A clear understanding of the physical and mechanical principles that govern phacoemulsification can facilitate usage of this technique for effective and efficient cataract removal.

It is essential to understand the basic principle of phacodynamics. This is even more relevant to bimanual microphaco and is mandatory for the evolution of this technique.

Phacodynamics is defined as the study of the fundamental principles of inflow rates, outflow rates, vacuum, phaco power modulation along with microsurgical maneuvers with different types and grade of cataract.

A true understanding of this will help in logical setting of the machine parameters in adaptation to different surgical techniques.

Even the most modern machine will not give adequate results as compared to an older machine if the principles of phacodynamics are not well understood.

Most of the surgeons use their equipment without really understanding their machines or the basic values which allow them to operate in great safety.

The most important parameters in microphaco-emulsification, in order to be performed well requires a good understanding of fluid mechanics.

Basically the dynamics of phaco in both conventional and microphaco remain the same In microphaco irrigation is through the side port rather than through the irrigation sleeves (Fig. 15.1).

With this one of the major problems encountered is that not enough fluid is going into the eye through the side port irrigating chopper. In conventional phaco the silicon sleeve delivers up to 65 cc/min into the eye whereas the best irrigating choppers of 20 G cannot deliver more than 45 cc/min. keeping this basic fact in mind one has to work around it in term of surgical manoeuvers, fluid management, ultrasonics and type and grade of cataract.

Some of the obvious advantages of bimanual microphaco are decreased incision size, less astigmatism, good anterior chamber maintenance if we understand the logic of phacodynamic.

Because irrigation is separated from aspiration the added advantage theoretically is that all fluids comes in through one incision and exit through the other. We have always to take in account some leak from the irrigation sideport and from the aspiration sideport that’s we demonstrate in our experimental set-up.

The irrigation fluid in conventional phaco has a tendency to push the fragments away from the aspiration tip.

With bimanual microphaco we are improved followability, we are able to manipulate tissue with the incoming stream of fluid and we have a much more stable chamber because all of the fluid is entering through one side of the eye and leaving through the other side so we do not have competing currents of fluid around the phaco...
needle. Of course bimanual irrigation and aspiration systeme of the cortex has been known for a long time to be advantageous.

The fundamental principle of every cataract operation is to improve the vision of the patient after surgery of the cataract and not to diminish it.

The purpose of the stability of the anterior chamber is to distance the endothelium and the posterior capsule from the tip of the probe.

Consequently, in order to avoid any lesion of the corneal endothelium, the consequence of which is considerable corneal oedema with a risk of the need to perform a graft, it is imperative to control the stability and depth of the anterior chamber.

We must always bear in mind that the principal cause of corneal grafts is the cataract operation.

The most important heading in phacodynamic that will be discuss below are:

- Fluidic
- Surge

Phacoemulsification is a cataract surgery in a close chamber, in a such close chamber, one must monitor the inflow (irrigation), the outflow (aspiration) and the leak.

There are three components of fluidics.

**Irrigation**

For most machines irrigation is passive, i.e. it is determined by the height of the perfusion and the diameter of the tube. Most of these machines do not possess a pressure control or a control of the flow rate of the liquid entering the eye. Such a control would make it possible to prevent the collapse of the anterior chamber. This is the weak point of all of the phacoemulsification machines and the bimanual microphaco technique.

There are two ways of increasing the flow rate of the liquid in the anterior chamber:

- By increasing the pressure
  
  Many authors have described theirs own methods to increase the flow by increasing the pressure everybody have forget the Poiseuilles law increasing the pressure increase also the pressure inside the eye and affect the endothelium

- By increasing the diameter of the perfusion probe utilising a Duet handpieces design by Larry.Lacks of Microsurgical technology in which the chopping lumen of a 19 G tip deliver at least 60cc/min with a pressure of 33 mm Hg

- An other way to increase inflow volume is to add an anterior chamber maintener as has been described
by Michael Blumenthal, this device may be use in addition to or instead of an irrigating second instrument, although it involves a third incision for access to the anterior chamber.

**Aspiration**

*Outflow Rate*

Outflow rate is defined as the volume of fluid by unit that exit the anterior chamber that governs the speed of the procedure and the danger to aspirated the iris or the posterior capsule.

Vacuum is what grips the nucleus which is occluding the phacotip, this grip allow to decrease ultrasound and aids chopping.

**Leak**

In a conventional phaco the leak is a composant of the surge and the instability of the anterior chamber. In a bimanual microphaco with 19 G irrigation needle (that mean at least a 60 cc/min of irrigation). The controled leak is to cool done the phacotip without induce an instability of the anterior chamber (Fig. 15.2).

The inflow rate has to be higher than the outflow rate even with the maximum of vacuum with every type of pump to avoid the surge.

**Surge**

This phenomenon is produced when the phaco tip is occluded by nuclear masses. The increase in the negative pressure occurs up to the limit values that have been predetermined. The greater the negative pressure and the longer the time it is maintained, the larger will be the volume of liquid to be replaced along the length of the tubes at the time of the decompression. The vacuum will be propagated up to the anterior chamber leading to its collapse (Fig. 15.3).

The best way to avoid the problem is to increase the flow rate upstream of the anterior chamber. In the case of bimanual surgery, it is necessary to increase the diameter of the irrigation probe to 19 G tip.

**BIBLIOGRAPHY**

4. Bovet J, Achard O, Baumgartner JM, Chiou A, C de Courten, Rabineau P. 0.9 mm Incision Bimanual Phacoand IOL Insertion Through a 1,7 mm Incision Symposium on


