ASCRS Course 01-107

Title: Phaco Arena: To Sleeve or Not To Sleeve; That Is the Question

Date: Tuesday, May 1, 2007

Time: 8:00 AM-9:30 AM

Location: RM 30 C (SDCC)

Chief instructor-Dr Cyres Mehta ,MUMBAI,INDIA

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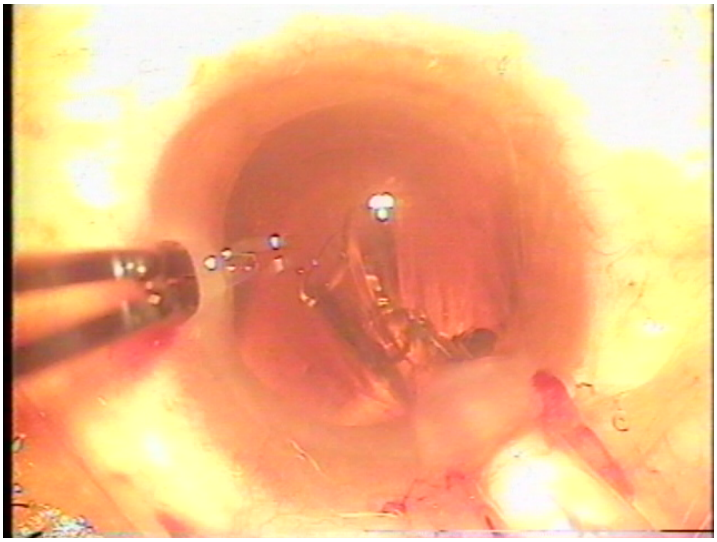


ACRYSMART LENS BEING INJECTED

Cataract surgery has evolved over the past few decades with a progressive decrease in the size of the incision.Originally from a 12 mm intracapsular incision we now present bimanual phaco through 700 microns

Microphaco,or Bimanual Phacoemulsification is not new.As far back as 1985 Dr Steven Shearing MD in Las Vegas USA propounded the separation of Ultrasound/aspiration and the irrigation handpiece.

Soscia et al evaluated wound burn in 2 studies on cadaver eyes and found that wound burn is not generated when the phaco needle is naked (sleeveless) when an irrigating chopper(Olson irrigating chopper.ASICO) is used and at worst only mild temperature elevation occurred at the tunnel. Wound burn only occurred when the fluid ***inflow*** was completely cut off at nearly 100% power !

At the annual meeting of the Japanese Society of Cataract and Refractive Surgery in Kyoto (1999) Crozafon,reported using a 21 G sleeveless Teflon (a poor thermal conductor) coated tip and the Opitkon pulsar unit.

Also in 99' Amar Agarwal from India presented PHAKONIT through a 0.9 mm incision with constant dripping of cold BSS over the phako needle.This is because they felt that

friction between the tip and the tunnel is the main factor for heat production and pouring BSS on the incision site is needed to disperse the heat buildup.
Donnenfeld et al evaluated wound temperature using a micropulse system and showed only a minimal temperature elevation and comparable endothelial cell loss at 3 months with conventional coaxial phaco.
Tsuneoka and colleagues presented a study of 965 eyes in 2001 with no case of thermal burns using a Tsuneoka irrigating hook which later became the Tsuneoka tip on the DUET system.

Fine, Olson ,Mehta, Agarwal, Alio and many others have expanded modified and refined this technique bringing it to its present level of refinement.
Dr Amar Agarwal operated the first case live in India in front of an audience of hundreds using a chopper made out of an bent 18G needle and a bare phaco needle back in 1998.
So why didn't we think about this before.Well,we were in a comfort zone with phaco, bimanual phaco necessitated adopting one more new skill ,one more learning curve to negotiate and had some inherent disadvantages.

Some of the names coined for this new technique are Microphaco (Dr Randall Olson,USA) or Bimanual Phaco or Phakonit(coined by Dr Amar .Agarwal).
Phakonit stands for **P**hacoemulsification with **N**eedle **I**ncision **T**echnology

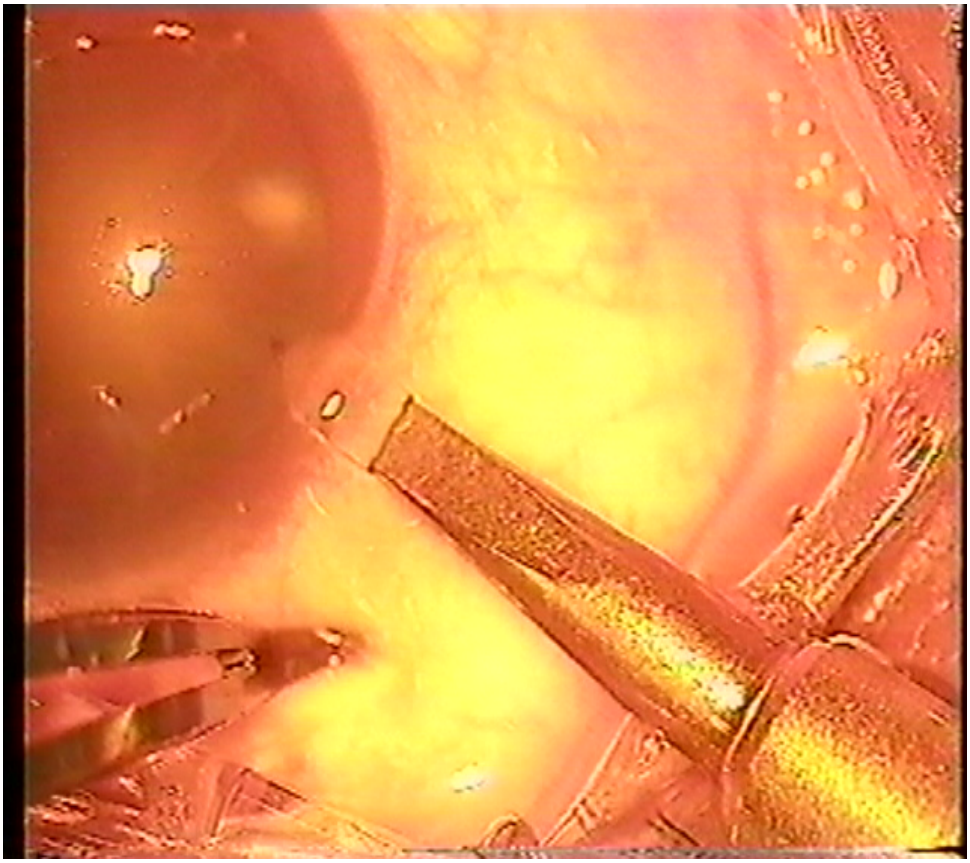
The removal of the cooling irrigation sleeve and separation of infusion and emulsification/aspiration through two separate incisions is now a viable alternative to traditional coaxial phacoemulsification. Machines such as the AMO WhiteStar, STAAR Sonic, Alcon NeoSoniX,Alcon Aqualase(fluid based) ,)ZIL (ocillatory phaco) and Dodick Nd:YAG Laser Photolysis systems offer the potential of offering relatively "cold" lens removal capabilities and the capacity for bimanual cataract surgery. Alio(Alicante ,Spain) has described a technique using the Venturi pump system ,Alcon Accurus which maintains pressurized inflow through gas forced infuson and a surgefree system.

The advantages in a smaller incision as compared to one of 2.8 mm is self evident.It has been proved by topography and by abberometry ,by many researchers to produce an astigmatically neutral incision. Secondly the smaller the incision ,the lesser the chance of the entry of bacteria and fungi leading to endophthalmitis.

Here I am going to describe my personal technique (CM) that for me has made this surgery safe and reproducible.

The two tunnels are made with diamond MEYCO (Switzerland) 610 knives ,which create reproducibly a square tunnel of 0.9 mm. Openings of consistent size are very important as a larger opening will lead to leaks and result in surge. However a too tight opening for the phaco needle will result in no fluid exiting the eye on the side of the needle and hence a greater likelihood of wound burn. The most stable incision is naturally one which is a little longer than it is wide ie oversquare and trapezoidal in

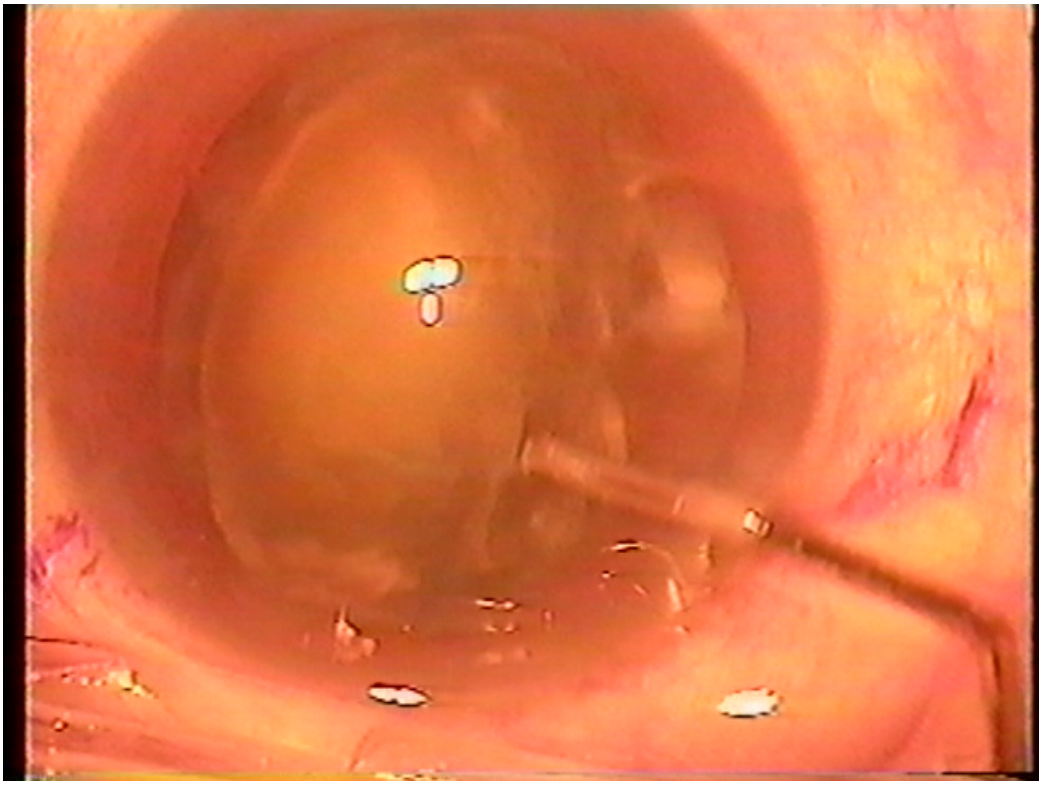
shape.However too long an incision can lead to trapping or oar locking of the instrument in the tunnel leading to lack of maneuverability. The tunnel must always be one gauge larger than the phaco tip in the interest of fluid egress from the sides which helps to cool the tip and prevent friction between tip and tunnel.Also the larger tunnel allows a little bit of additional maneuverability.



MEYCO 610 0.9 mm DIAMOND MICROPORT KNIFE

Openings are best created at 2' O clock and 10' O clock so as to put the surgeons hands at the angle of about 90-100 degrees for efficient chopping maneuvers.
Inject methylcellulose and then introduce the microcapsulorrhexis forcep .Presemtly im usin both the DUET(MST ,USA) forceps and the Rumex forcep .A microrhexis forcep is a better alternative to a needle for a few reasons.A needle rhexis relies on the sharp tip of the needle to engage and pull the flap around a single pivot point,ie the minute opening created by the needle. Thus you cannot tilt the needle or alter the line of pull as the tip

will disengage from the flap. Also with a needle a certain amount of flex is inherent compounding the problem. In hypermature cataracts, paediatric cataracts,eyes with high vitreous pressure when the rhexis runs out pulling it in with a needle is difficult and sometimes not possible due to the line of pull and transmission of force required. Unlike rhexis performed with a Utrata's forcep in regular 2.8mm phaco,you will need more regrasps,at least 4-6 as compared to 2-3 as the angle of action varies very little due to the relatively tight tunnel. However as a happy consequence of a small opening you are spared having to refill the chamber with viscoelastic. A single filling usually suffices!
I prefer a rhexis 5 mm or larger for the lens salute procedure.
Hydrodissection is carefully performed with a 24 gauge needle and BSS at 2 opposite poles.Before starting hydrodissection especially with HMW like Viscoat or Healon -5 , remove viscoelastic from the anterior chamber with an aspiration cannula and low vacuum.Olson et al (Utah) has shown that presense of viscoelastic in the anterior chamber during ultrasound blocks fluid flow into the eye and leads to rapid elevation of needle temperature .In as little as 2 seconds of on time the phaco tip can reach very high temperatures.
During hydrodissection inject very small aliquots of fluid as the increase in pressure in the anterior chamber can lead to an inadvertent blow out. This is because there is a limited exit pathway for fluid egress as compared to a 2.8 mm tunnel. Make sure you can see the fluid wave move across to the opposite side of the lens. Once the nucleus elevates a little push it back down into the bag to "decompress" the lens.This has the effect of lysing all remaining cortico-capsular adhesions and prevents the creation of loculi of fluid below the lens which might blow out. Next through the right hand opening slide the cannula all the way to the equator at 12 'O clock and progressively with low pressure inject fluid till the opposite pole of the lens tips up. This is the classic lens salute maneuver .The basis of this technique ,is space creation below the nucleus for a chopper so that the nucleus is chopped through and through ,the densest part between the chopper and the tip .However only in lens salute and chop do the chopper and phaco tip approximate each other from opposite poles of the lens .



TIPPING UP THE NUCLEUS IN HYDRODISSECTION

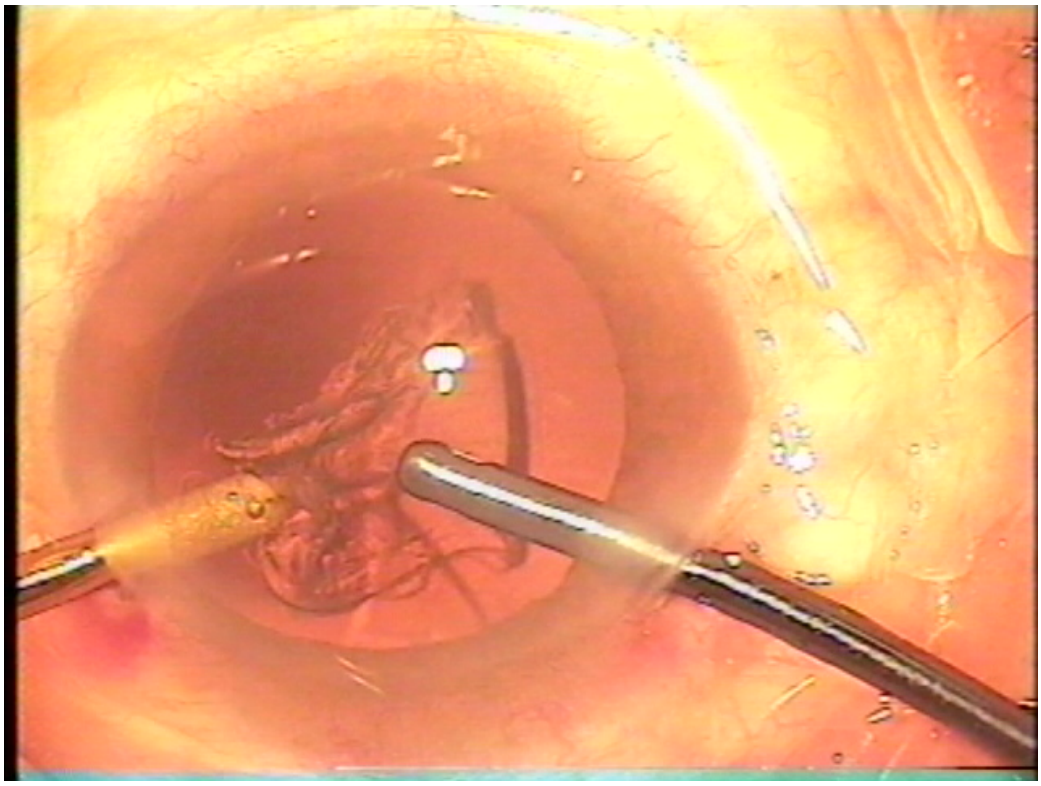
The advantage of lens salute microphaco is that ,unlike in a quick horizontal chop with a sharp chopper, firstly, there is no downward pressure on the posterior capsule at all. This is advantageous especially in cases with a zonular dehiscence,hard nuclei and cases where the rhexis has run away. Phacoemulsification in the iris plane or even a little in the anterior chamber has its fair share of detractors and rightly so, as minimizing the quantum of ultrasound energy in the anterior chamber determines how fast the cornea will recover. Today even with hard cataracts ,thanks to 'power modulation' ,using micropulse and microburst the amount of actual ultrasound time can be reduced to sub second levels .This allows a return to iris plane phaco as a safer quicker alternative to chopping in the bag. Secondly all phaco in the iris plane is possible without any bevel up maneuvers and as Dr Fishkind has shown the phaco energy radiates in a cone from the tip bevel. So bevel down means even less effective energy exposure for the endothelium. Once the lens has been tipped up introduce the irrigating chopper first always to pressurize the anterior chamber and only then introduce the phacotip bevel down. I usually use 30-40 % microbursts of power of 30 m/second on an Alcon Infiniti The Soverign Whitestar(ICE) system as well as the new Optikon Pulsar 2 unit also produces these micropulses.The Staar Sonic Wave uses sound pulses at the 100 Hz range which does not produce heating of the needle.At full sonic power you can hold the dry tip of the sonic wave unit in your fingers and there will be no increase in temperature.

The key to surgeless bimanual phacoemulsification is enough fluid inflow through the irrigating chopper. The amount of inflow must be greater than the outflow through the needle. One way to achieve this is to raise up the bottle,use a chopper of at least 20 G diameter or use a pressurized irrigation bottle .Do you think your current chopper produces enough inflow? Lets find out ; raise up the bottle to the bottle height you usually operate at and position the irrigating chopper at patient eye level. Open the irrigation and collect the inflow in a graduated measuring vessel .Over 1 minute most of us will find a max of 25-30 cc of BSS in a minute with the average 21-22 G irrigating chopper made by most manufacturers. You need at least 40 cc/min to achieve a relatively surgeless situation during surgery. Inflow with the DUET (Microsurgical Technology ,USA) is about 45 cc/min(bottle at 110 c m above eye level) which increase to beyond 60 and more with a pressurized bottle. Even with these high volumes, set your flow rate to less than half ie 30 or less cc/min . This effectively eliminates surge.This duet irrigating chopper is developed by Larry Laks of Microsurgical Technology and is a natural evolution of the Tsuneoka hook made by ASICO.As the flow is linear from the big single end opening port,it does not have the restrictive turbulent flow of a side chopper with 2 side ports.

An end opening chopper is far superior to a side opening one as it provides much more inflow for the same diameter.

Using the CRUISE CONTROL,(STAAR USA), is another way out. It consists of a pencil length device connected to the aspiration line after the phaco handpiece, and basically acts as a flow restrictor while trapping nuclear debris in a plastic mesh.The flow restrictor is a simple constriction in the outflow pathway that by the laws of physics slows down outflow at occlusion break when the speed of outflow doubles and triples causing surge. Earlier ,outflow restrictors had been tried but failed due to clogging by nuclear debris which is collected in this device by a side pathway thus leaving fluid passage though the narrow channel proceed unhindered.

I prefer my own curved tip(scythe) on the DUET system in the Some of the other available tips are theNagahara, Fine,Alio,Agarwal,Chang,Olson among others. Simply follow your normal technique , chopping through the centre of the nucleus.This is possible only if the nucleus is tipped up .In regular coaxial phaco the fluid currents move out wards from the needle and thus lead to particles being pushed away from the tip. In order to overcome this we increase the vacuum levels even as high as 600 mmHg in modern machines . However in bimanual phaco 350 is more than adequate as ,inflow sets up currents that push pieces towards the tip. The blast of fluid inflow can be used as a surgical tool as well, to open up the bag,to push pieces around or to reposition nuclear material at the phaco tip.Remember to enter the eye with the irrigating chopper and to exit the eye with the irrigating chopper after you have withdrawn the tip. First in last out is a good rule to follow.
Irrigation Aspiration is performed with the DUET system with sandblasted tips.The aspiration port is 0.3 mm .These tips fit in very snugly through the paracentesis openings as no leakage equals no surge when coupled with adequate inflow.

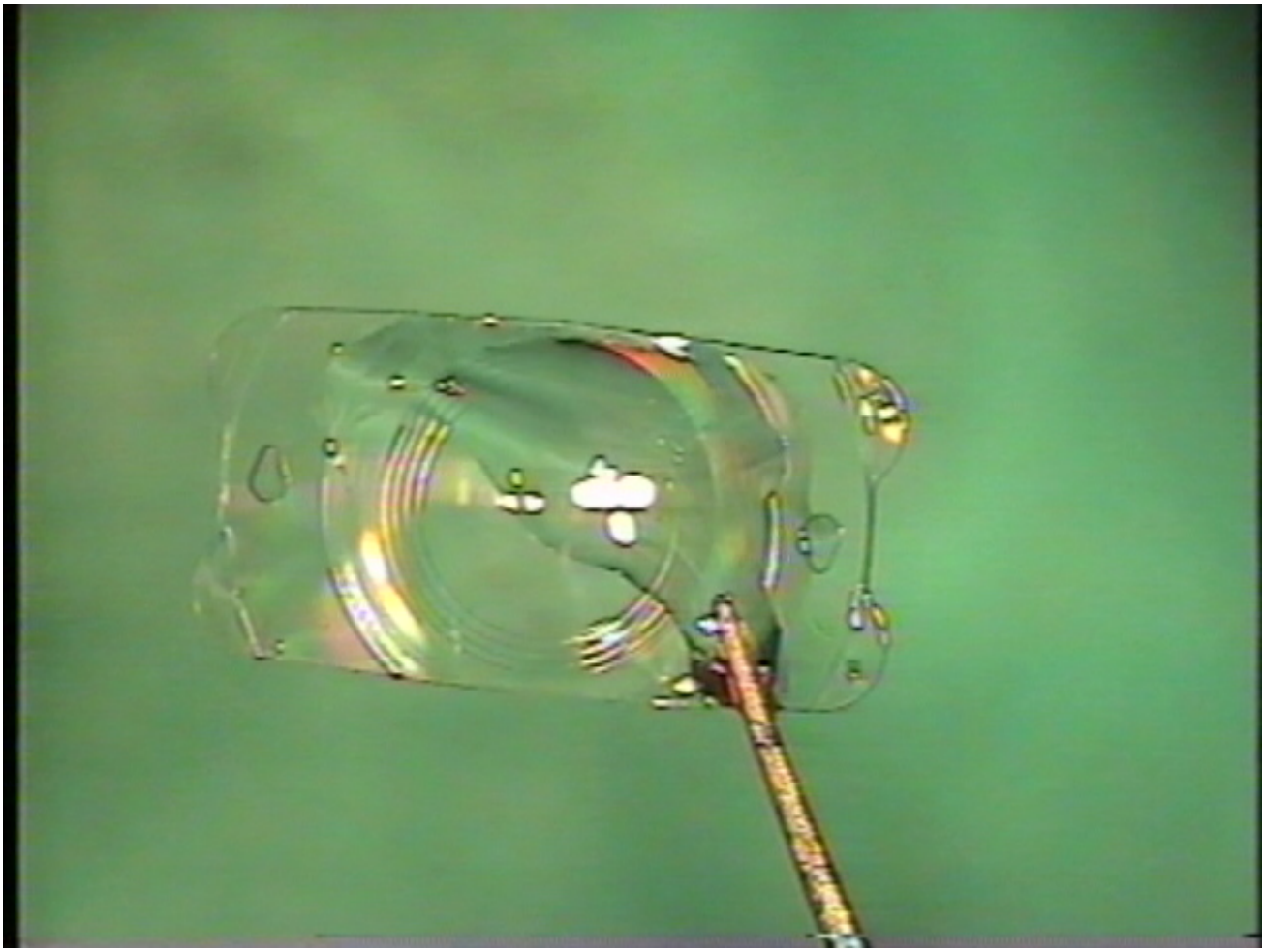


IRRIGATION N ASP. WITH THE DUET

Lens Injection is performed depending on which thin lens we choose. Today we can use the MICRIOL (IOCARE,BARODA) the THINOPTX (USA) and the ACRYSMART (ACRITEC GERMANY).The MICRIOL and THINOPTX both go through 1.8 mm

while the ACRYSMART will only enter through 2 mm. The option available in the near future is the new SMARTLENS (MEDINNIUM) which is a thermodynamic hydrophobic gel polymer rod that enters through 2 mm and swells up inside the bag to occupy it fully. This lens should restore accommodation and be amenable to YAG laser posterior capsulotomy unlike the fluid/refillable lenses being developed which will leak into the vitreous after posterior capsulotomy. Another advantage of the SMARTLENS is that as it completely refills the bag it may cause pressure necrosis of the capsular epithelium leading to decreased or no posterior capsular opacification.One disadvantage with refillable lenses is that surgeons will have to perform cataract surgery through a 2 mm rhexis which will then be sealed!

THINOPTX/MICRIOL insertion is a simple matter of loading the lens into the injector system(GEUDER, GERMANY) and injecting it into the eye.The tip of the injector never enters the paracentesis ,only the extruded tip of the lens.These 2 lenses work on the fresnel lens principle (diffraction of light)and thus can be made extremely thin.The optics of the THINOPTX (hydrophilic acrylic) in studies comes very close to that of an ideal lens The THINOPTX should not be rotated in the bag once it opens as the footplates attach and ruck the bag (footplates are soft and only 50 microns thick).If the bag rucks it leads to a Maddox rod effect for the patient.Plate haptic lenses have a well documented propensity to applanate themselves against the posterior capsule Will the ability of these thin lenses(basically plate haptic lenses) to applanate themselves to the posterior capsule prevent migration of lens epithelial cells onto the Posterior capsule?? The polymer they are made of causes a fibronectin pseudocapsule to form on the lens sticking it to the posterior capsule.Will this futher diminish the chance of posterior capsular opacification??Only time will tell!
Another advantage of an acrylic polymer is that the fibronectin pseudocapsule isolates the lens from the ocular environment thus proving useful for uveitis patients.



THINOPTIX LENS(NOTICE RAINBOW COLOURS)

The Acrysmart lens ,is loaded into its injector and through a opening of just 2 mm is smoothly injected into the eye.However in large myopic eyes the lens has a tendancy to propeller and dislodge itself anteriorly from the confines of the bag. Barring that its superb optics and streamlined construction offer a viable alternative to the THINOPTX/MICRIOL combine.

I,ve performed microphaco with one other machine the Optikon Pulsar Minimal Stress.This compact unit has a 0.9 mm Teflon(PTFE) coated tip that further diminishes the friction and thermal energy transfer to the corneal tunnel. It has a stroke ruler system that will keep the same stroke length regardless of nuclear hardness.In addition a superbly stable anterior chamber (external surge protector diaphragm) allows the safe use of vacuum as high as 300mmHg with the DUET and makes this an effective bimanual weapon ..Their slim 4 crystal titanium handpiece is much lighter and smaller than the competition as well.

Lucky for us that Charles Kelman MD has an inspiration while having his teeth ultrasonically cleaned in the dental chair.

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COAXIAL MICROPHACO FOR WHITE CATARACTS

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White cataracts have always represented a challenge to ophthalmologists.Bugbears include frequently a shallow chamber,a convex surface which predisposes to the rhexis running away to the periphery and cortical material gushing out obscuring the view as soon as you make the smallest nick in the capsule.Add to that the “now you see it now you don’t ,invisible capsule” ,a weak capsule and zonules and we begin to see how a white cataract is not the best way to start a surgical morning.
As we have a profusion of white cataracts with hard nuclei in our practice we have devised some basic guidelines to manage them.Coupled with this the video will display the new nanosleeve which goes through a 1.8 mm incision(Alcon)
Follow these steps and white cataracts will stop posing a threat!
1.Stain with trypan blue under an air bubble(Cataract surgey can be divided into AT and BT ,AT- after trypan blue was invented and BT ,before trypan ie the dark ages!)
2.Good high molecular weight viscoelastic to make the convex lens surface flat or concave.My personal favourite is healon -5 for this maneuver
3 many regrasps so as to not let the rhexis run away.Make a 6 mmrhexis at least

small aliquots of hydrodissection.Inject a lot and an already weakened Posterior capsule may give way.
4.tilt the nucleus as we have made a large rhexis and chop with the chopper underneath the lens and the phacotip on top of the lens-ie-lens salute.
5.reduce vacuum for the last 2-3 pieces as capsule is always lax in these cases.

Follow these pointers and mastery over the white cataract shall be yours

Coaxial microphaco refers to a nanosleeve ,essentially a thinner and stiffer sleeve made by Alcon for the Infiniti whereby we can use flow rates as high as 40 cc/min without surge and follow conventional phaco technique ,all this through an incision of just 1.8mm.
Bimanual Microphaco entails learning using a thick heavy irrigating chopper.Also one cannot use higher power for fear of burning the incision.After all that we still have to open the 1.2 mm incision to 1.8-2 mm.So if we can do regular coaxial phaco through 1.8 mm its basically the same incision size without the attendant hassles of bimanual surgery.

Update on-NEWER TECHNOLOGIES IN PHACO EMULSIFICATION AND CATARACT REMOVAL TECHNOLOGY

Ever since the advent of phaco emulsification ,technology has sped up and given us various alternatives.
Newer modalities for cataract removal have arrived on the scene like Vortex Phacoemulsification,Yag Lasers, subsonic oscillation in the form of Neo-SoniX and the Staar Sonic Wave ,Pulses of warmed water(AquaLase) and Ocillatory phaco(Ozil),just to enumerate a few.

In addition conventional phaco machines have evolved further to include micro or "hyper" pulse power delivery, vacuum settings can go as high as 700 mmHg and flow rates have touched 100 cc/min,all with relatively stable chambers.
The ability to micropulse has led to new terminologies like "Cold Phaco" and is responsible for the proliferation of unsleeved "Microphaco" techniques.

In this chapter ,lets examine these new developments for their effectiveness and application.

CATAREX:ENDO CAPSULAR VORTEX PHACOEMULSIFICATION

This was first displayed to ophthalmologists by Richard Kratz MD at the 1998 ASCRS meeting and evoked great interest. It has certain great advantages over normal existing phacoemulsifiers.

After a small 1 mm capsular opening, nucleus and cortex are emulsified by the probe tip in a one handed, single step procedure that obviates the need for chopping cracking and other maneuvers.
The center piece of this technology is the single use hand piece which is a 1.37 mm diamond tipped impeller probe.This tip is contained in a translucent protective sleeve and can be withdrawn or advanced .Similar to dental drills a turbine spins the impeller between 20,000 an 100,000 rpm.Inflow ,aspiration and air lines attach to the main unit on the Millennium (Bausch&Lomb) console.
The tip has 3 struts.Each strut has a vertical and a horizontal component.The horizontal component looks like a propeller and generates the vortex flow that brings the nucleus and cortex to the impeller where the vertical component essentially emulsifies it.

TECHNIQUE

A clear corneal tunnel is created after which a decentered 1 mm capsulotomy is fashioned in the anterior capsule with SW dithermy.After hydrodissection with a specially designed cannula the tip is inserted 1 mm into the bag and the device started .Inflow pressurizes the bag and the propellers generate a fluid vortex which draws the lens contents to the tip which emulsifies them.This process took 1 to 3 minutes in eye bank eyes with grade 1 to 3 cataracts.
The great advantage is that no nuclear manipulation is required and the process is quick and reproducible.Further studies are being carried out and this new technology may soon appear in our operating rooms.The ability to remove a cataract through a 1 mm opening is highly appealing as this will allow the injection of a room temperature vulcanizing polymer which will restore accommodation .Naturally with the vortex most lens epithelial cells will be stripped away so the chance of posterior capsular opacification developing is remote.

LASER TECHNOLOGY IN CATARACT REMOVAL

The idea of a single handpiece which would vapourise the lens material leading to rapid cataract removal through a microincision is not a new discovery.
The Erbium YAG laser was first researched by Peyman and Tsubota 2 decades ago.This laser produces a wavelength of 2.94 micrometer.This is an infrared laser highly absorbed by water .This is how it works.In the first micron ahead of the laser tip a cavitation bubble forms allowing the beam to traverse that bubble.In front of the first bubble another bubble forms and so forth.In the nuclear matter of the lens a succession of bubbles form due to the cavitation effect causing a shock wave to generate.This disrupts lens material forming an emulsate that can be aspirated from the eye.This laser came to market in 1997 brought by Asclepion-Meditec (Jena,Germany),and was called the MCL-29.The handpiece of this unit had irrigation and aspiration and the fiber that delivered laser energy was made of Zirconium Flouride.
Acceptance of this laser led to the development into the Phacolase system which is coupled to Geuder,s Megatron unit which has a dual peristaltic-venturi pump

The next entrant was the Paradigm medicals Photon laser PhacoLysis system.This uses an Nd:Yag 1064 nM laser to provide a photo-acoustic ablation of cataract material under aspiration.The tip design is such that aspirated nuclear fragments are trapped in the tip and the laser fiber is aimed at this so called “photon” trap.This laser is coupled to the Mentor SIStem peristaltic I&A unit.

The next unit on the scene was the Dodick Photolysis Q-Switched Nd:Yag Laser system(ARC Corporation) introduced in 2000.
This unit has the following features.
Q switched Nd:Yag laser shots are focused on a titanium plate.This results in shock waves generating that can emulsify the nucleus. Laser and aspiration are on the same probe which is inserted through a 1.4 mm clear corneal tunnel.In the other hand an irrigation cannula enters the eye through 0.9 mm.The laser shots impact on a titanium target resulting in shock waves at 200 to 400 nanoseconds intervals.
The machine uses a venturi pump and has a regular phaco-ultrasound handpiece for cataracts which are too dense for the laser.The laser method works to about grade 2 cataracts beyond which the regular handpiece is much quicker.The obvious.advantage here is that we can easily perform bimanual cataract surgery as there is no heat generation by the unsleeved laser-aspiration probe.

NEO-SONIX TECHNOLOGY

Since the dawn of Phacoemulsification its known that ultrasound has certain undesirable effects on ocular tissue.Endothelial cell loss continues to occur for some time after the surgery as demonstrated in long term studies.Our effort today is to reduce to the minimum the amount of ultrasound energy used in the anterior chamber to a minimum.
In 2001 Alcon Surgical (Texas) incorporated its Advantec NeoSoniX technology into the Legacy 20000 series phacoemulsifier.
NeoSoniX is a hardware upgrade consisting of a handpiece which incorporates a motor .This produces a 100Hz oscillation of the tip from side to side of upto 2 degrees from neutral. This oscillation is programmable for power level in foot position 3, starting time, and percentage of 2 degrees of oscillation.This has the effect of continuously repositioning the nuclear matter at the tip thereby allowing the surgeon to use less ultrasound power for a comparable grade of cataract.When the motor in the handpiece is on a distinct vibration is felt as the tip rotates from side to side.Its possible to remove grade 1-2 cataracts using zero ultrasound power and Neosonix alone to embed the tip for chopping techniques.This side to side oscillation effectively repositions nuclear material at the tip.Its greatest use in my opinion is in grade 4 and 5 hard brown or black cataracts where it reduces by nearly 30-40% the amount of phaco power needed to emulsify the nucleus. In Dr. Fine’s studies comparing the Legacy with and without NeoSonix, effective phaco time with NeoSonix dropped from 11.5 seconds to 1.5 seconds, and average power dropped from 15 percent to 6.5 percent. The percentage of clear corneas

rose from 90 percent to 98 percent, and the percentage of patients with postoperative uncorrected vision of 20/40 or better (at two to 24 hours postop) rose from 70 percent to 96 percent

AQUALASE

Aqualase is a new technology from Alcon .It has been incorporated into its Infiniti platform as a separate handpiece.

How does this work?

The handpiece has electrodes in its body.When the salt containing BSS is in the handpiece and a current is applied to it, this warmed fluid pulses at the volume of 4 microliters per pulse, propelled upto 50 times a second (50pps)

This impact of warmed pulses rapidly strains the cataract causing liquefaction

There is no high frequency mechanical motion of the tip and thus no heat generation at the incision. Magnitude of aqualase can be increased ie pulse length increases from 3 microsecond to 9 microseconds.

This aqualase handpiece has both irrigation and aspiration and a smooth disposable silicone tip.Basically the cataract is emulsified using a sculpting technique .Stop and chop is difficult with this handpiece until a large part of the cataract has been emulsified by sculpting as the tip does not embed.A great advantage of this tip is that its absolutely atraumatic and even cortical cleanup can be done with it. This shows us that its not the shape of the phacotip or the fact that its port size is large that leads to capsular breakage on occlusion,rather that the edge should be smooth and pliable.

This lends itself well to Refractive lens exchange and to paediatric cataracts.The only problem with this technology is that cataracts harder than grade 2 need an inordinate amount of time and are faster managed with conventional pulsed ultrasound

OZIL

Another new technology from Alcon is the Ozil upgrade to the Infiniti platform .

OZiL™ is Alcons brand name for a torsional phaco handpiece.

How does this work-

- Oscillatory torsional amplitude creates lateral tip movement that cuts more efficiently due to less repulsion, and results in decreased thermal energy at the incision. Thus torsional phaco cuts the lens by shearing as against regular phaco which employs a jackhammer effect
- When a conventional phaco tip encounters a nuclear fragment part of the forward stroke of the tip actually pushes the fragment away until vacuum pulls the fragment back to the tip.This decreases cutting efficacy.The harder the cataract the greater the repulsion.This is totally avoided in OZIL as here there is no forward repulsion and thus greater followabilty.

- This torsional occilaion with a Kelman tip generates the same stroke at the tip end as phaco but in transverse direction

- Oscillations of the OZIL handpiece are 32 kHz (32,000 times per second)

This is much faster than 100 Hz for NeoSoniX, so oscillations alone have enough energy to cut.Its however lower than the 40 kHz of regular phaco which results in a 20% energy saving and much less heat generation at the incision.
Overall there is about 2/3 less heat at wound site according to studies.

The company maintains that torsional is most efficient when applied continuously – pauses will slow down removal and may induce clogging on the 4+ lenses.However in my experience it works great in pulse mode and corneas are much clearer the next day than if continuous power is used.

In contrast as it has repulsion ,regular phaco is best in pulse or burst mode to minimize repulsion by using high vacuum.

SONIC PHACO WITH THE STAAR SONIC WAVE.

Staar has produced a machine called the sonic Wave that on the same handpiece can give both sonic and ultrasound. The Sonic WAVE™ blends low frequency pulses (40-400 Hz) with new ultra vacuum technology to produce a cataract removal system which is more efficient than ultrasound.
The company claims that there are no thermal burns as sonic vibrations produce no heat .Indeed at 100% sonic power you can hold the bare tip in your fingers without feeling any heat.In similar circumstances a ultrasound tip woud rapidly cross 100 degrees centigrade.
A special feature of the Staar machine is its coiled ***supervac*** tubing.This tubing is attached in the aspiration line and greatly decrease or eliminates surge on occlusion break.It generates turbulence in the line and forces the aspirated fluid to slow down on occlusion break.Its the sudden speeding up of the fluid in the aspiration line on occlusion break that's responsible for surge The SuperVac tubing increases vacuum capability up to 650 mm Hg (Figure). The key to chamber maintenance is a positive fluid balance between infusion flow and aspiration flow. When occlusion is broken, vacuum previously built in the aspiration line generates a high aspiration flow that can be higher than the infusion flow. This results in anterior chamber instability. The coiled SuperVac tubing limits surge flow resulting from occlusion breakage in a dynamic way. The continuous change in direction of flow through the coiled tubing increases resistance through the tubing at high flow rates such as on clearance of occlusion of the tip. This effect of generating turbulence only takes place at higher flow rates (more than 50 cc/min). The fluid resistance of the SuperVac tubing increases as a function of flow, and most importantly unoccluded flow is not restricted. Results: Comparing the sonic to the ultrasonic machine, using the same parameters, Dr. Fine found an increased effective phaco time, as expected. The power was approximately the same at around 7.5 percent phaco power. The percentage of clear corneas was exactly the same at 96 percent, and the patients' uncorrected visual acuity 20/40 or better remained the same at 79 percent.

"It still is a spectacular system," Dr Fine said. With the foot pedal, one can move back

and forth between ultrasound and sonic energy, thus covering all grades of cataract. "With harder grades, the tip tends to become occluded, so we kick over to ultrasound for a second, clear the tip and then move back into the sonic mode," he said.

The Staar Wave also has a unique tightly coiled aspiration vacuum tubing. The continuously changing direction of fluid leaving the eye is associated with a dramatic increase in the resistance of flow at high flow rates. "This is fabulous for chamber stability and as an antisurge device," Dr. Fine said.

PULSATOME (VISIJET INC. AND PONTE NOSSA ACQUISITION CORP.)

This new device uses a lower pressure, pulsed waterjet for the fragmentation, irrigation, hydrodissection and aspiration of cataracts. The Pulsatome hand piece goes through a 2.9-mm incision, and it uses short pulses of 20 mL of BSS under a pressure of 1,000 psi to break the nucleus into smaller fragments that are aspirated through the aspiration port on the hand piece.

The advantages of this system are its potentially high safety profile, no wound heat and easy learning curve, noted Richard L. Lindstrom, MD. However, it is likely good only for soft cataracts and may be slower than ultrasound, he said, but the technology is still in the lab.

HYPERPULSE MICROBURST AND WHITESTAR ICE TECHNOLOGY

This is a proprietary technology of AMO on its flagship Soverign phaco machine. Designed to reduce heat build up at the phacotip and minimize the US power needed thus enhancing purchase on the fragment the Soverign pioneered this technology 5 years ago. These pulses of ultrasound energy are as short as 1/100 of a millisecond.This is shorter than the thermal relaxation time of the tissue,thus there is no heat build up.
This basically means that we can have hyperpulses of even 5 millisec with a offtime of 995 millisec at every pulse cycle.AMO was the first to launch this technology in the Soverign with its ICE upgrade.Now however the capability to simply generate hyperpulses can be found in much cheaper machines and basic models as well.Another feature of the Soverign is that once the tip is embedded the vacuum can be lowered automatically to a previously preset value thus reducing surge on occlusion break.This is a worthwhile feature and is termed CASE(Chamber Stabilisation Enviroment) by the company.
To take it one step further the ICE upgrade added to this the concept of shaped pulses .This means that in the first millisecond of the pulse the power automatically steps up and

then decreases for he rest of the pulse.This reduces cavitation and increases followability of the fragment which the company refers to as magnetic followability.

IN CONCLUSION

Endocapsular phaco technology will combine well with refillable lenses.Hyper and customized pulses will further reduce ultrasound expended in the anterior chamber.Alternative modalities like aqualase and neosonix will continue to apper.The further development of laser technology will indeed allow true cold bimanual phaco as a procedure of choice.

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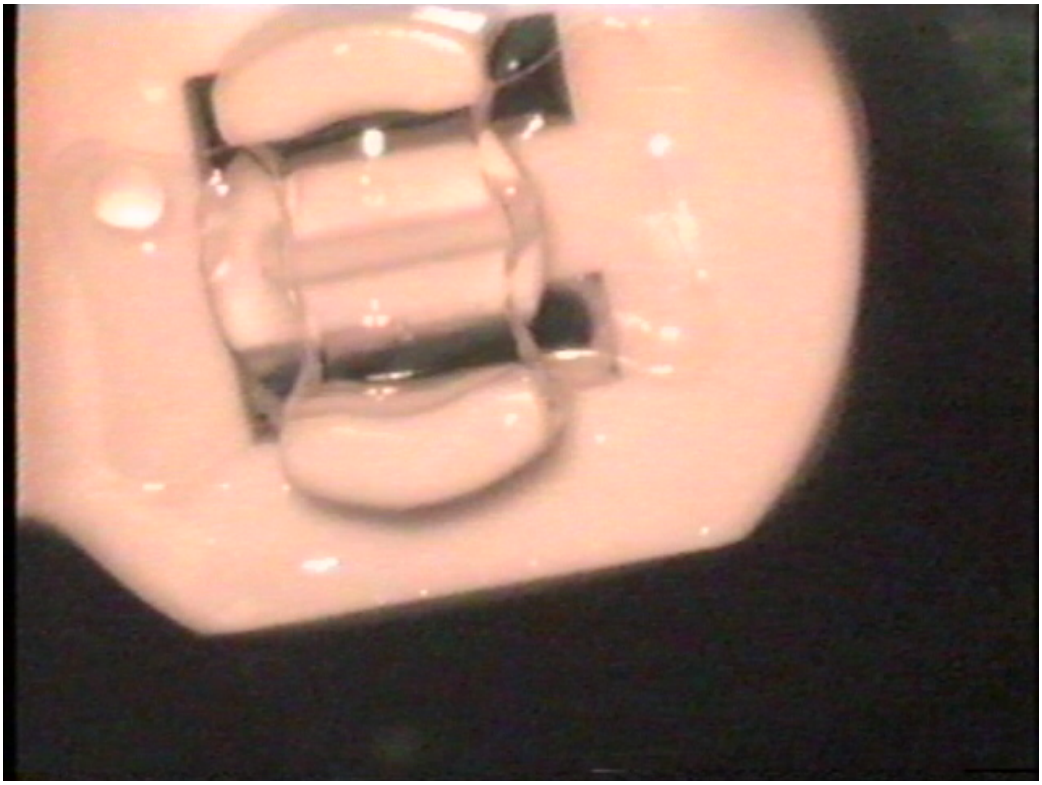
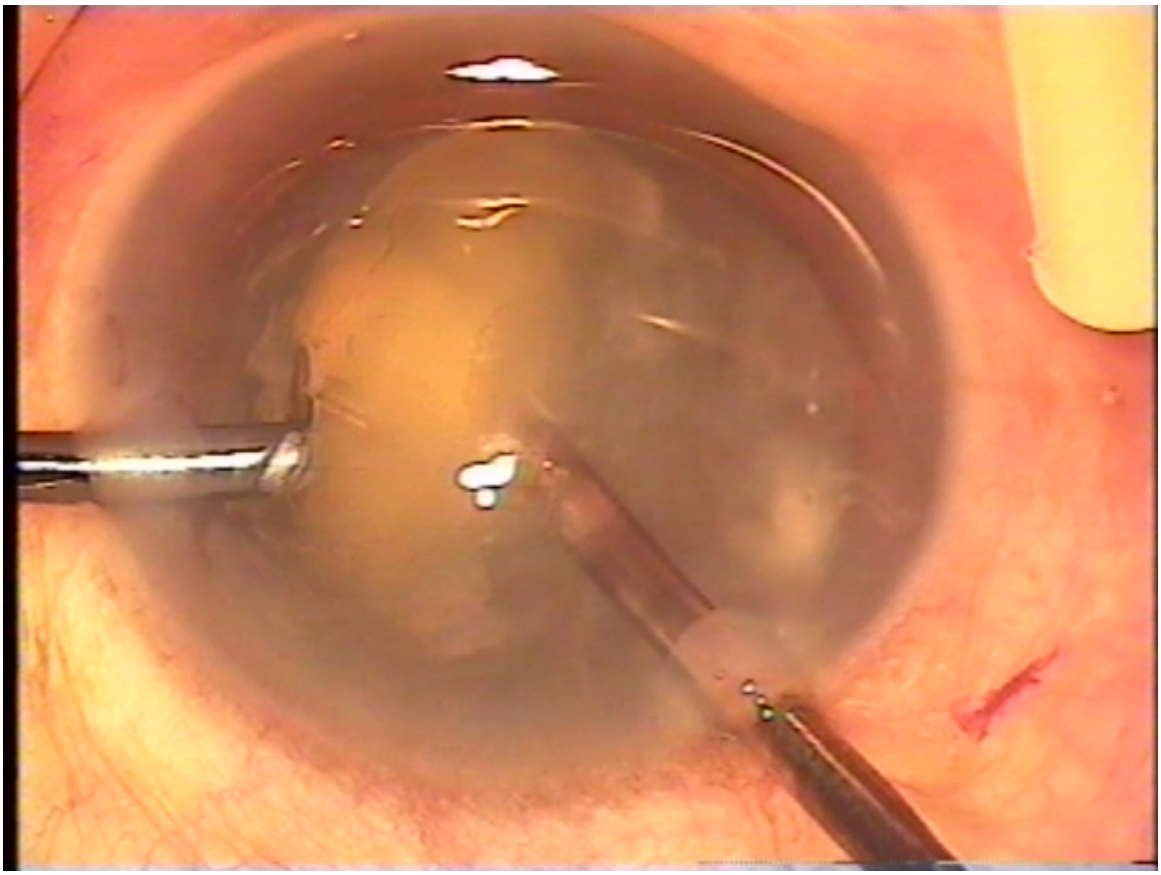
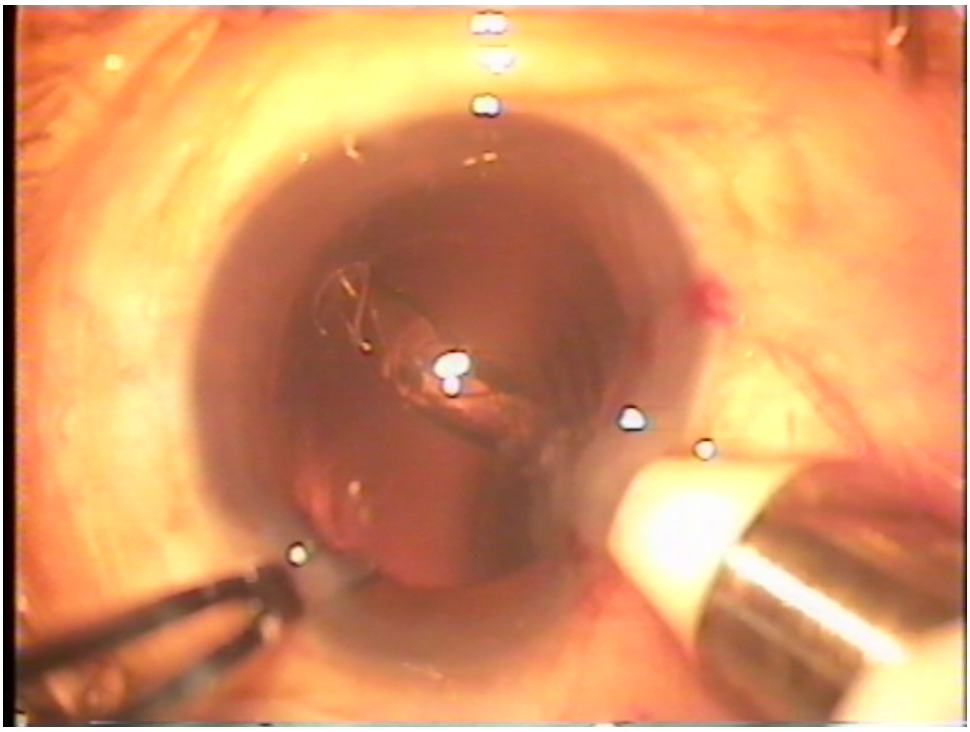
ACRYSHOOTER



ACRYSMART LENS



LENS SALUTE MICROPHAKO WITH THE DUET 1



THINOPTX LENS INSERTION 1