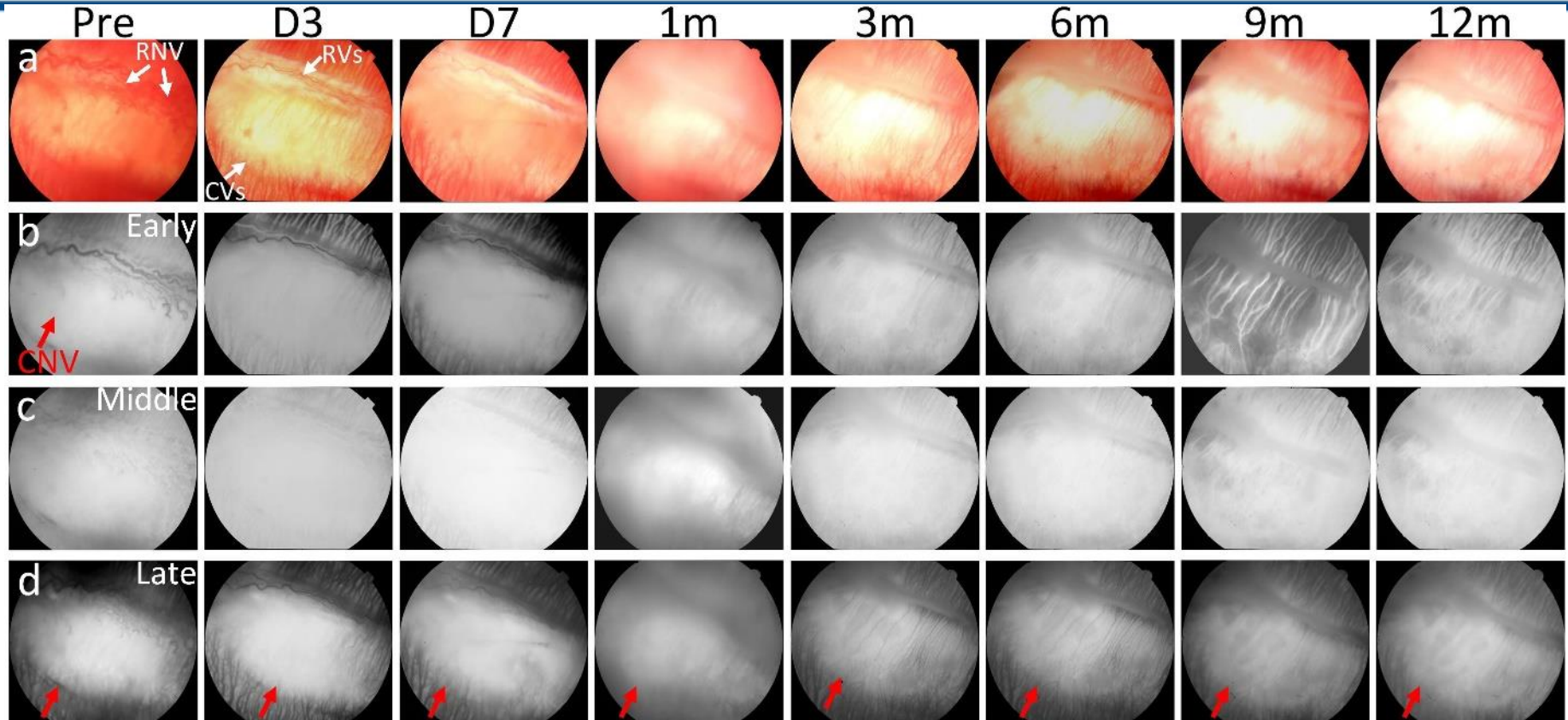
- There were no signs of pain or discomfort found in any treated rabbits
- Anterior and posterior segments of the eye demonstrated no evidence of inflammation, infection, necrosis, or other signs of toxicity.

In Vivo Treatment of AMD



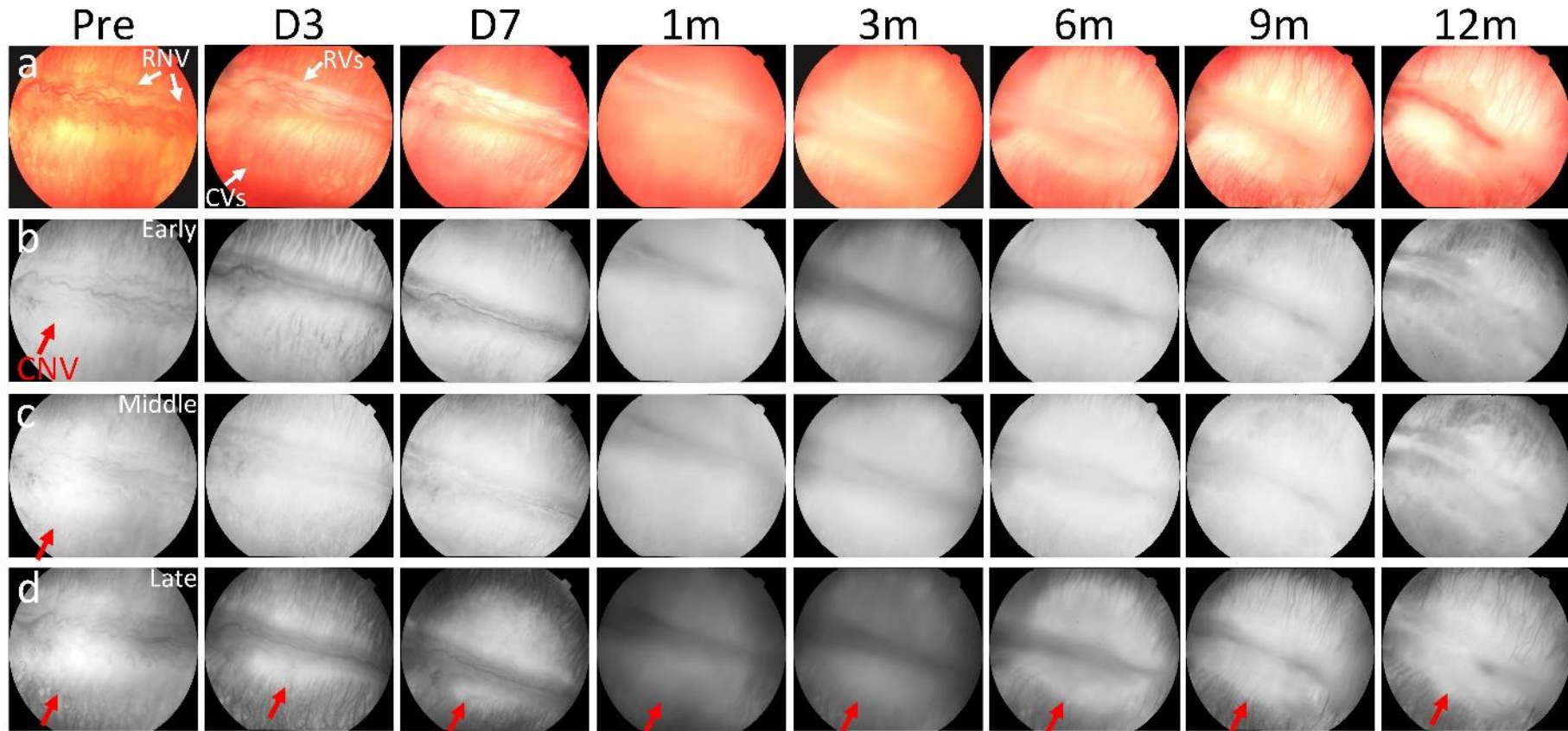
- The Si NNs-Bev treated group demonstrates significant reduction in leakage areas post-treatment

Color photography and fluorescein angiography images of CNV treated with control Si NNs alone



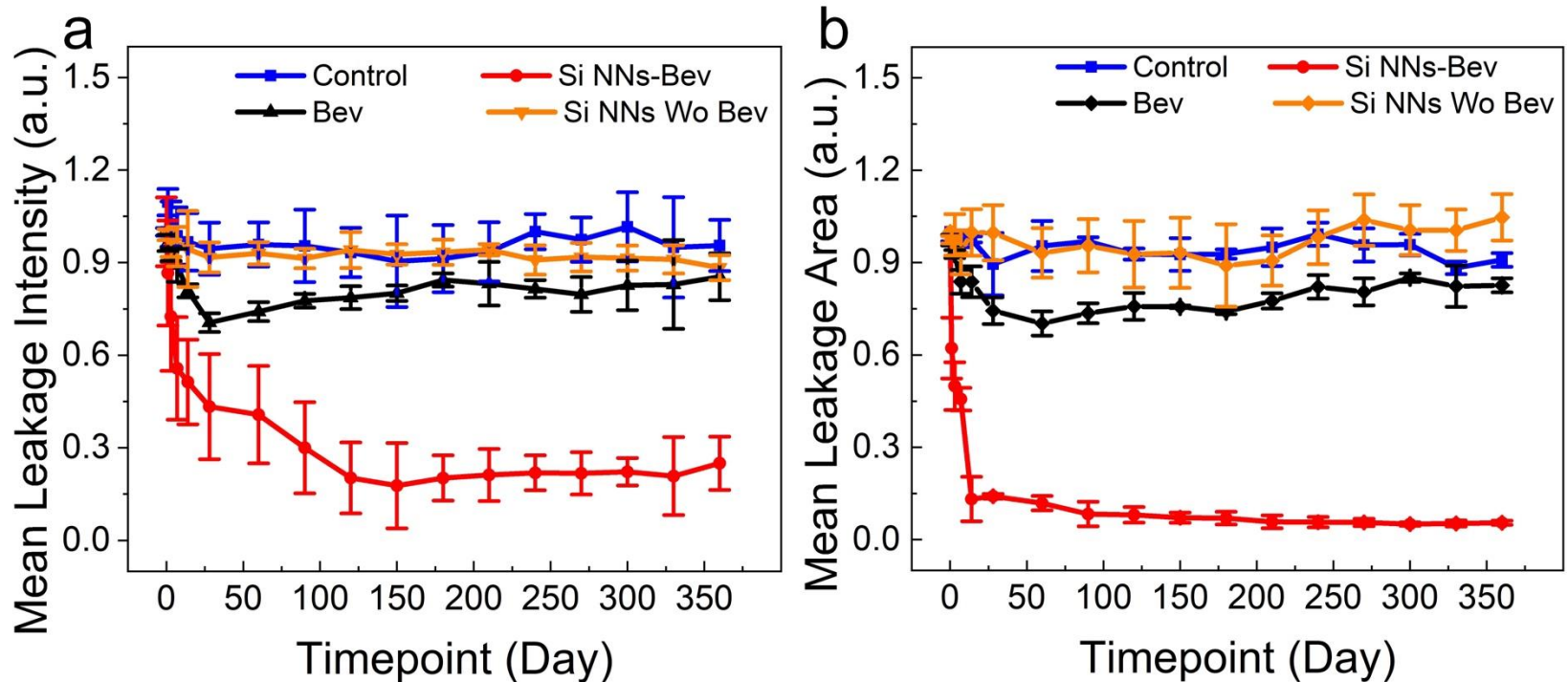
- The Si NNs without Bev treated group shows clear fluorescent signals at the CNV lesions

Color fundus photography and fluorescein angiography (FA) images of CNV treated with intravitreal Bev



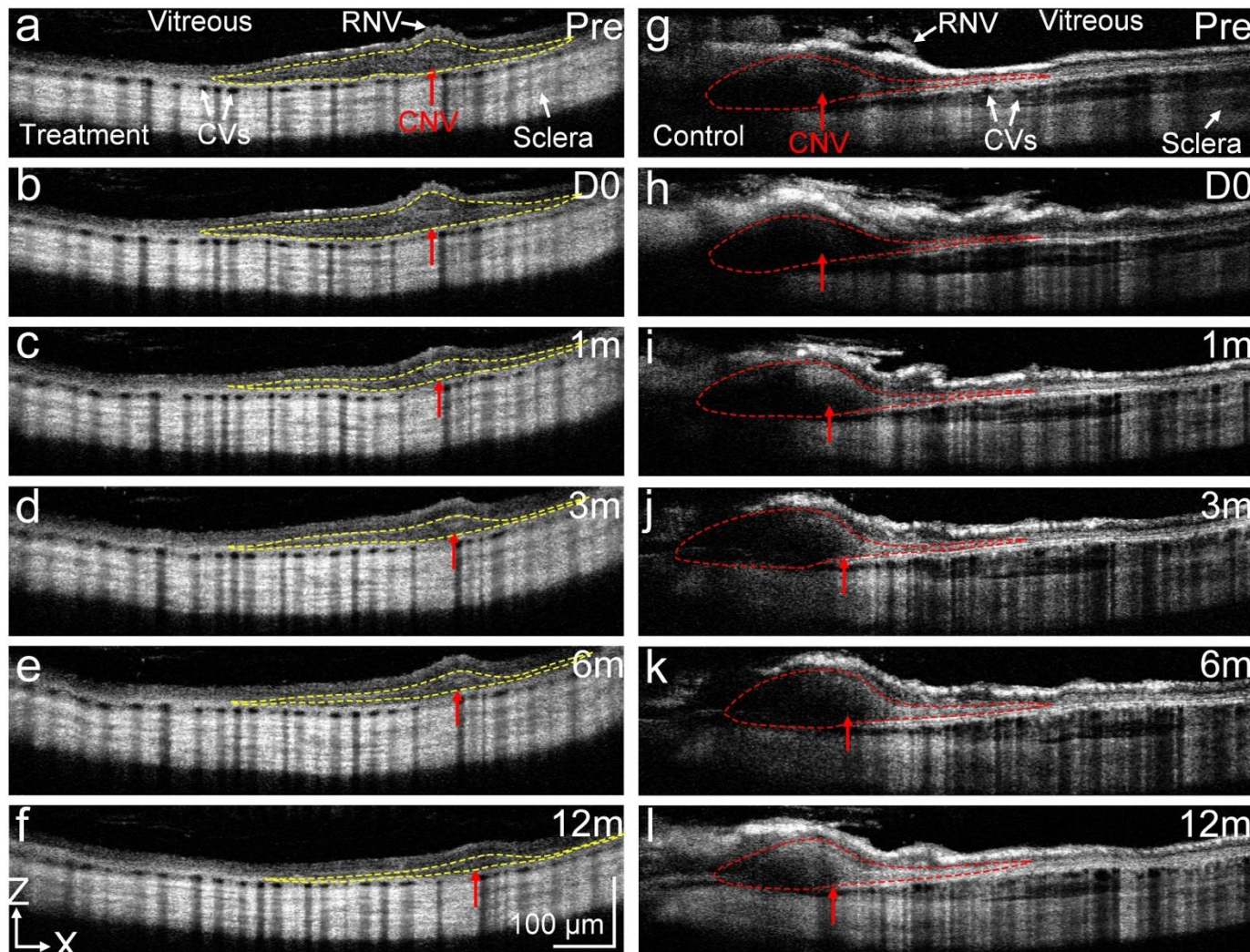
- The intravitreal Bev group shows CNV lesions slightly reduced for 1-3 months with subsequent regrowth and stabilization up to 12 months

CNV Leakage Quantification



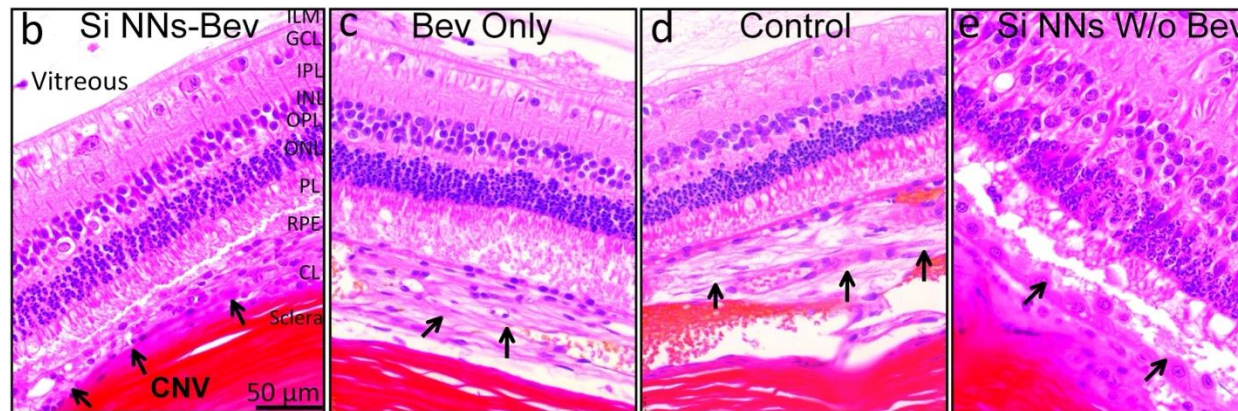
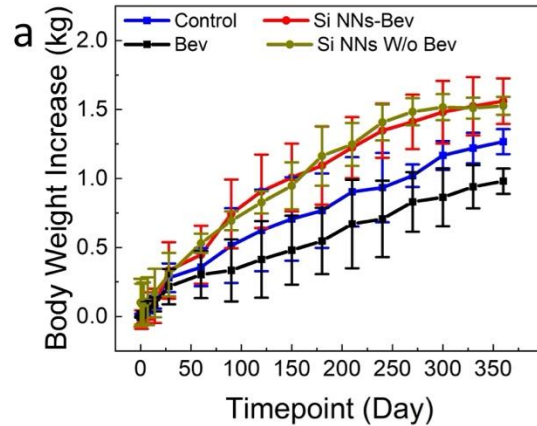
- The mean FLI in the treated group was reduced by **82%**, whereas the control group and treated group with Si NNs without conjugation with Bev showed a reduction of only **5-12%**

In Vivo OCT Monitoring CNV Progression



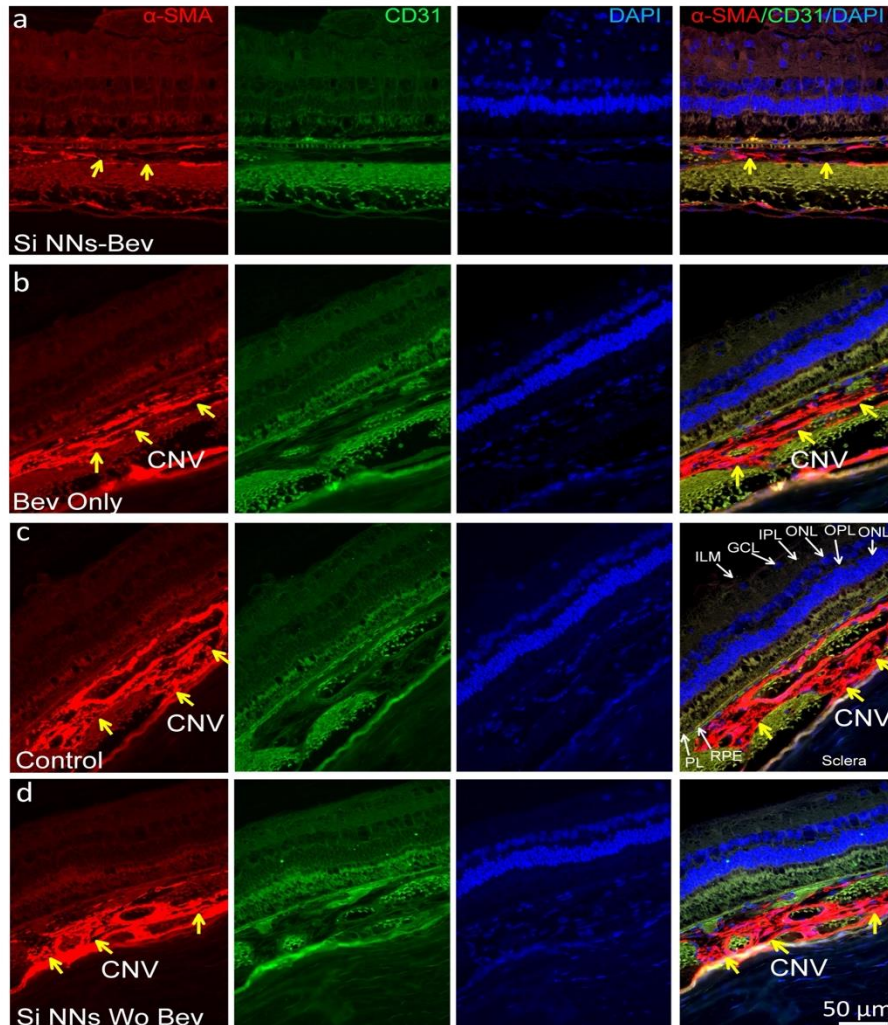
- The CNV lesions in the treated group gradually decreased over time.
- The control group showed no significant reduction in CNV lesions

Histological Analysis



- The CNV lesions in the treated group gradually decreased over time.
- The control group showed no significant reduction in CNV lesions

Immunohistochemistry Imaging of CNV Following Treatment with Si NNs



- The density of alpha-SMA-positive tissue was lower in the treated group with Si NNs-Bev compared to control groups

Take-Home Messages

- This study presents a new sustainable treatment method for CNV using Si NNs subconjunctival patch.
- The Si NNs-Bev embed into the sclera in a minimally invasive manner and dissolve within 1 min post application.
- CNV reduced up to 82% by 4 months that is persistent for at least 1 year with minimal recurrence.
- Si NNs length could be adjusted and conjugated with different type of anti-VEGF antibodies via covalent bonds.
- The Si NNs patch treatment provides a potential platform for long-term, sustained ocular therapeutics.

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- Michigan Medicine-Peking University Health Science Center Joint Institute
- Research to Prevent Blindness
- Alliance for Vision Research
- Knights Templar Eye Foundation
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- **Collaborators**

- Lee Lab, Purdue University
 - Linus Park, PhD
 - Yale Yeon, PhD
- Entire Wilmer Eye Institute!



SUPPORTED BY



Research to Prevent Blindness





Paulus Advanced Retinal Imaging & Laser Lab

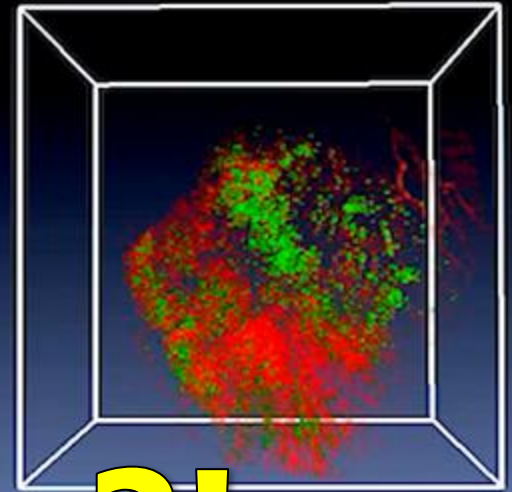
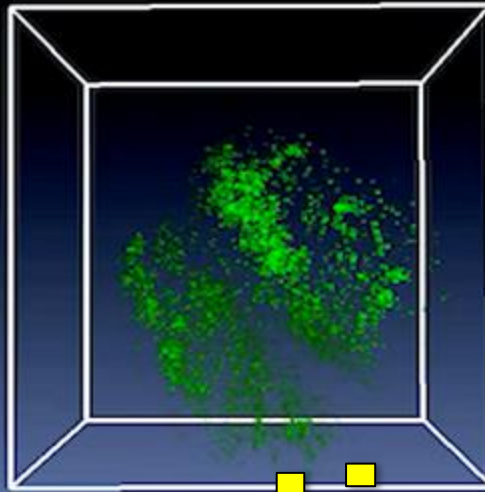
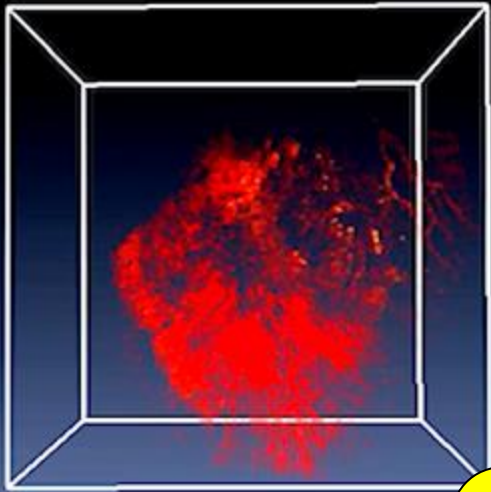
Thank You!

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578nm

650nm

Overlay



Questions?!

