

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

Phacomachine & Phacodynamics

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Basic functions of phaco machine

1-Ultrasound emulsification (phaco power)

2-fluidics:

balance between

a-Irrigation (fluid inflow)

b-Aspiration(fluid out flow)

Phacomachine & Phacodynamics

Foot pedal positions

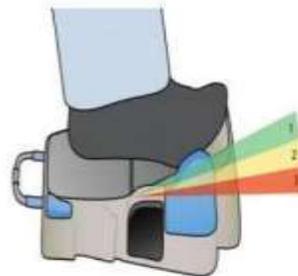
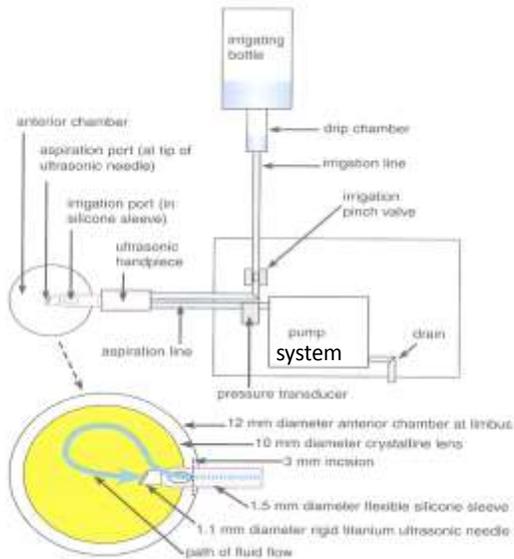
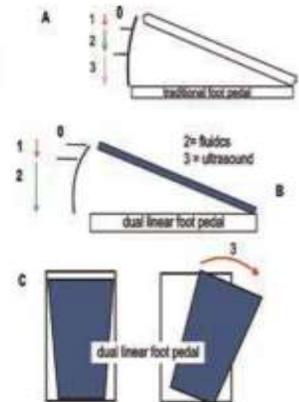


Fig 7.11 Phaco footpedal positions:

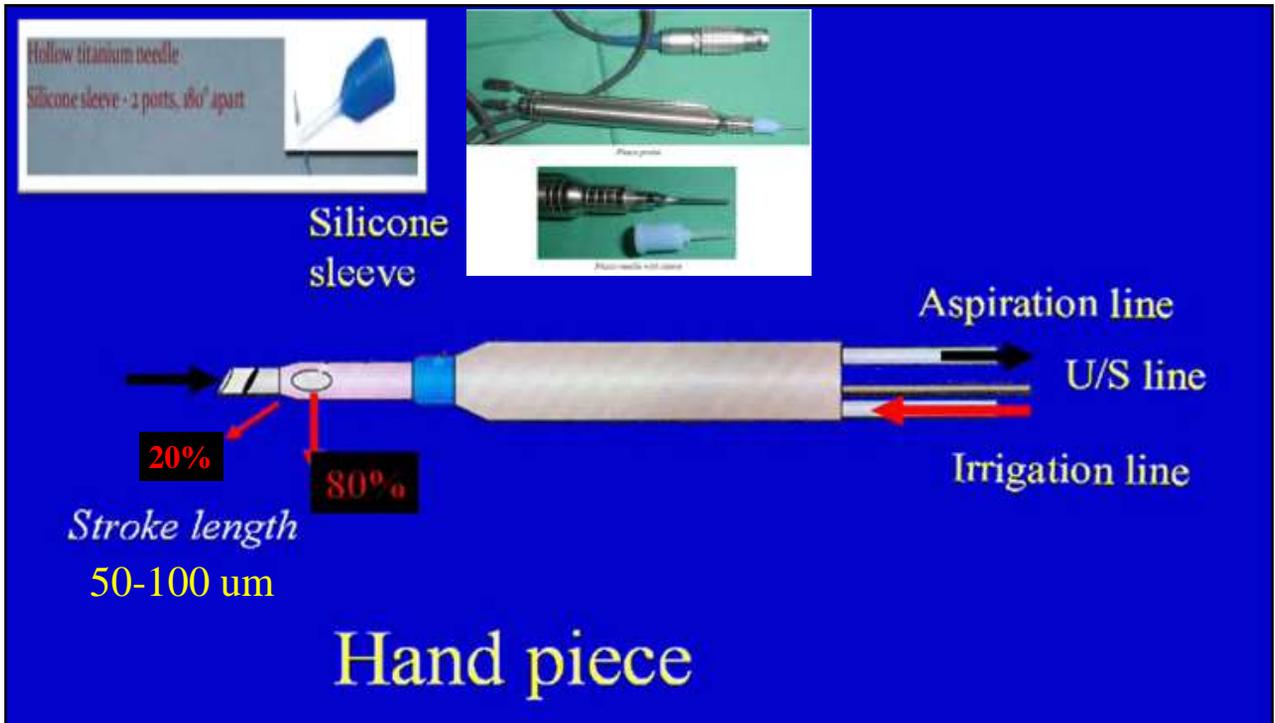
Position 1: irrigation only; Position 2: irrigation + aspiration; Position 3: irrigation + aspiration + phaco power



Irrigation

- Fluid flow from the bottle into the AC **until** the pressure built inside AC **prevent** further fluid (**except if there is wound leak**).
- IOP= amount of fluid in the column of the tube
- Depend on the **bottle height**:
- If we need deep AC → ↑bottle height → ↑inflow
- * **However** modern machines have digitally controlled and automated infusion systems.





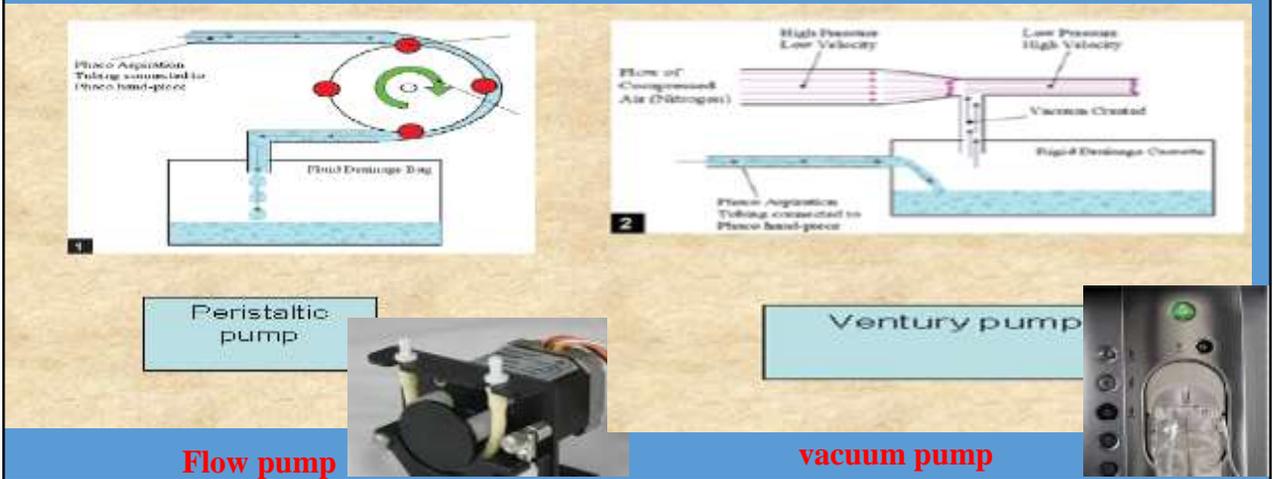
Aspiration flow rate (AFR)

1. Rate at which the fluid is removed from the eye (Measured in ml/min).
2. How fast something coming to the tip i.e. Pull (attract) something towards (lens matter) the tip (remove it outside) & counteract the heat effect of U/S



Mechanism of AFR and Pump system

AFR is controlled by a pump system .



	peristaltic	venturi
mechanism	Flow based Milking of aspiration line	Vacuum based Use of compressed air or gas
vacuum	only when occlusion occur	Vacuum created instantly via pump once surgeon press foot pedal
Safety	Very safe (less surge)	Poor (more surge)

Main parameters to be adjusted on the phacomachine

Flow rate

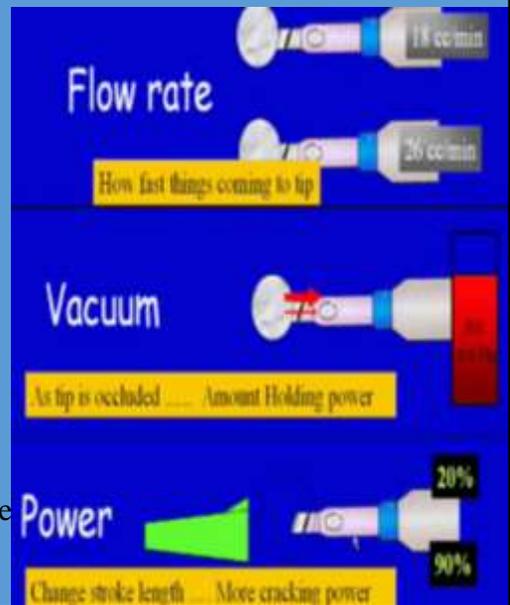
e.g. **Small** near **fragments** need **slow** flow rate

Vacuum: in mm of Hg

- When occlusion of the tip is complete by lens fragment, the vacuum **holds** the lens matter to the tip. This allow efficient U/S emulsification and fixing the lens fragment for further manipulation e.g. chopping
- Preset say 20 mm/Hg , when occlusion →slight holding power, Preset say 300 mm/Hg strong holding power

U/S power:

- 20 power (low) the tip will move forward 20% of its length ,while more power → more stroke length and more effect of the tip (more cracking)



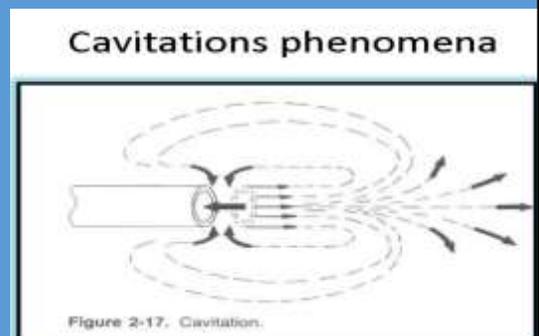
Power of phaco(emulsification)

□ Phaco energy depends on

1-jack hammer effect (stroke length)

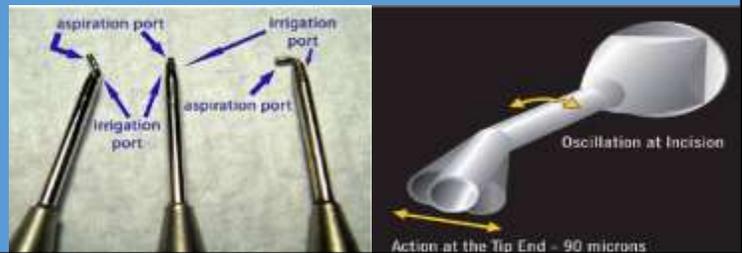


2-cavitation energy(transient cavitation)



Phaco power

- **Straight** movement forward backward (jack hammer effect)
or with Transverse movement → elliptical phaco (more powerful)
- **Angled** with a circular oscillating movement (**torsional** phaco)



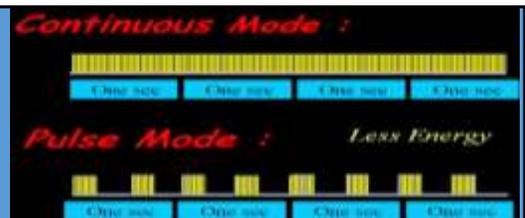
Phaco modes

1. Continuous mode:

during the **whole seconds** the phaco power (U/S energy) is on , sculpting the nucleus.

2. Pulsed mode:

part of the second has phaco power on and another part has phaco power off traditionally 50:50 i.e. duty cycle is 50%.



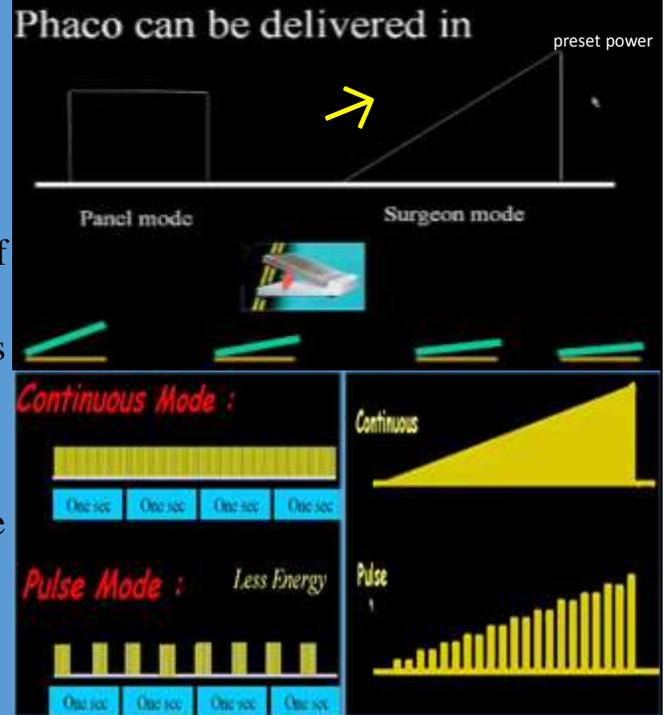
- **Duty Cycle**—time during which power is on as % of cycle (traditionally 50%) i.e 50% time USG ON, 50% OFF
- **Pulse duration**- time of phaco power on (PYRAMID)
- **Interval duration**—time from one pulse to another
- **Cycle time**—pulse duration+interval duration

Delivering of phaco(U/S)

1- panel mode: at position 3 the whole energy will delivered to the maximum of preset power (continuous or pulse)

2- surgeon or linear mode:(continuous or pulse)

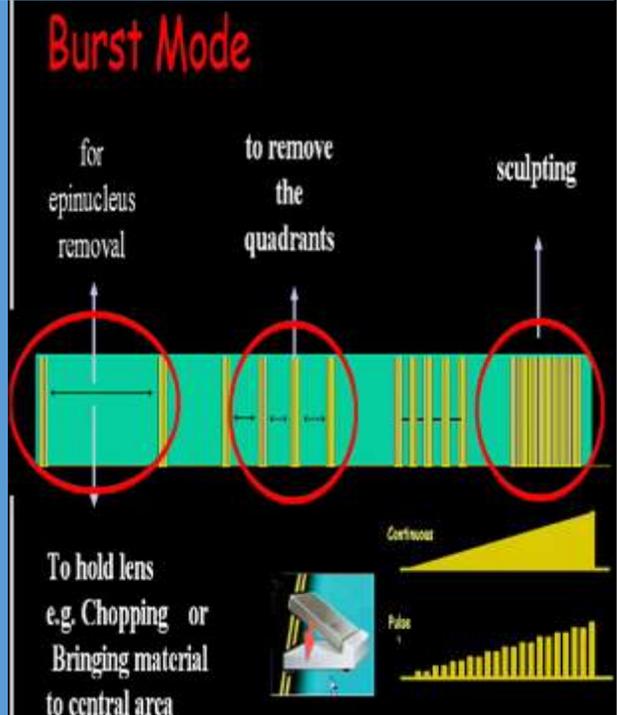
- As we get the position 3 down gradually, the energy will increase gradually e.g. 70% power will increase gradually 10,20,30 etc. till reach the preset power



3- Burst mode

* U/S and in between there is long period of no U/S, at the early position 3 .

* The interval of no U/S power (off period) is greater, then gradually decrease until at the end of position 3, there is no off period and a become a continuous phaco



4-Micropulse or Hyperpulse: = Cold phaco (misnomer)

Traditional Pulse

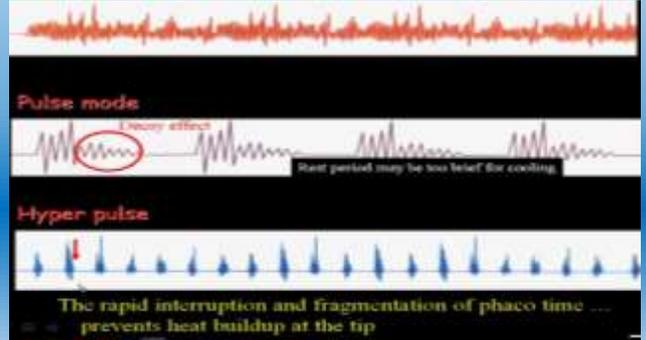
Max 20 PPS

Traditional Burst

Min width 30 msec

high pulse rates can be achieved with "on" and "off" times as short as 4 msec

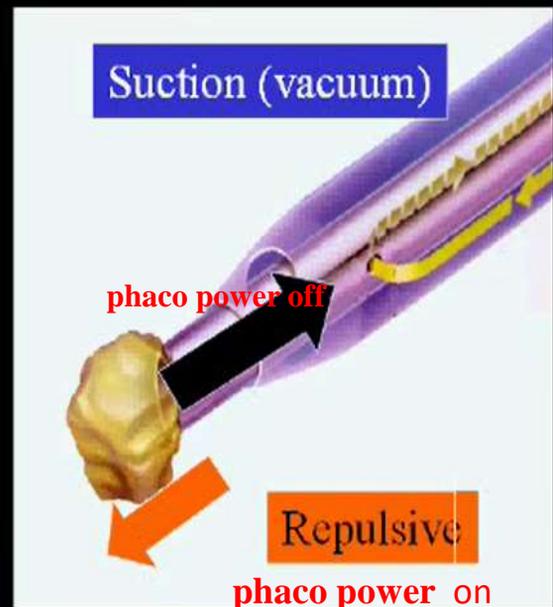
(giving an effective pulse rate of 125 pps since each cycle is 8 msec)

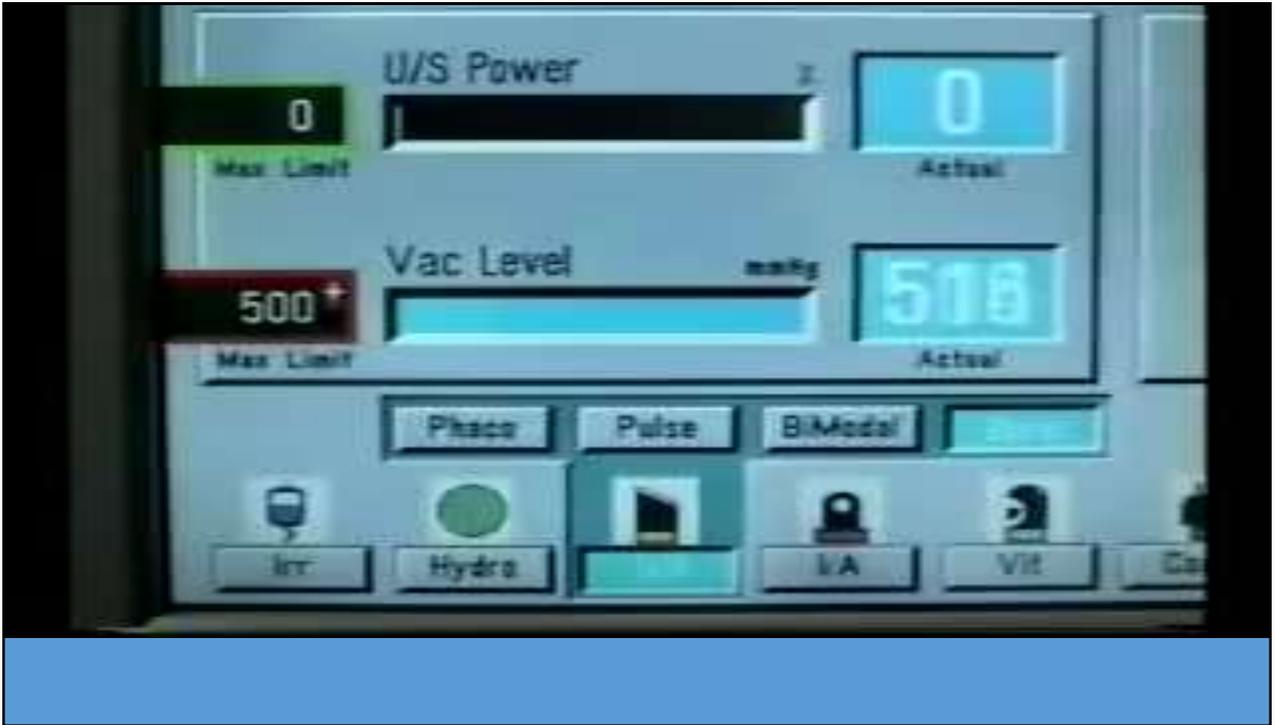


in **pulse** mode decay is **gradual** so there is no enough time for cooling while in **hyper pulse** decay is **rapid**

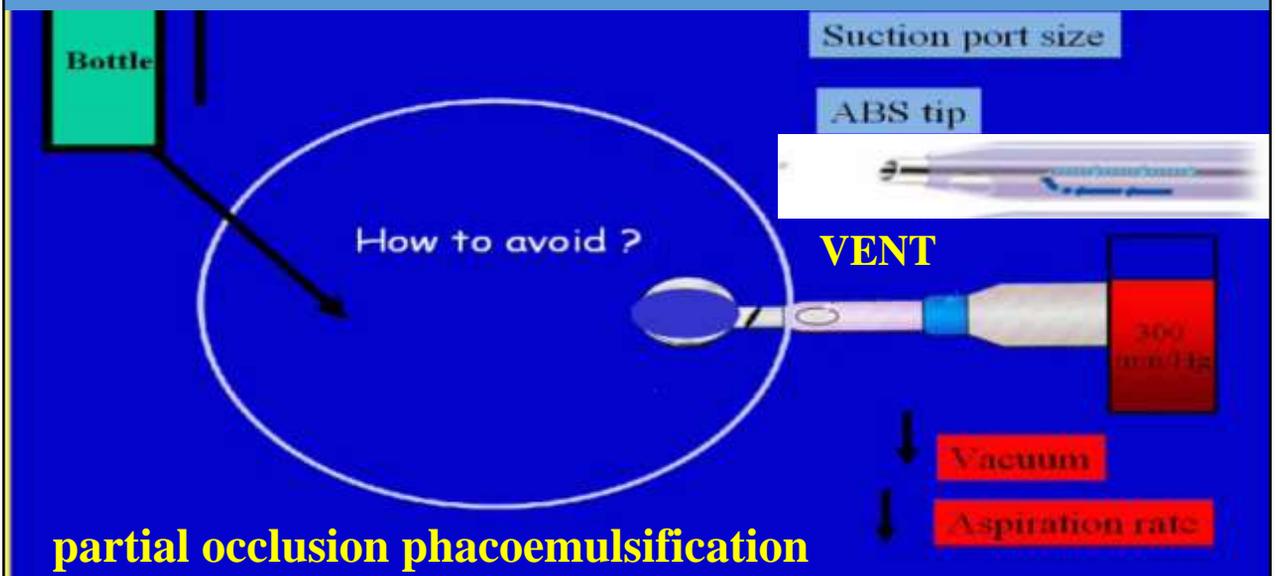
Emulsification
Heat production

Repulsive versus
attractive force

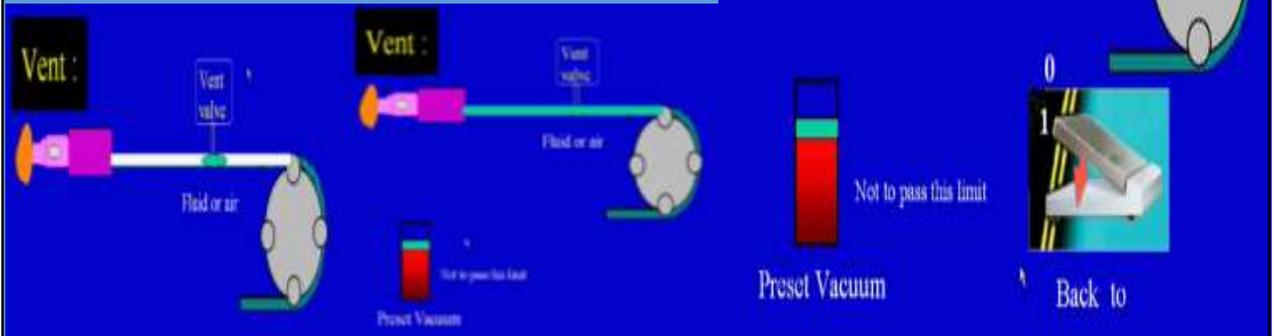




How to avoid surge



- Releases residual pressure in aspiration line
- Activated upon release of foot pedal
- With momentary opening of aspiration line to air or fluid
- Releases tissue against the tip

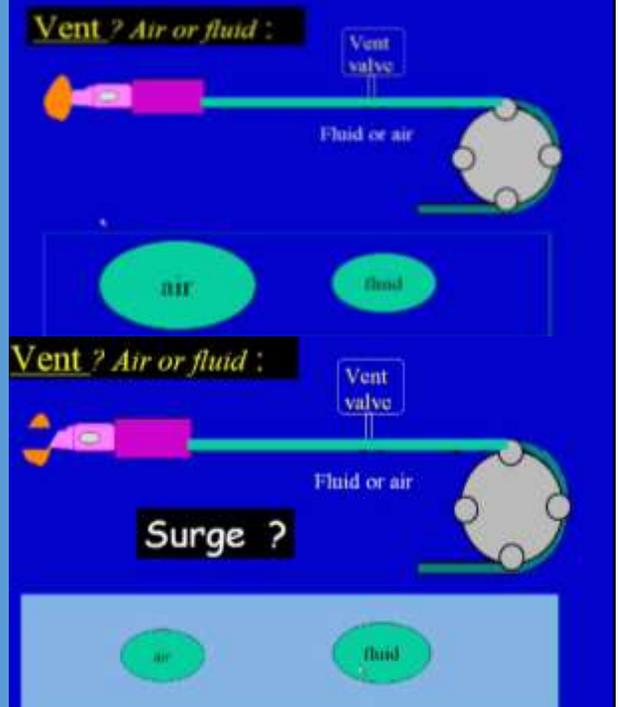


Air vent or fluid vent

On occlusion, When vacuum reach the preset level , vent will open air or gas passes in the tube to prevent further \uparrow of vacuum.

1- air or gas under vacuum will expand much but fluid little

2- after overcoming of occlusion(i.e. no vacuum), air shrunken much (but fluid little) making space around it \rightarrow more surge .



Partial-Occlusion Phacoemulsification

(surge requires total occlusion) so to avoid it we must prevent total occlusion:

By

I- using micro-pulse phaco :4-millisecond period of aspiration (no time for complete occlusion i.e. partially occlusion. With the onset of a 4-millisecond burst of phaco energy, the fragment is emulsified before it can totally occlude the phaco tip. Therefore, flow never falls to zero and vacuum never builds to maximum.

II- slow increase in the phaco power:(slow releasing the occlusion)

II-Torsional technology

The oscillatory movements of the phaco tip automatically knock the fragments off the phaco tip. longitudinal phaco (coring) while torsional phaco, is shaving. Thus holds lens material close to the phaco tip without total occlusion,

Thank u