Vitrectomy basics & principles

Basic steps and instruments of vitrectomy: Tarek Mamoun

Basics of visualization and illumination: Ayman Lotfy

Tamponading agents and silicon removal: Mahmoud Farouk

Epiretinal membranes: Magdy Tawakol

PVR: Mohamed Ismael

Giant retinal breaks: Ayman El Kawwas

Diabetic Vitrectomy: Ahmed Abdel Aleem

Intraoperative complications of vitrectomy: Abdel Rahman Gaber, MD

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Basic steps & Instruments of Vitrectomy

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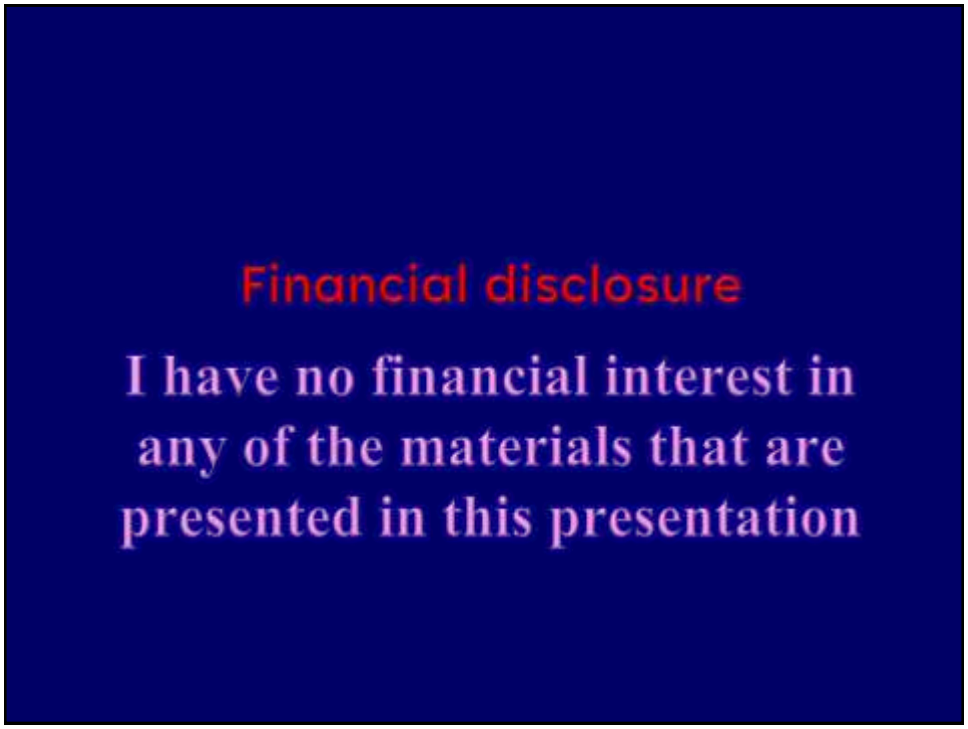
Financial disclosure
I have no financial interest in any of the materials that are presented in this presentation

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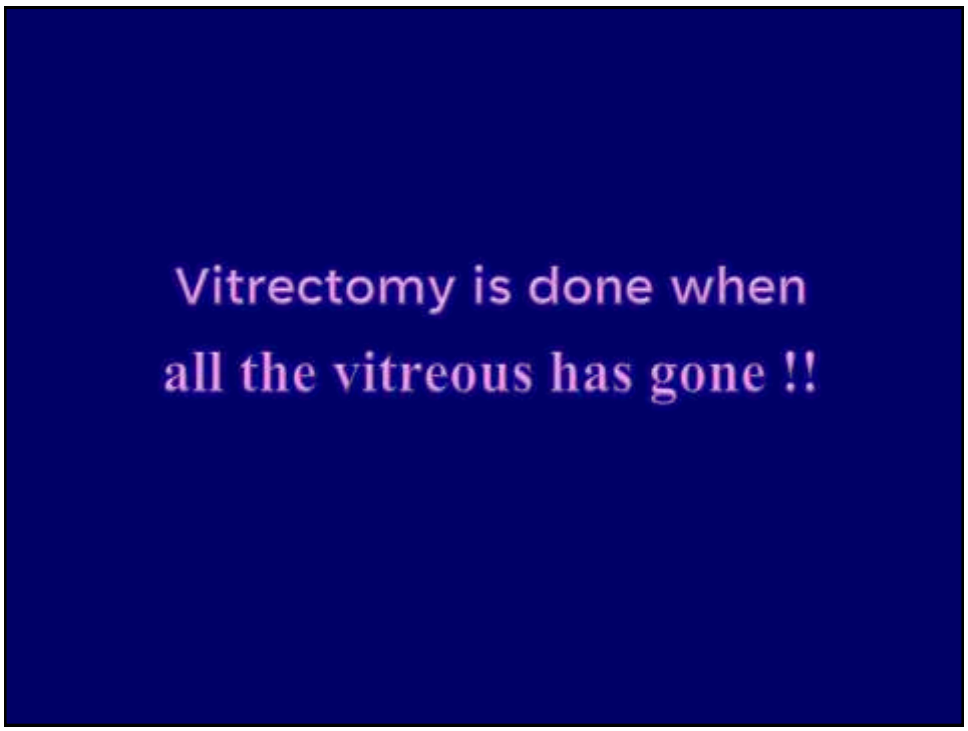
Vitrectomy is done when
all the vitreous has gone !!

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How to be safer
The Flow Equation

- Flow rate (Q) is proportional to the pressure gradient (P).
- Flow rate (Q) is inversely proportional to 8 times the length of the tube **(so that the infusion cannula should be as short as possible)**.
- Flow rate (Q) is inversely proportional to 8 times the viscosity of the fluid **(so that very high pressure is required to inject silicon oil)**.

$$Q = \frac{\pi P r^4}{8 \eta l}$$

Q	Flow rate
P	Pressure
r	Radius
η	Fluid viscosity
l	Length of tubing

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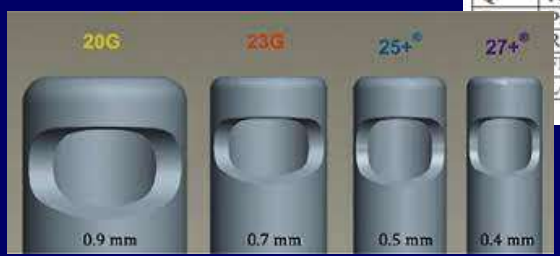
How to be safer
The Flow Equation & the gauge

- Flow rate (Q) is proportional to the fourth power of the inner radius (r) of the tube.
  - Doubling the radius → 16 times the flow.
  - The smaller gauge vitrectomy systems require more pressure and vacuum than the 20 G system.

$$Q = \frac{\pi P r^4}{8 \eta l}$$

Q	Flow rate
	Pressure
	Radius
	Fluid viscosity
	Length of tubing



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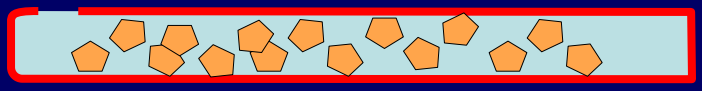
The Flow of fluid with particles



The flow depends on the size of the particles in relation to the radius of the tube.

- **For small gauge systems: the higher the cut rate → the smaller the vitreous bites → the higher the flow.**

The final efficacy of vitreous removal is a function of all the factors:

- **The gauge of the probe.**
- **The vitreous particle size (smaller with high cut rates).**
- **The vacuum setting.**
- **The duty cycle (Alcon Constellation) or AFR (DORC).**

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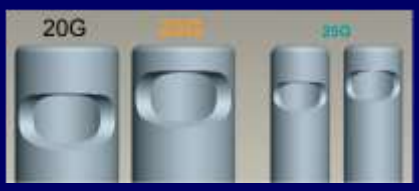
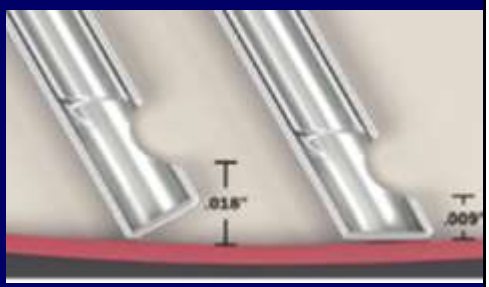
How to be safer

1. The smaller gauge of the probe

- Requires high cutting rates & higher vacuum.
- The cutting port close to the tip → acts as a scissors.
- The infusion P should be increased to avoid hypotony during vitrectomy.





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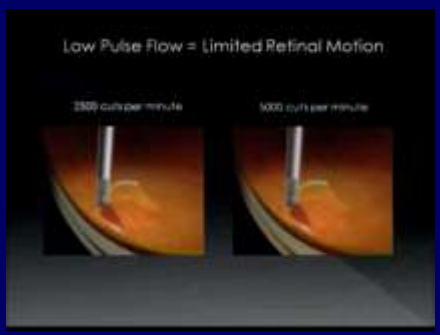
How to be safer
2. The high cutting rate

- Higher cut-rates reduce the pressure variation across the port with each port-opening cycle, → greater fluidic stability → less iatrogenic traction and tears → the vitreous cutter can be placed closer to the retinal surface with safety (vitreous base shaving near mobile retina & dissecting membranes close to retinal surface).



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The engineering behind the high cutting rate

- **The spring recoil probes:**
  - Constant recoil speed.
  - The fewer the CPM → the more closed the port.
  - Max 2500 CPM.
- **The pneumatic recoil probes:**
  - Up to 10000 CPM (with dual cutting probes → 20000 CPM).
  - Can control the duty cycle (percentage of time the port is opened) → control of flow rate.

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How to be safer

3. The duty cycle & AFR

- The duty cycle means the percentage of time during which the cutting port is opened.
- **Biases opened** → suitable for core vitrectomy.
- **Biased closed** → for shaving the vitreous base.
- In some machines the pump flow rate can be controlled independent on the vacuum.

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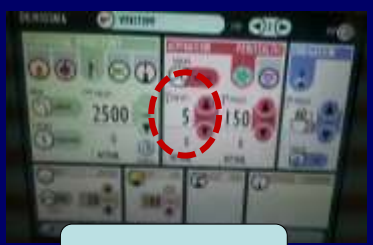
How to be safer

3. the duty cycle & AFR

- The peristaltic pump allows choice of the proper aspiration flow rate, not only the vacuum:
- Core vitrectomy: High flow rate.
- Shaving the vitreous base: Very low flow rate.

Venturi



peristaltic

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How to be safer

4. The vacuum

- The vacuum should be set such that it is low enough for safe vitrectomy while being high enough for adequate removal of vitreous.
  - Excessively high vacuums induce unnecessary vitreo-retinal traction.

5. The infusion pressure

- The infusion P is set according to the gauge if the infusion cannula; the smaller the gauge the higher should be the infusion pressure.
- Unnecessarily high P can cause optic disc pallor.

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Settings

The gauge	Infusion P (mm-Hg)	The vacuum (mm-HG)	
		Core Vitrectomy	Shaving the vitreous base
20 G	20-30	150	70 -100
23 G	30-40	400-500	200-250
25 G	35-50	500-600	250

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Basic tasks done in almost every case

1. Opening of the 3 ports & fixation of infusion cannula.
2. Core vitrectomy.
3. Injection of TAA.
4. Detachment of the posterior hyaloid.
5. Shaving of the vitreous base.
6. Maintaining good visualization.
7. Using endo-diathermy.
8. Using the flute needle & fluid / air exchange.

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Basic tasks done in almost every case (cont.)

9. The drainage retinotomy.
10. Injection of PFCL.
11. Injection of silicon in air filled eye.
12. PFCL / silicon exchange.
13. Filling the eye with long-acting gas.
14. Endo-laser.
15. Check the retinal periphery especially at the sites of sclerotomy.
16. Closure of the 3 ports.

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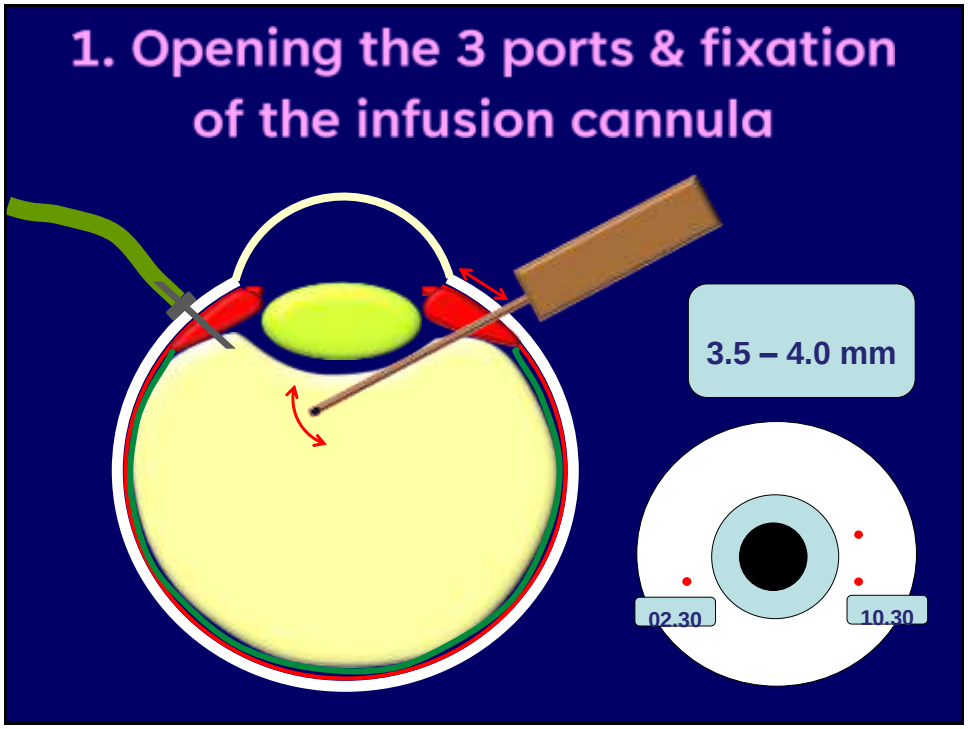
1. Opening the 3 ports & fixation of the infusion cannula
3.5 – 4.0 mm
02.30
10.30

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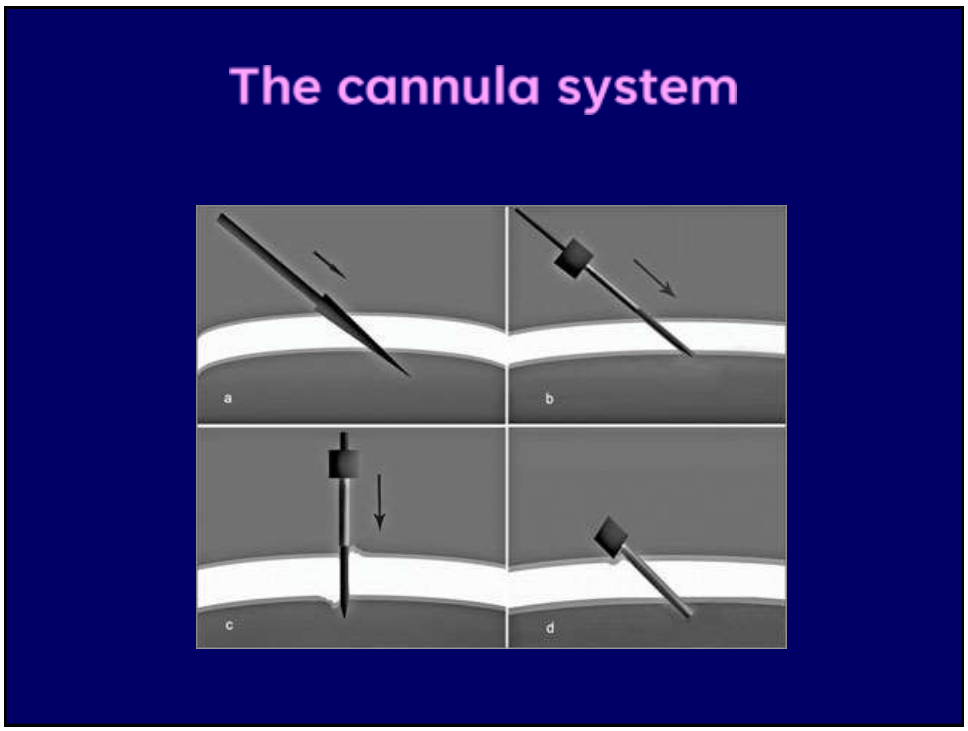
The cannula system
a
b
c
d

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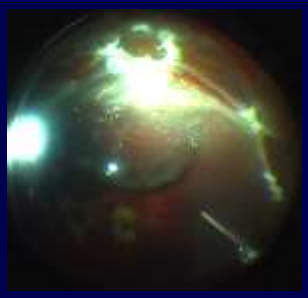
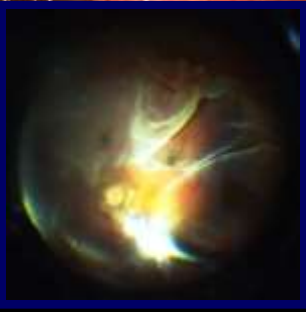
Check the infusion cannula before opening the saline





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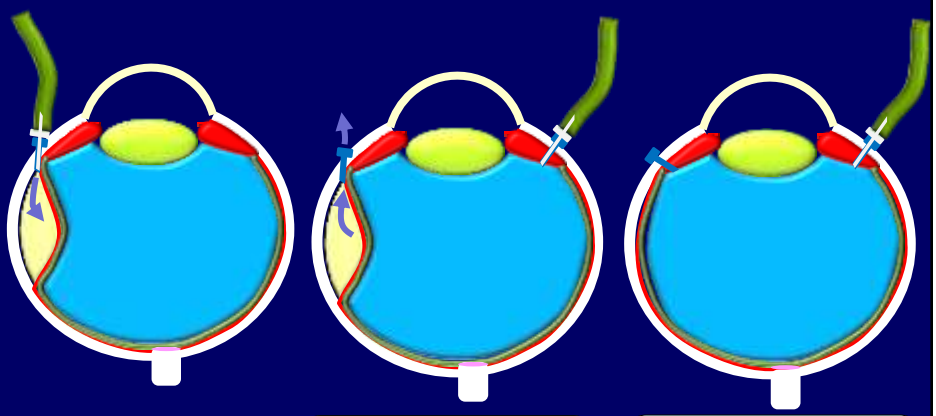
Suprachoroidal infusion while using the trocar system



Early diagnosis of the problem

1. Insert a correct infusion
2. Leave the first trocar to drain the fluid

3. Correct the position of the trocar after evacuating the suprachoridal fluid

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The cannula system

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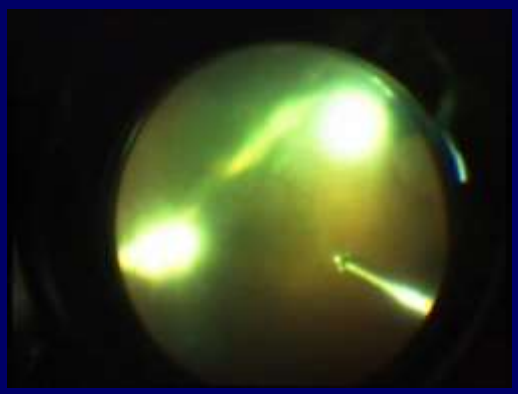
2. Core vitrectomy

- Moderate vacuum about 250 mm-Hg.
- High flow rate if using the peristaltic pump (12-15 ml/min).
- High cutting rate.
- Biased opened duty cycle.



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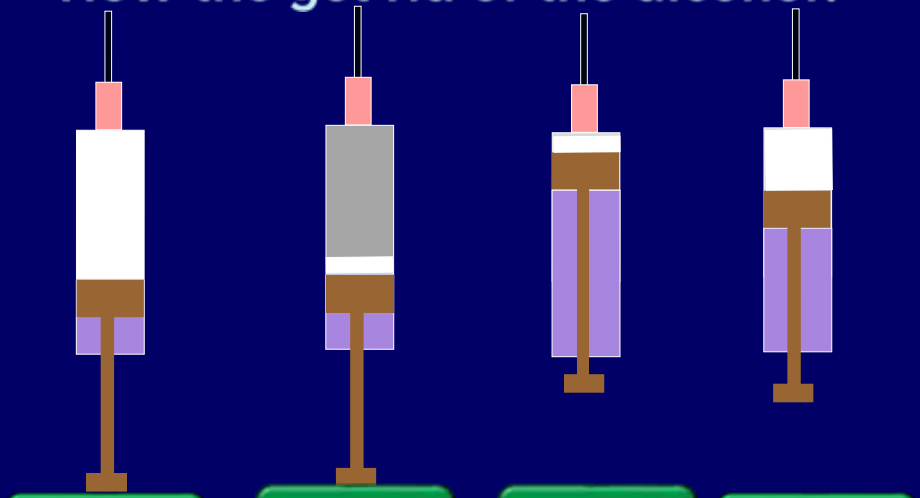
3. Staining the ghost with TAA

How the get rid of the alcohol?



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4. Detachment of posterior hyaloid

This is where you win or lose the battle!!!

- Start at the nasal edge of the disc.
- High vacuum (500 mm-Hg).
- High flow rate (12 ml/min).
- **NO cutting.**
- Pull slowly towards the cornea then gradually towards the periphery.
- **Move slowly → see the advancing wave of PVD.**
- Iatrogenic breaks if you exceed the vitreous base.

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4. Detachment of strongly adherent posterior hyaloid by forceps

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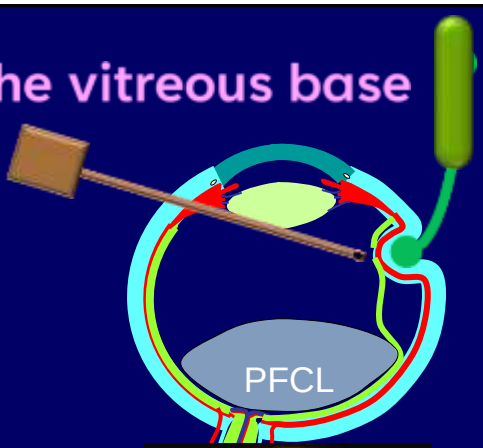
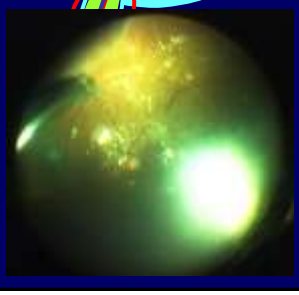
5. Shaving of the vitreous base

- PFCL to prevent excessive retinal mobility.
- High indentation.
- **Very high cutting rate (5000 - 8000).**
- **Low vacuum & AFR.**
- Duty cycle biased closed.





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5. Shaving the vitreous base

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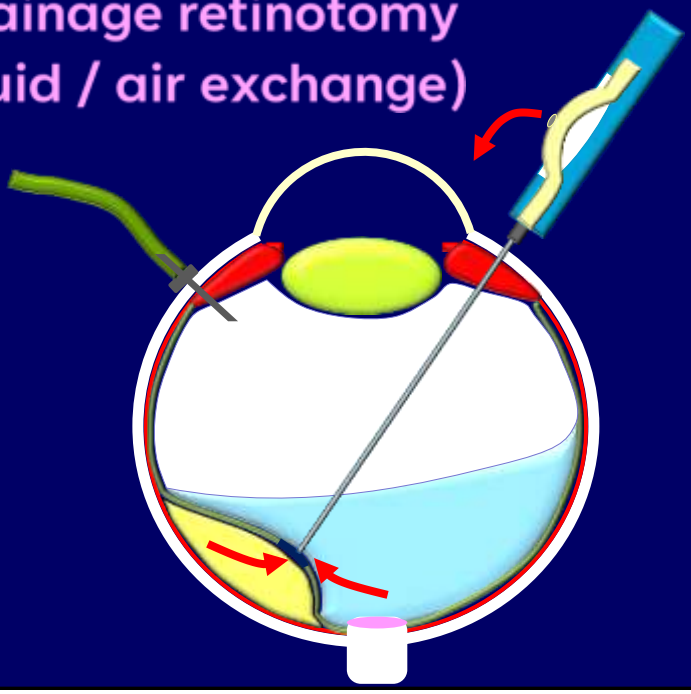
Drainage retinotomy (Fluid / air exchange)



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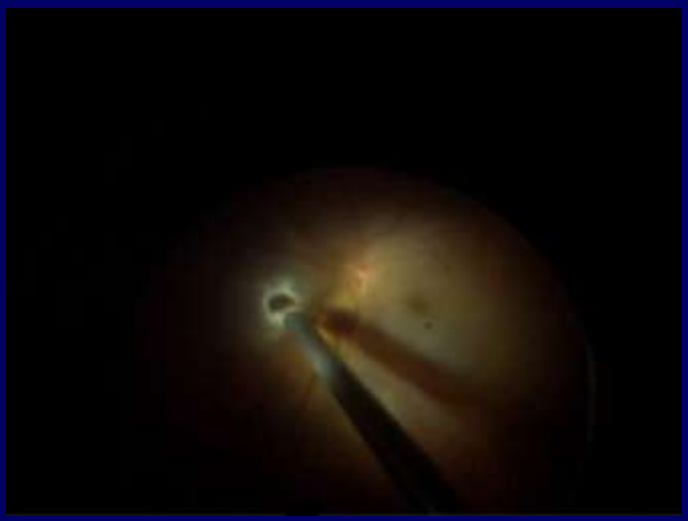
Drainage retinotomy (Fluid / air exchange)



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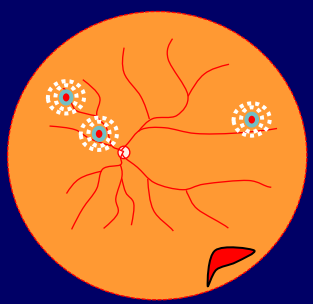
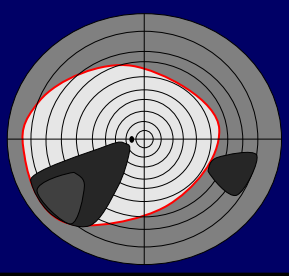
The drainage retinotomy; Where to do ????

- Upper, nasal & posteriorly
- **The correct drainage site:**
- Just posterior to the equator.
- **Do it at the same side of the break to facilitate postoperative positioning.**
- Avoid areas of failed PVD.
- Avoid large retinal BV.





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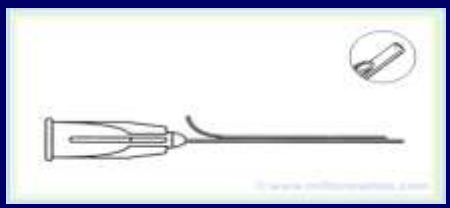
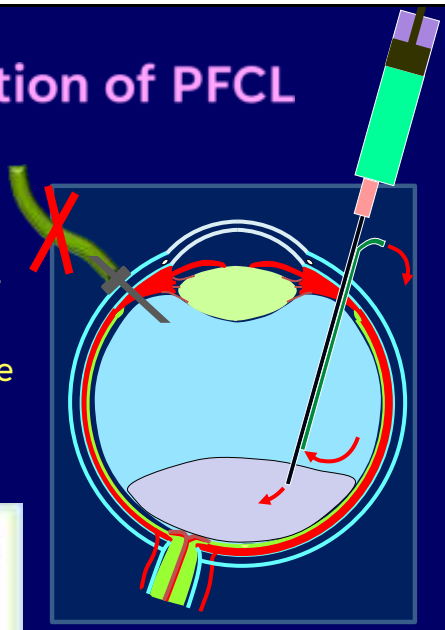
10. Injection of PFCL

- Close the infusion in order to prevent fragmenting the PFCL into small bubbles.
- Use the special double way needle to allow venting of saline.





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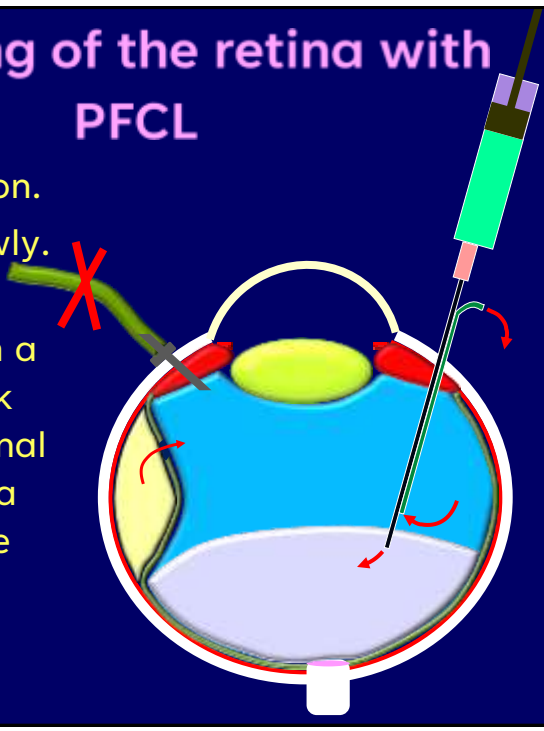
Flattening of the retina with PFCL

- Close the infusion.
- Inject PFCL slowly.
- SRF with be drained through a peripheral break (either the original one or done by a single cut by the cutter).



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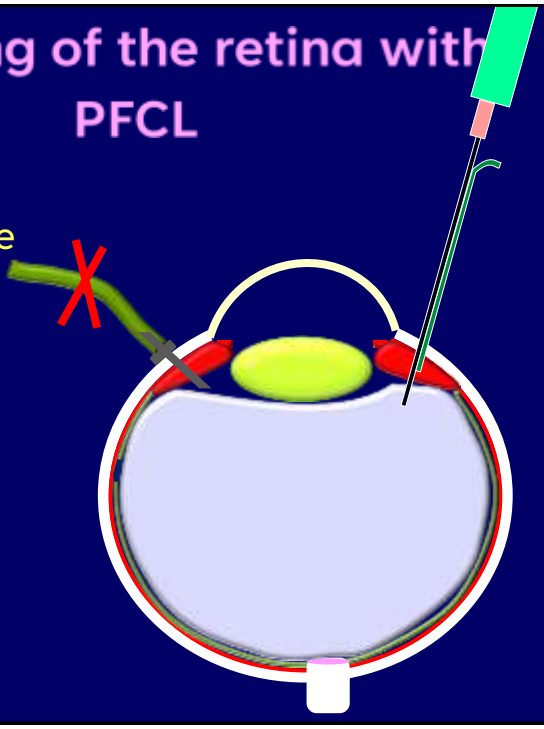
Flattening of the retina with PFCL

- Increase the PFCL above the level of the break.
- Gradually elevate the needle as you inject



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Injection of PFCL without venting of saline → small bubbles

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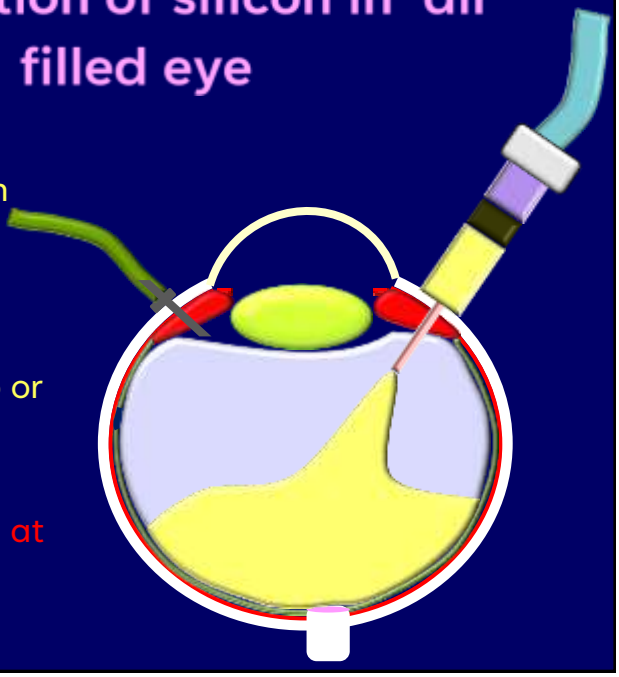
11. Injection of silicon in air filled eye

- Decrease air pressure as much as possible.
- Use a short wide needle.
- Use silicon pump or manually.
- Check IOP continuously and at the end.



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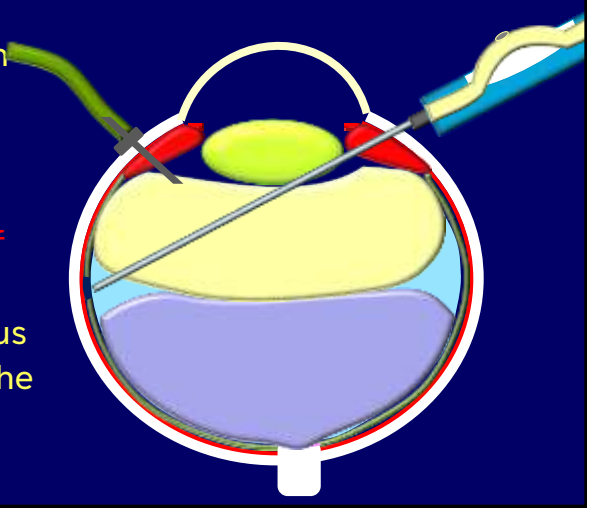
12. PFCL / Silicon exchange (giant breaks & relaxing retinotomies)

- Silicon is pumped through the infusion cannula.
- The tip of the flute needle is inserted close to the edge of the giant break to remove the meniscus of saline between the PFCL & silicon.



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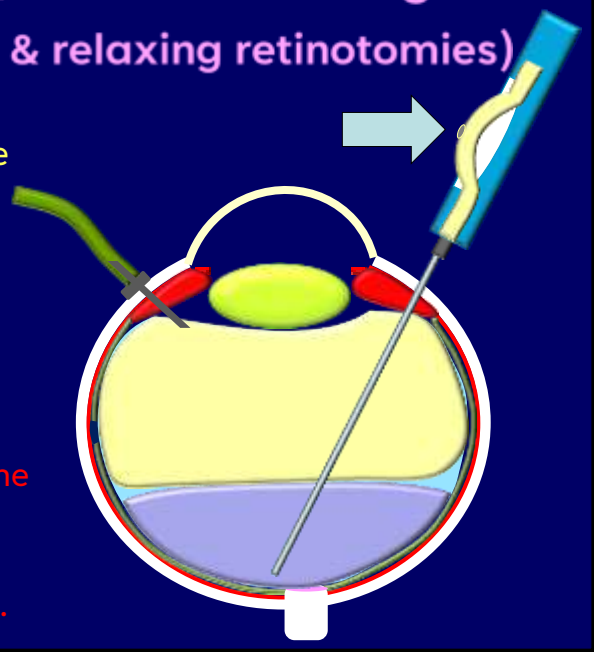
12. PFCL / Silicon exchange
(giant breaks & relaxing retinotomies)

- After exceeding the edge of the tear → the tip of the flute needle is inserted close to the disc inside the PFCL bubble.
- Avoid pressing on the rubber of the flute needle → creates small PFCL bubbles.



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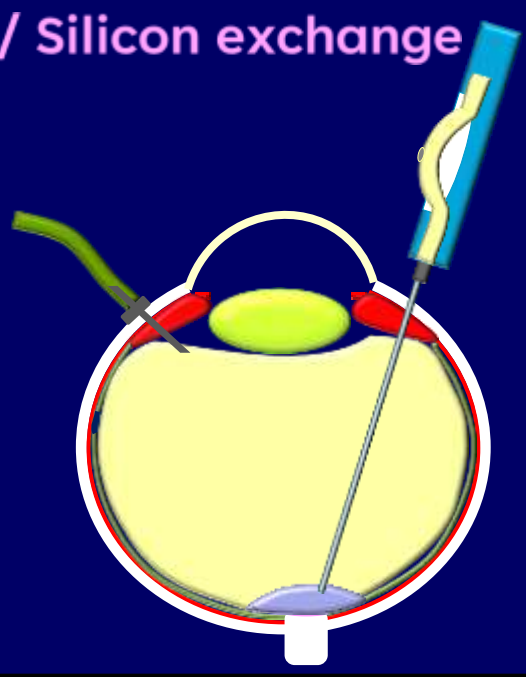
12. PFCL / Silicon exchange

- Do not leave any bubbles of PFC.
- **Care of IOP throughout the exchange & at the end.**



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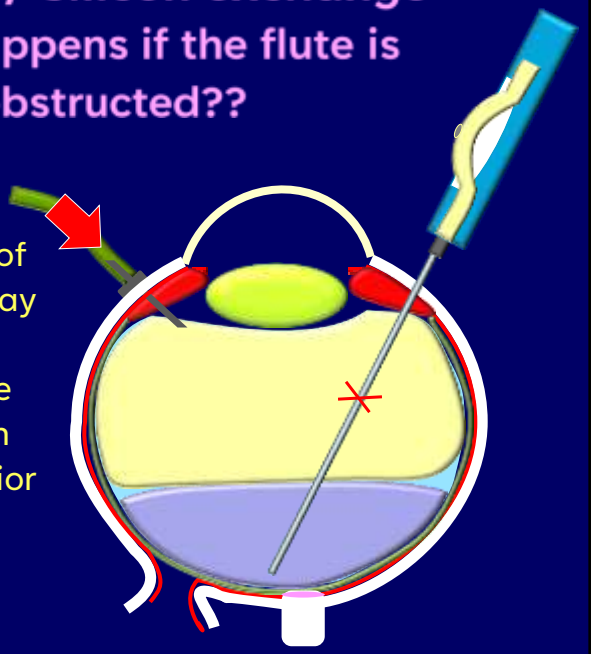
12. PFCL / Silicon exchange

What happens if the flute is obstructed??

- The huge pressure of the silicon pump may cause posterior rupture of the globe especially with high myopia and posterior staphyloma



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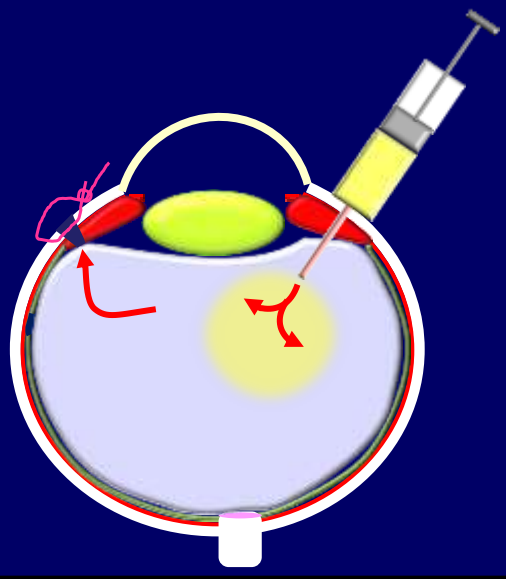
13. Filling the eye with long-acting gas

- After filling the eye with air, close 2 sclerotomies.
- Keep the 3rd one ready for tightening the knot.
- Through a separate 25G puncture flush the eye with 40 – 60 cc of the proper gas mixture.
- Immediately tighten the ready knot.



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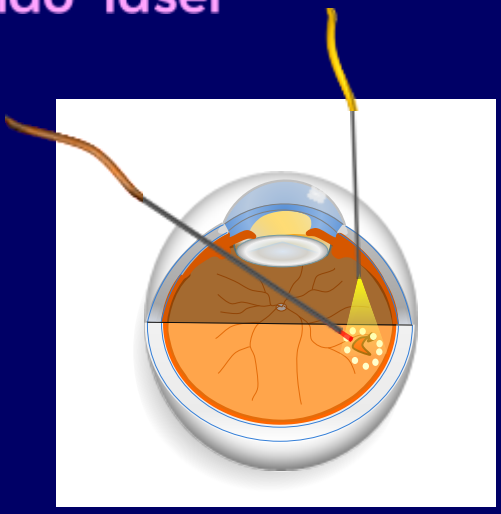
14. Endo-laser

- Surround all the breaks and suspicious areas.
- 360 degrees parage??
- PRP
- No focal or grid laser.



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15. Check the retinal periphery at the sclerotomy sites

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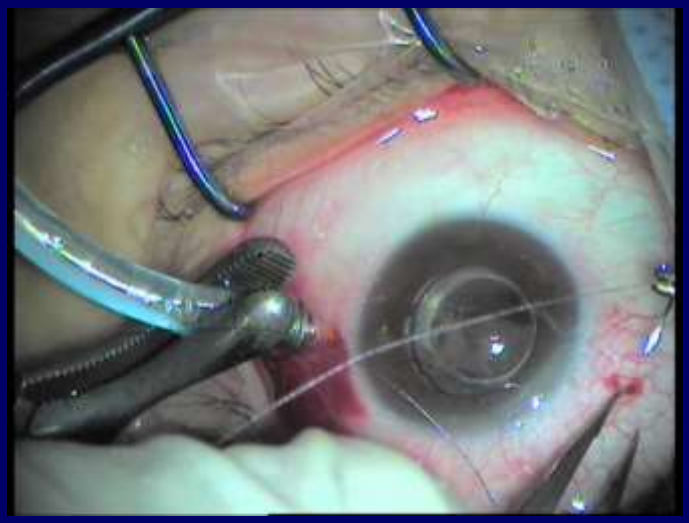
16. Closure of the sclerotomies



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Thank You

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