

DEVICE FOR EXTRACTION OF NON-METALLIC INTRAOCULAR FOREIGN BODIES

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Client

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- Ophthalmology Facial Plastic Surgery
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Background: Human Eye

- IOFB enter through:
 - **cornea** (65%)
 - **sclera** (25%)
 - Etc.
- IOFB end up in:
 - **Vitreous body** (61%)
 - Anterior chamber (15%)
 - Retina (14%)
 - Etc.¹
- **Vitreous body**
 - Gel-like vitreous fluid
 - Pressurizes eye²
- **Retina**
 - Optic nerves
 - Sensitive

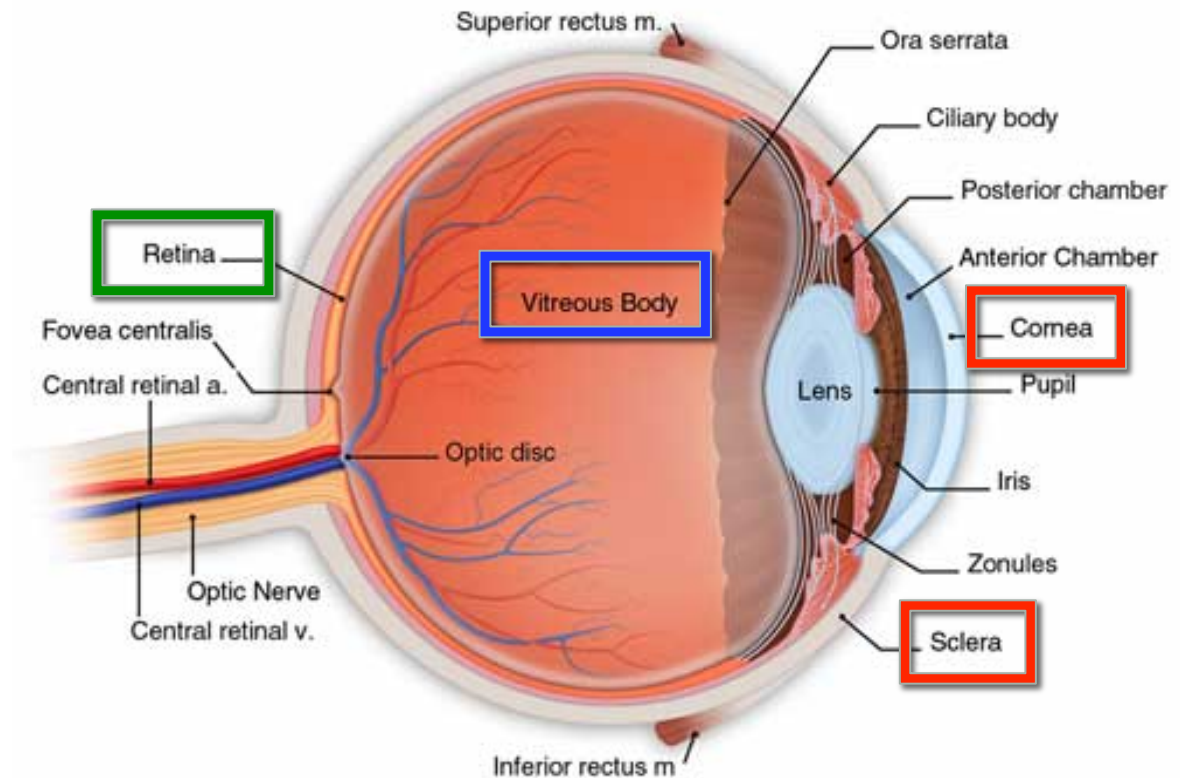


Figure 1. Anatomy of a human eye³

Background: IOFBs

- **IOFB** = *intraocular foreign bodies*
 - Penetrate into ocular tissue⁴
- Common types - causes:
 - Metal - hammering
 - Plastic - BB guns
- Commonly injured sites
 - Lens and retina⁵



Figure 2. Hammer & Nail⁶



Figure 3. BB gun and plastic BB bullets⁷

Background: IOFB

- Our target:
 - Round, plastic
 - Maximum diameter 8 mm
 - In posterior segment (vitreous body)

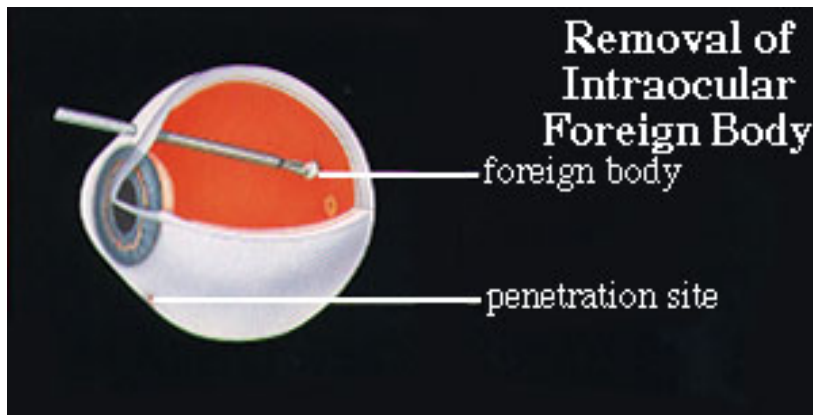


Figure 3. Anatomy of removing IOFB⁸



Figure 4. Image of samples of air soft pellets of 6 mm diameter⁹

Procedure: Pars Plana Vitrectomy

Steps¹⁰

- Remove vitreous (vitrector)
- Sever IOFB-vitreous attachment (vitrector)
- Insert instrument for grasping
- Grasp IOFB
- Move IOFB to sclera
- Extract IOFB



Figure 5. 25 gage-Vitrector designed by Alcon Surgical¹¹

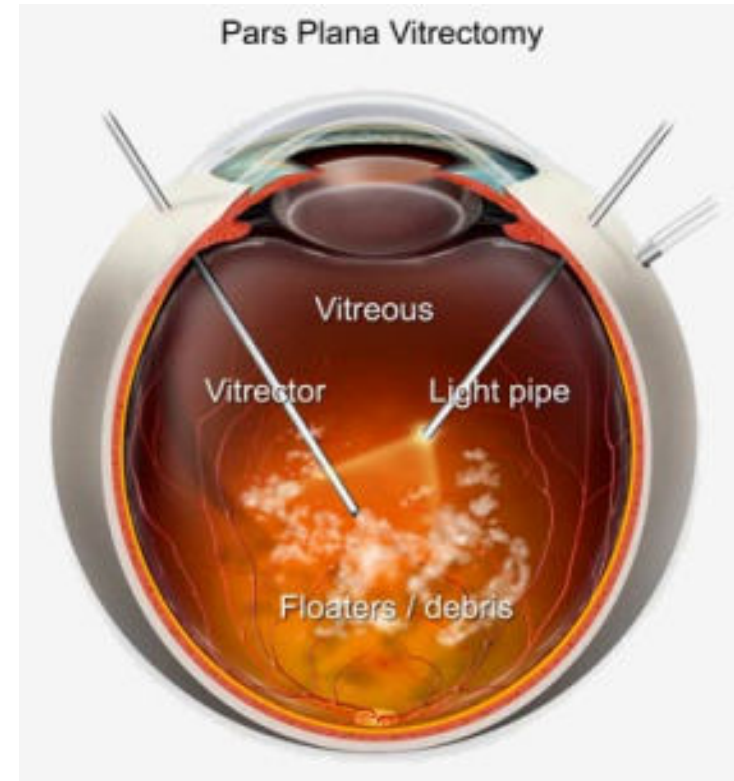


Figure 6. Diagram of Pars Plana Vitrectomy: An animated cross-section of the eye including the components used during a vitrectomy procedure ¹²

Current devices¹³

- Currently, no instrument designed specific for removing smooth, round, and non-metallic IOFB
- Commonly used:
 - 25+gage Forceps
 - Various kinds of tips
 - Difficult if non-metallic IOFBs

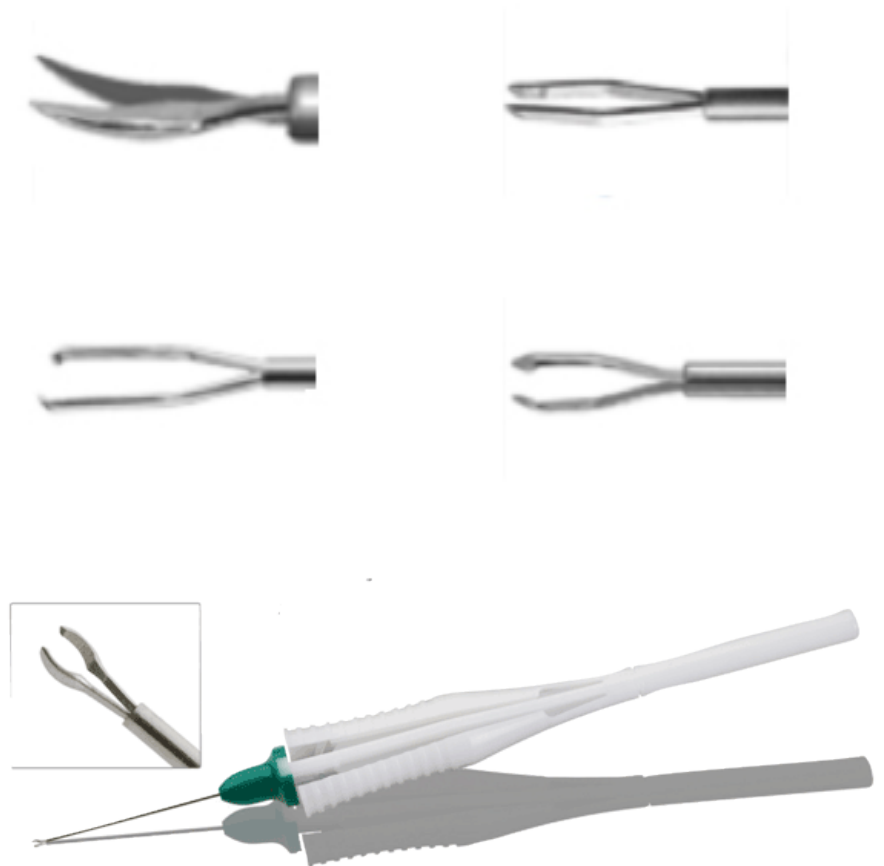


Figure 7. Examples of currently used forceps with various kinds of tips for IOFB removal. Designed by Alcon Surgical

Product Design Specification

- **Size**
 - Maximum diameter: 8 mm
 - Length: 32 mm
- **Safety**
 - Biocompatible
 - Disposable or autoclavable
 - Not harmful to inner-eye
 - Minimize entrance wound
- **Ergonomics**
 - One-handed operation
 - Comfortable no-slip grip
- **Reliability**
 - Locking mechanism

Design #1: Ice cream scoop

- Two half-spheres encapsulate foreign body
- Spring and gear mechanism rotates half-sphere
- Autoclavable
 - stainless steel



Figure 8. Model of an ice cream scoop¹⁴

Design #2: Fish net

- Spring embedded in handle
- Mechanism:
 - Push
 - Compresses the spring
 - Pushes out the net
 - Release
 - Relaxes the spring
 - Pulls in the net
- Disposable
 - Polymer



Figure 11. Currently in use Roth Net Retriever for grabbing objects in digestive tract¹⁵

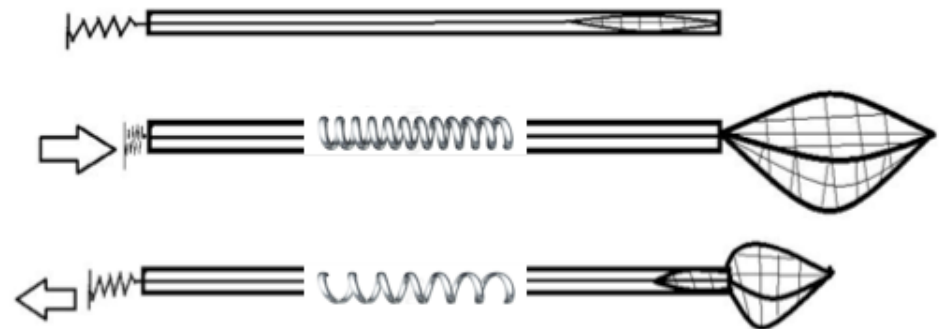


Figure 10. Image showing the mechanism of Fish Net design

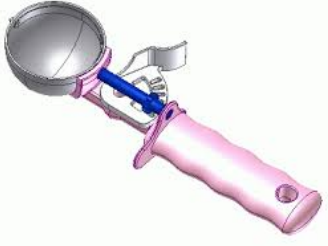
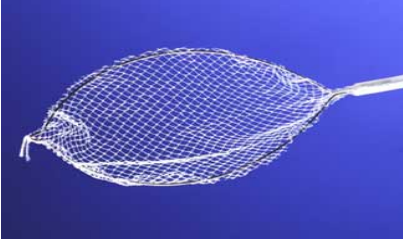

Design #3: Claw

- Four prongs to grasp foreign body
- Spring-loaded mechanism to release claw
- Relaxing spring tightens claw
- Autoclavable
 - Stainless steel



Figure 11. Example of a claw design currently in use¹⁶

Design Matrix

Design:	Ice Cream Scoop		Fish-net		Claw	
Criteria (weight)						
Reliability (30)	5	30	4	24	3	18
Size (25)	4	20	5	25	3	15
Ergonomics (15)	5	15	4	12	3	9
Safety (15)	3	9	5	15	3	9
Feasibility (10)	3	6	5	10	4	8
Cost Effective (5)	4	4	3	3	5	5
Total (100)	84		89		64	

Summary: Final Design

- Design #2. Fish net
 - Highest relative score
 - Size
 - Safety
 - Feasibility



Future Work

- Material Selection
- Order materials and components needed
- Fabricate a prototype
- Testing
 - Model: cow/pig's eye
 - Ease of use and controls
 - Successfully removes
 - Does not enlarge the wound

Acknowledgement

- Client: Dr. Leslie Wei
- Advisor: Dr. John Webster

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Questions?

