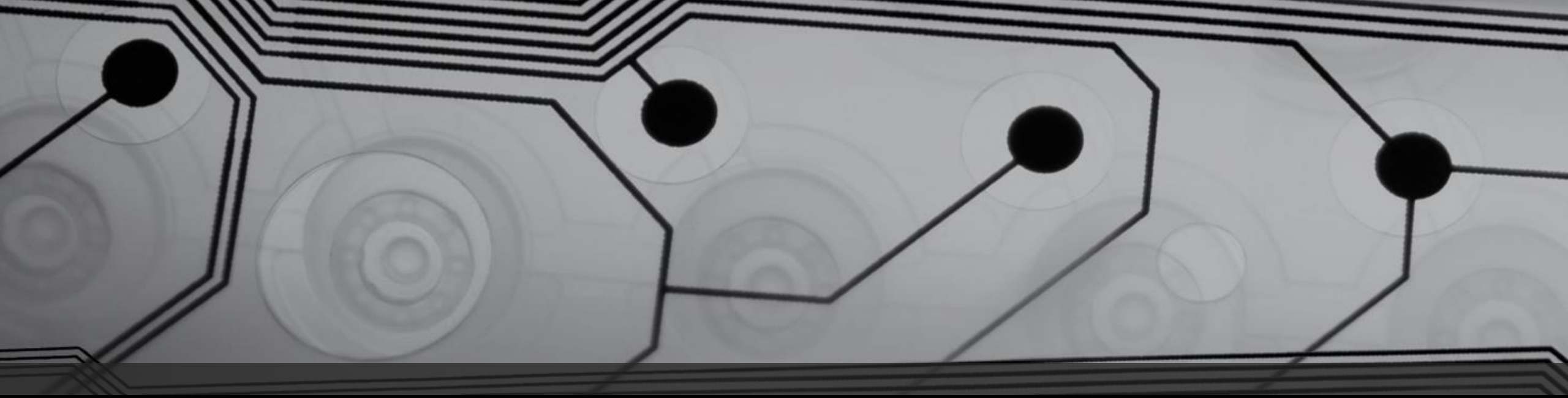


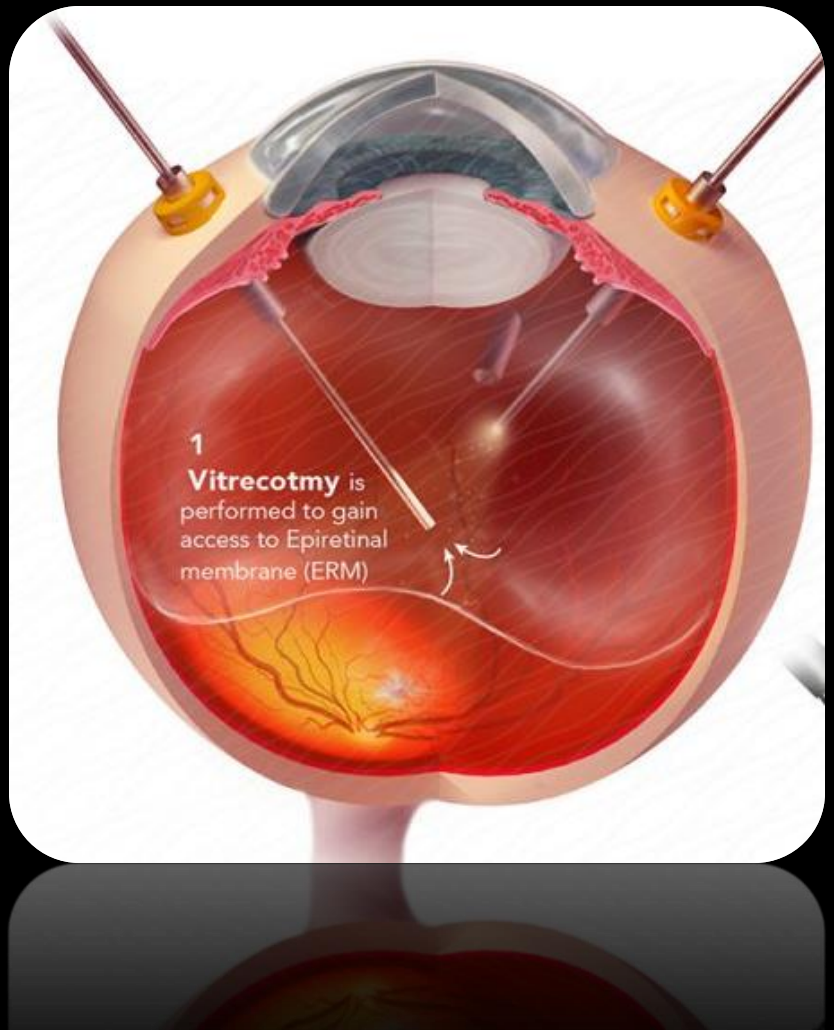
Final Project - Haptics

Vitrector Insertion Simulator/Orbital Region

Rogerio Nespolo

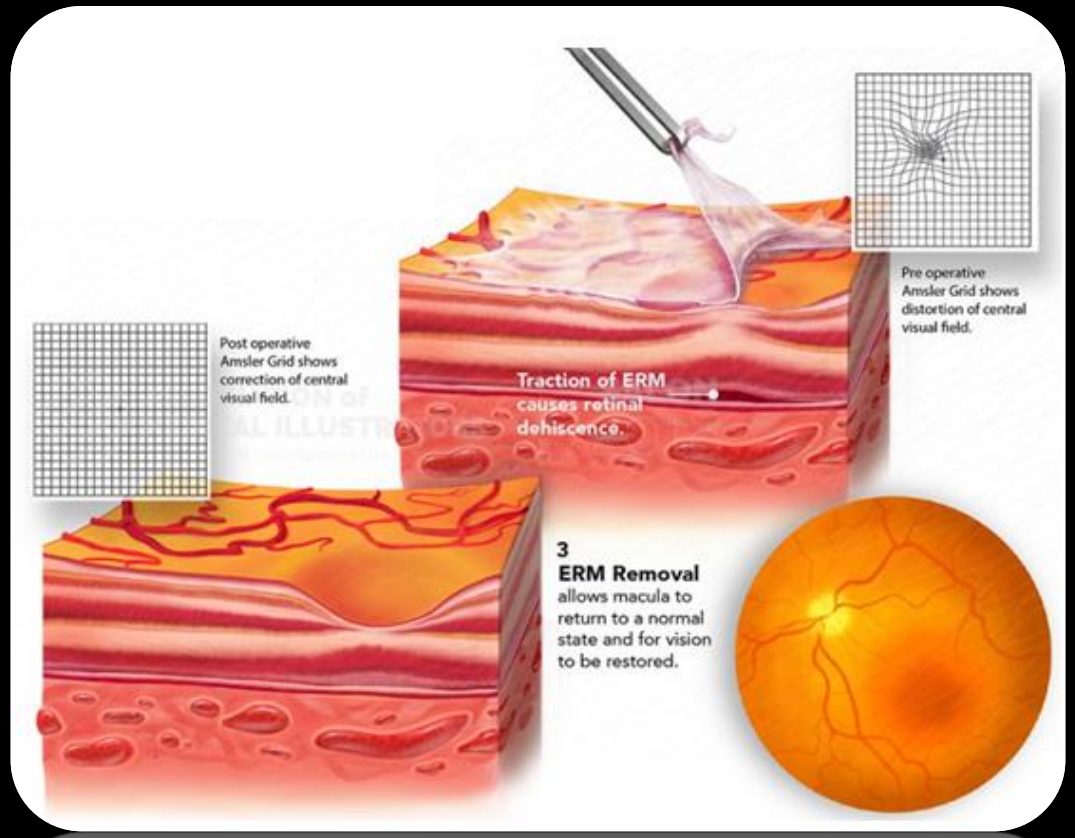
Vitrectomy

Eye surgery to treat various problems with the retina and vitreous. During the procedure, the vitreous is removed and replaced with another solution.



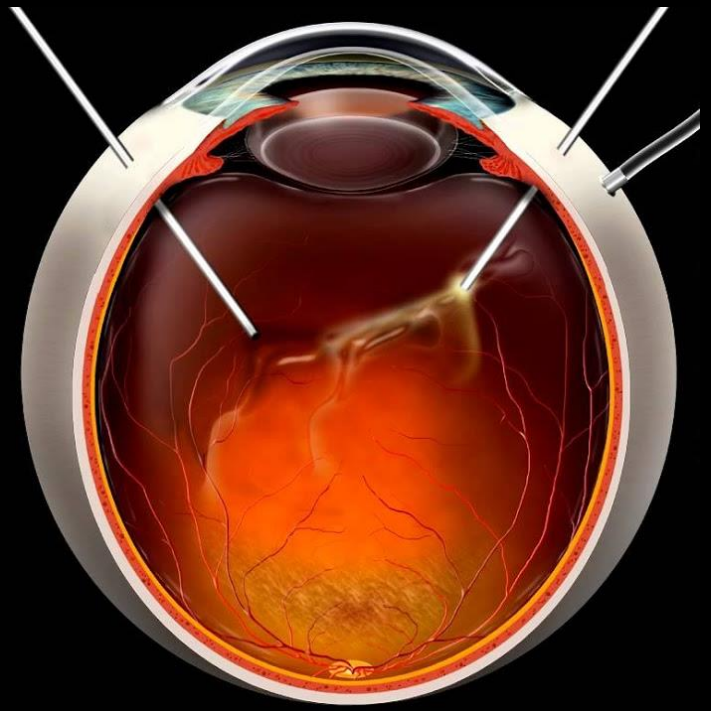
Membrane peel

The **Vitrectomy with epiretinal membrane peel** is the most common vitreoretinal surgery - an epiretinal membrane is a condition where a very thin layer of scar tissue forms on the surface of the retina. This membrane must be peeled to recover the distorted/blurred vision.



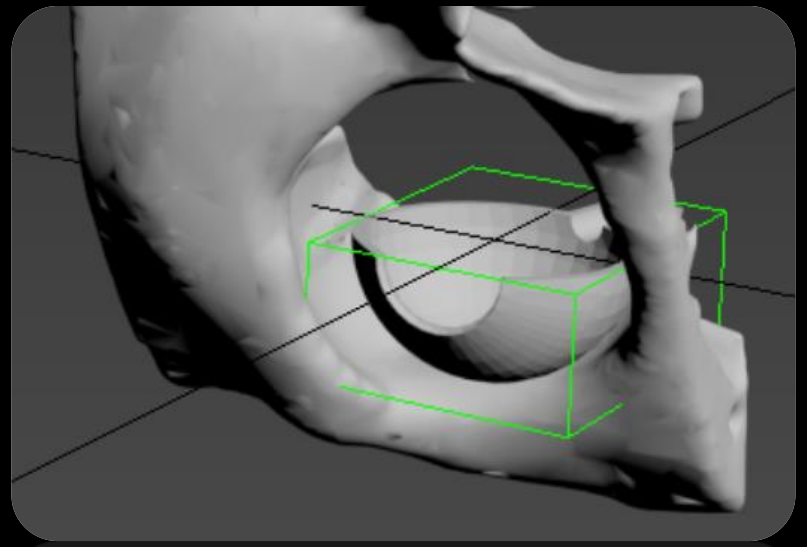
Goals

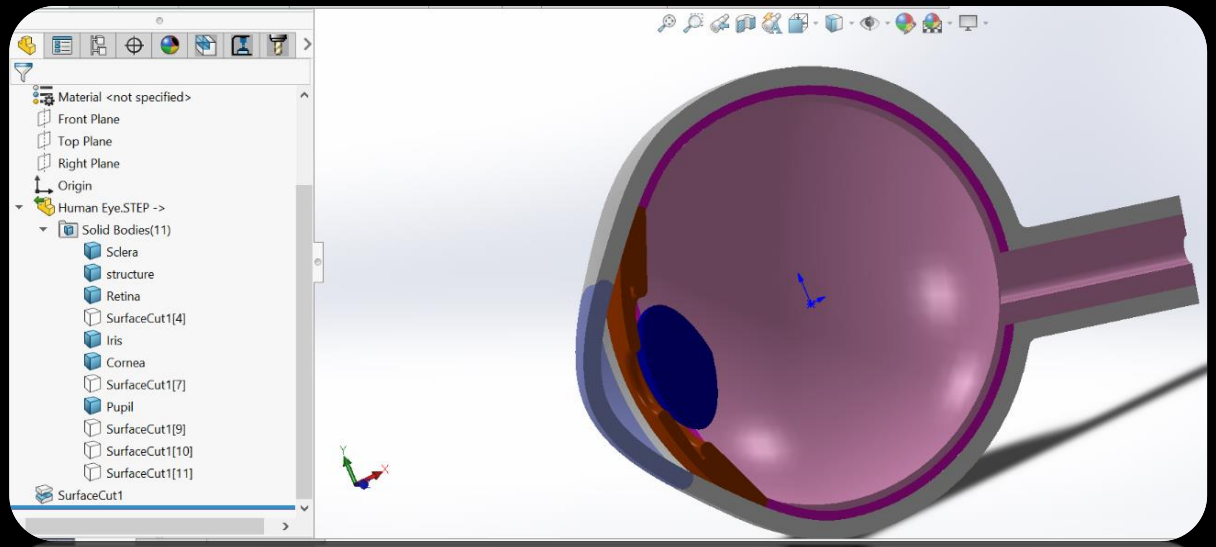
- Create an environment where medical students can learn the best practices for the incision of a vitrector into the vitreous chamber
- Provide guidance about the best approach and the most common problems the surgeon can face, using textual, haptic and audio feedback



Models

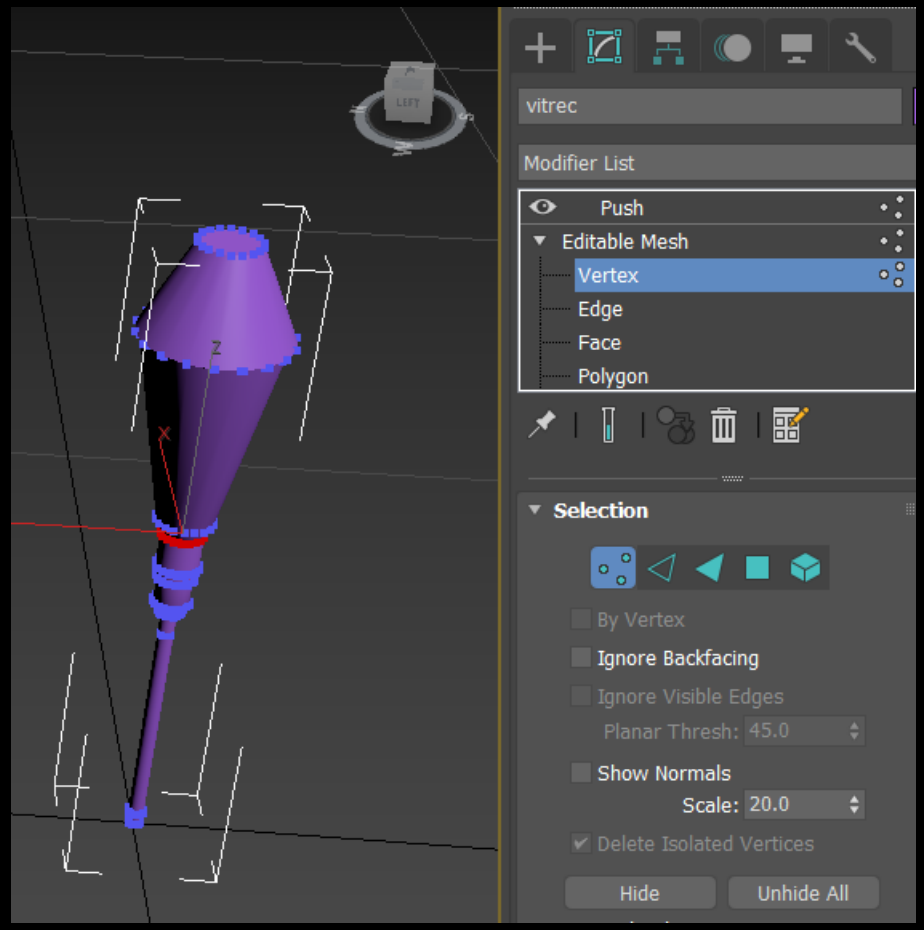
- Eye model acquired from a 3D database
- Lateral cut and segmentation of each element of the eye - SOLIDWORKS
- Textures and alignment of the models - Autodesk 3DS Max

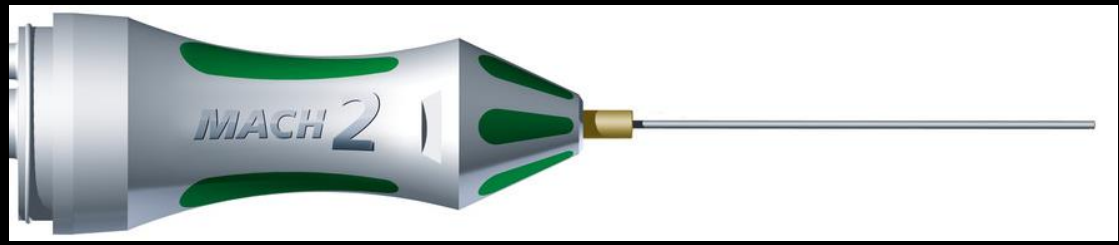




Cursor

- Created from Scratch with Autodesk 3DS Max
- Mesh and Poly editor tools
- following a model of a commercial-available vitrector





Effects

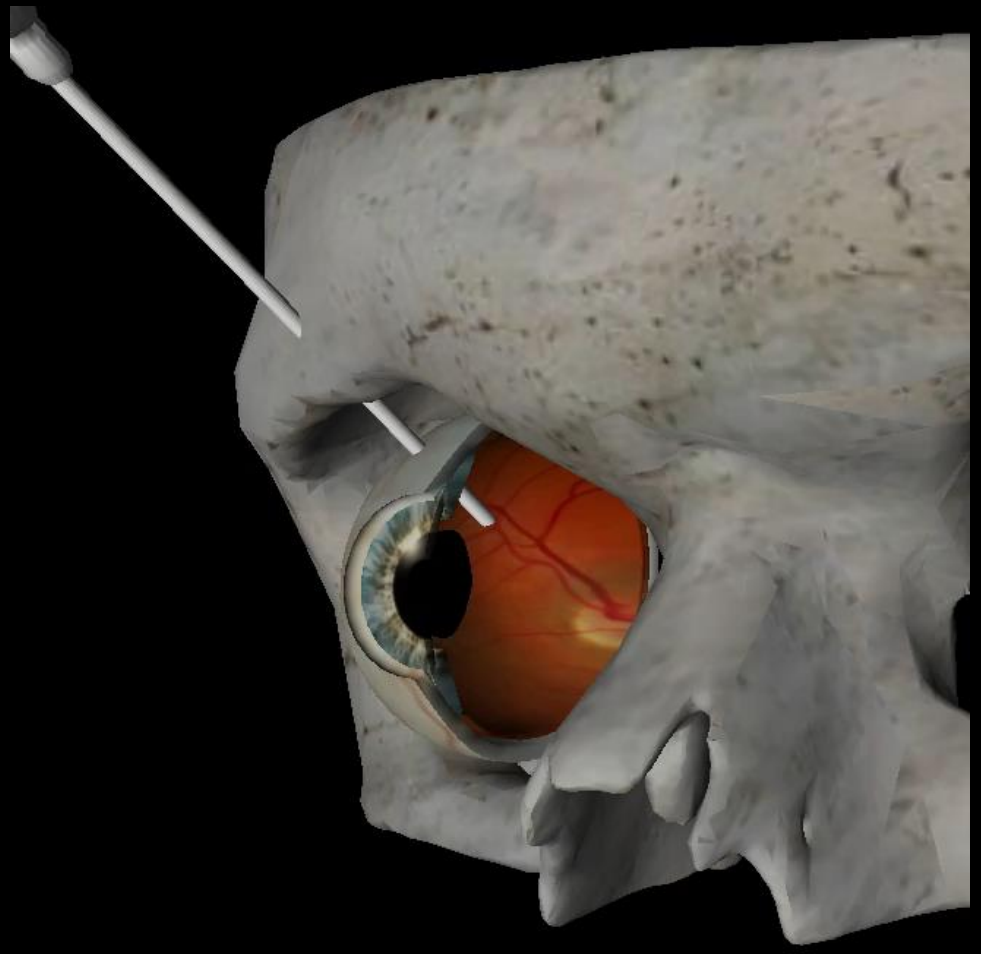
- Eye rotation
  - Force acquired during graphics callback
  - *setRotationInPlace* with the direction and magnitude of the force in real-time
  - The movement is limited to imitate the real behavior of the eye

Effects

- Fulcrum effect within the vitreous chamber

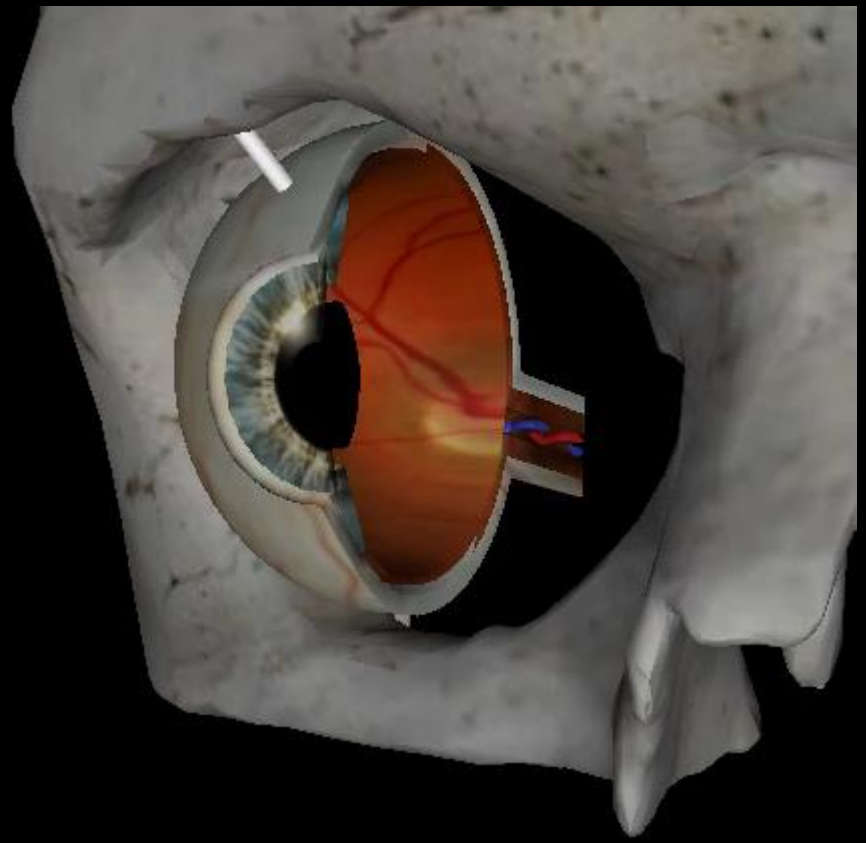
Effects

- Vibration and warning when collision with the retina is detected



Effects

- Vitrector volume increases according to the distance to the retina/optical nerves
- 3D sound follows the position of the model inside the scene



Warnings

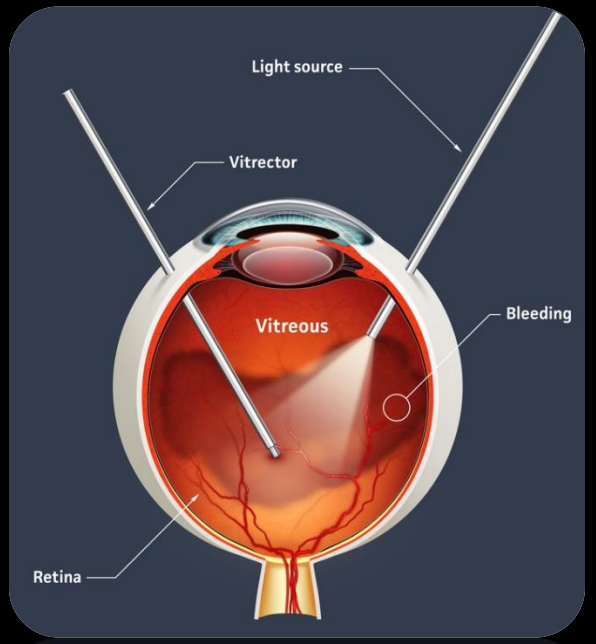
- Warnings are presented during the execution – an example of how the vitrector must be guided is exhibited
  - Touching the iris or pupil prior the insertion
  - Applying too much force when the membrane peeling is being executed
  - After the insertion of the tooltip into the vitreous chamber

Limitations

- Pop through effect value of the sclera is relatively small to deactivate properly the fulcrum effect automatically
- The user can reset all the effects releasing the button 2 - this avoids the program to keep applying the effects even after the tool removal

Future developments

- The use of a second haptic device for the simulation of the fiberoptic endoillumination (light source)
- The possibility of changing the cursor to simulate all the vitrectomy tools available during the real procedure
- Simulate the procedure of inserting multiple cannulas



Thank you!

Please execute in Debug Mode, x64 – Be sure that the Windows SDK version is correctly selected and OpenAL is properly installed