Phaco Machine

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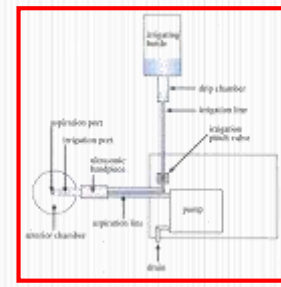
Phaco Machine

Irrigation

3 Functions: **U.S.**



Aspiration

Irrigation

Source:

- **Gravity driven (most machines).**

  Infusion pressure → easily changed by changing the bottle hight.

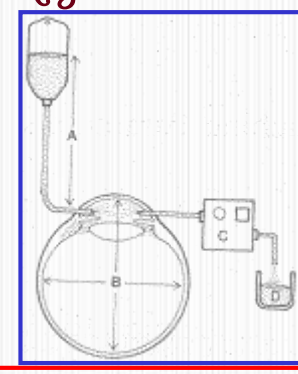
- **Irrigation must be (at least) 40 c.c./min**

  i.e. > AFR to pressurize the globe

Bottle height

- **Aim: keep AC safely formed without over pressurization.**

Over pressure { *Stress zonules*; *↑ Vit hydration*; *↑ Incisional leakage*



- **Usual height = 70 cm above pt eye level**

When to change the bottle height?

- **↑ Bottle height → Deep AC**
  - **Phaco 2**
  - **Excess leakage**
  - **Eyes with shallow AC**

- **↓ Bottle height e.g:**

1. **Torn post. Capsule (↓vit. Hydration, ↓tear extension) .**
2. **During Ant-vitrectomy (↓hydration & expansions of vit.)**

Ultra Sound

Source of Ultra Sound

Piezoelectric (T) الكهربية الضغطية

= Based on "Reversal of the piezoelectric phenomenon"

- **Piezoelectric phenomenon: certain crystalls, on compression electric currents**
- **The reverse: electric currents crystal contracts**

Phaco Needle

- Hollow titanium needle
- Distal opening (aspiration port).
- Proximal opening (threads into hand piece).

Needle Diameter :

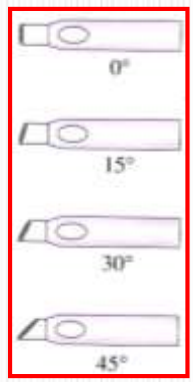
- Correlation with incision size.
- Take care of fluids parameters.
- Standard needle (19 G): highly efficient and less safe
- Micro needle (20 G): Less efficient more safe.

Phaco Needle

Bevel:

The larger the angle of bevel

- **Better**
  - **Sculpting "chisel"**
  - **Visibility**
  - **Holding force (large surface area)**
- **Difficult occlusion & coupling**



0° & 60° rarely used

30° commonest

Phaco design (shape)

- **Straight**
- **Kelman: angle 22° in tip shaft 3.5mm from the tip**
  - ↑ cavit.
  - ↑ visual.
  - Torsional U.S.
  - Partial Kelman 12.0°

- Siebel tip
- Cobra tip
- Flare tip

⟶ ↑ Cavitational Effect

Power Generation at the phaco tip

U.S power

Frequency

= Speed of Needle Oscillations

28.000 – 45.000 Hz (C/S)

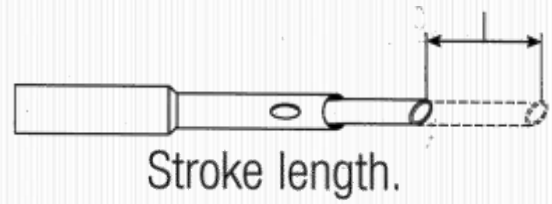
= Manufacturer determined

Stroke length

= Length of needle movement

2-6 mils (thousand of an inch)

= Surgeon control (position-3)



Sleeve:

- 2 side holes (Irrigation ports).
- Insulate the tip (cooling).
- Bevel is 90°sleeve opening
- Sleeve is 1.5 mm beyond sleeve

How the energy is delivered?

Phaco Power:

- **Longitudinal:**
  - **Continuous**
  - **Pulse**
  - **Burst**
- **Non-Longitudinal:**
  - **Torsional (Ozil)**
  - **Ellipse (horizontal)**

- **Longitudinal:**
  - **Cavitational effect**
  - **Cutting in forward direction only**
- **Non-Longitudinal:**
  - **Mechanical effect.**
  - **Cutting in both directions.**

↓↓ U.S → ↓↓ chattering → improve followability & ↓EC loss.

Torsional → Kelman tip

Transverse → any tip

Aspiration and Vacuum

Aspiration = outflow

Dual Control

Flow rate (AFR)

Def.: Negative pressure necessary to overcome the resistance in the *nonoccluded* aspiration line to obtain the desired flow. Ie. Volume of fluid remove from the eye.

Unit: ml/min

Range: 0-40cc/min

Function: controls how well material is attracted to the phaco tip. i.e. followability.

Vacuum = suction= aspiration level

Def.: *With tip occlusion*, this negative pressure would be driven up to the maximum the machine can provide. i.e negative pressure in the tubing.

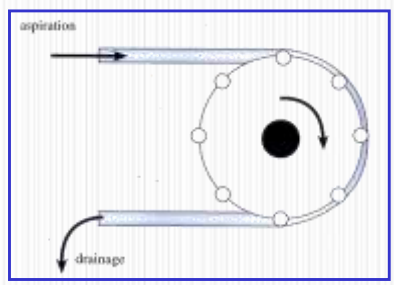
Unit: mmHg

Range: 0-500 mmHg

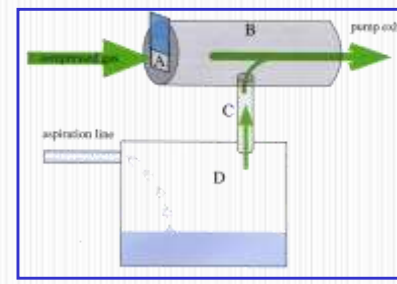
Function: Controls how well material is held against the tip once occlusion occurs.

Sources of AFR & Vacuum pumps

Peristaltic P.



Venturi



Sources of AFR & Vacuum pumps

Peristaltic P.

*Mech.:*Squeezing of small segments mounted on a wheel. As the wheel turns, the segments of fluid trapped() 2 rollers is moved, creating a vacuum behind →relieved by more fluid coming up the tubing.

Control: speed of rotation

Reservisor: open to atmosphere

AFR/vacuum: Independant

Venturi

Mech.: With tip occlusion, this negative pressure would be driven up to the maximum the machine can provide. i.e negative pressure in the tubing.

Control: Apreture of venturi chamber

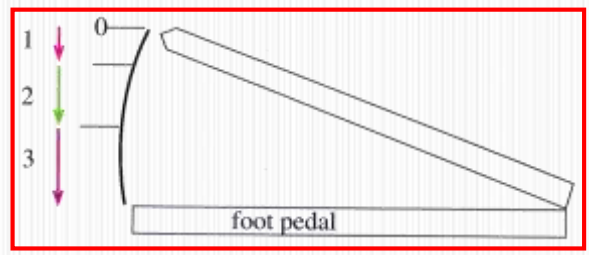
Reservisor: rigid closed system

AFR/vacuum: linked to each other

Foot Pedal

Foot pedal:

- Activate all functions of the machine
- Linear control.
- 4 positions 0: Rest position (No I,A.US)
  - 1: Irrigation only (the pinch valve opens).
  - 2: I/A (Irrigation open + pump function).
  - 3: I/A + U.S.



Phaco Parameters

Phaco (1)

- Sculpting : Machine settings

a) Power Continuous mode

α Nucleus hardness

(Tool low → nucleus moves.)

(Too high → risky)

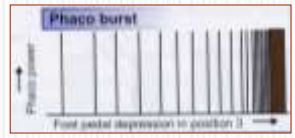
b) Vacuum : Not high. Why?

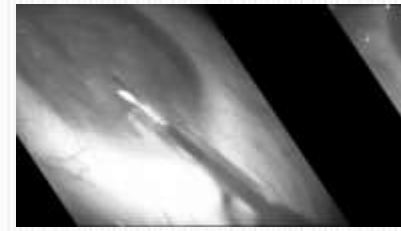
(20-30 mmHg)

c) AFR 12-20 c.c/min (clear AC)

Phaco (2)

- High
  - Bottle (Maintain a constant IOP → stable AC)
  - AFR (↑ follow ability)
  - Vacuum (↑ holding power)
- Low U.S. (pulse, burst, occlusion,..) *Why?*





What are the difference between pulse & burst modes?

*** Both are efficient in segment removal**

Pulse Mode	Burst Mode
Slower, more controlled surgery	Faster surgery
Suitable for beginners	Experienced surgeon
Preferred in certain instances Small rrhexis• Anterior capsula tear • Zonular weakness• Very dense nucleus• Shelved sections • Vitreous loss•	“Optimal conditions” Straight forward surgery

Terminology

Q: What is Preset vacuum?

Maximum vacuum chosen by the surgeon & this level will never be exceeded during surgery.

When to vacuum?

1. Nuclear fragment dislodge from the tip during chopping.
2. If chattering occurs.

What is Actual vacuum?

Vacuum present in the tubing at a particular time. It's never static & will never exceed the preset vacuum.

What is Chattering?

Nuclear fragment moves to-and-fro from the tip

What is occlusion?

Obstruction of u/s or I/A tip or aspiration line.

What is rise time?

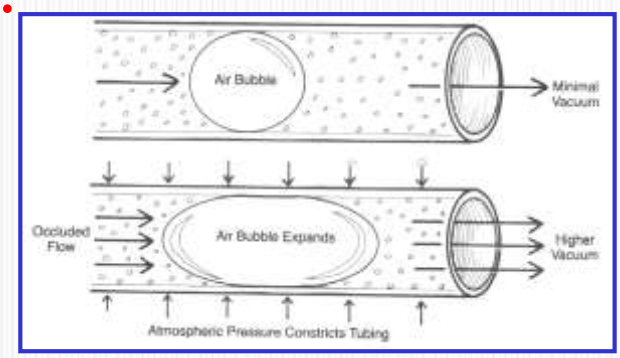
The amount of time required to reach a given vacuum present, assuming complete tip occlusion.

Surge

Def.

Sudden increase of the outflow beyond the compensating capacity of inflow → partial or complete AC collapse

Mechanism.:



Surge Modification

Pre-occlusion:

a) ↓ AFR → slower vacuum build up →i.e. ↓ rise time.

b) ↓ Preset vacuum

c) ↑ Irrig bottle

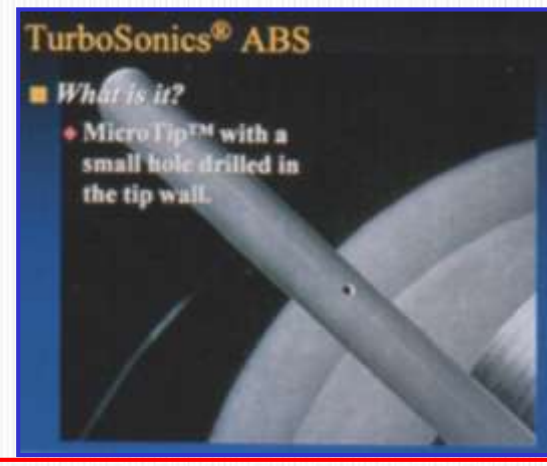
d) AC maintainer

e) ↓ Wound leak

f) Non-compliant tubing.

Occlusion:

- ABS system + reinforced tubing.
- This flow = 4cc/min at 50mmHg & 11cc/min at 400 mmHg i.e. there is never complete occlusion.



Post-Occlusion:

- Microprocessor technology = AMO sovereign

Monitoring the vacuum level 50 times/sec. →feedback loop to adjust (delay or reverse) pump.

- Dual linear foot pedal B & L Millenium. Separate both flow & vacuum from power.