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ACTAS DEL SECUNDUM FORUM OPHTHALMOLOGICUM

	Página
OLGA FERRER, M. D. CATARACT SURGERY IN HIGH MYOPIA .....	203
HERBERT M. KÄTZIN, M. D. THE LIQUID SCAPEL .....	209
LOUIS J. GIRARD, M. D. CATARACT EXTRACTION BY ULTRASONIC ASPIRATION .....	215
ERIC J. ARNOTT, F. R. C. S. COMPARISON OF CONVENTIONAL INTRACAPSULAR EXTRACTION AND PHACO-EMULSIFICATION FOR REMOVAL OF THE CATA- RACTOUS LENS .....	233
JACQUES CHARLEUX, M. D. L'INCISION CORNEENNE COURTE PUREMENT CORNEENNE ET A BISEAU INVERSE DANS L'OPERATION DE LA CATARACTE .....	239
NORMAN S. JAFFE, M. D. THE PATHOPHYSIOLOGY OF CORNEAL ASTIGMATISM AFTER CATARACT SURGERY .....	245

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ACTAS DEL SECUNDUM FORUM  
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“CATARACT SURGERY IN HIGH MYOPIA”

By  
OLGA FERRER, M. D.  
Miami, U. S. A.

This presentation will deal with aphakia in a very special group of patients: Those with high myopia.

We categorize myopia into, low myopia under -5D. medium degree from -5 to -9D and high above -9D. It is this last group the one with which we are concerned.

Of 25 cases selected at random 10 eyes had high myopia and 15 lower degree.

Slide 1

*Degree of Myopia in 25 cases*

<i>INTENSITY</i>	<i>Nº of Eyes</i>
-10.00D or more .....	10
-5.00D to -9.00D	13
-5.00D or less	27

The incidence of high myopia is low when compared to the other groups as is also percentage wise its casuistic of surgery.

The visual acuity appears to decrease as the myopia increases.

OLGA FERRER

Slide 2

<i>Visual Acuity</i>	<i>Degree of Myopia</i>	
46 eyes	-5.00&-D	-6.00&+D
20/20-20/30 .....	23	2
20/40-20/50 .....	4	3
20/60-20/80 .....		4
20/200-20/400 .....		3
FC-HM .....		7

The reduction in vision runs parallel to the degenerative complications, aside of surgery.

Slide 3

*Complications in 25 Myopes*

Amblyopia .....	5
Motility An .....	13
Glaucoma .....	5
Cataract .....	10
Retina & Choroid .....	6
Disc. ....	2
Maculopathy .....	5

On electing for surgery, one of our first concerns should be the evaluation of the macular function. As Edward Maumenee warned us day before yesterday, you may create trouble for yourself if the patient expects the impossible from your surgery. Hence it was said go slow on your decision for surgery when in doubt of macular function.

In the cataract of high myopia, however, we must weigh the fact that retino-choroidal-macular complications progress and increase in incidence with time. Hence we must rephrase the conclusions as to the best time for surgery, when applied to this group of patients.

**OLGA FERRER**

Intravenous Manitol 12 gr slowly injected produces the retraction of the liquid vitreous, leaving a deep concave face. After the first two cases we discontinued the use of Flieringa ring. The incision is made, 160°; cornea scleral 8.0 and now 10.0 nylon sutures are used: three preplaced and five post extraction, the results in 10 cases, thirteen eyes varied from:

Slide 7

<i>Name</i>	<i>Age</i>	<i>Myopia</i>	<i>Vision</i>	<i>Co.</i>	<i>Rx</i>
D.M.	63	-19.00	OS 20.150		OS - 7.00
A.G.	50	-20.00	OD 20/40		OD - 1.50 OS - 3.00
L.P.	54	- 8.00	OD 20/25		OD - 1.00
M.C.	66	-10.00	OD 20/25		OD + 7.00
M.E.	27	-24.00	OS 20/400	G	OS - 7.00
J.A.	69	-11.00	OS 20/200	G	OS + 6.00
J.A.	78	-21.00	OD HM	G	OD - 4.00
L.R.	81	-11.00	OD FC	G	OD - 1.00
M.G.	50	-15.00	OS 20/25	G	OS +12.00
J.S.	73	-10.00	OD 20/70	M	OD + 13.00 OS +11.50

Vision	20/25	4
	20/40 .....	2
	20/70 .....	2
	20/100—20/200 .....	2
	20/400 .....	1
	FC	1
	HM .....	1
		13 eyes

**OLGA FERRER**

She bears in mind that the decrease of visual acuity in them is due mainly to the degenerative complications inherent to myopia, and that the complications will continue progressing with time.

In the surgical technique used she emphasizes the uses of Neurolepto-analgesia and of Manitol instead of the Flieringa ring.

**RESULTS**

Vision 20/25 .....	4
20/40 .....	2
20/70 .....	2
20/100—20/200 ...	2
20/400 .....	1
FC .....	1
HM .....	1

She ends by recommending the extraction of the cataract as soon as the opacity of the lens produces a decrease of AV 20/100 and making post-operative controls of the macular function with angiofluoresceinographies.



## THE LIQUID SCAPEL

**HERBERT M. KATZIN, M. D.**

New York, U. S. A.

*NARRATOR:*

This is the Liquid Scalpel, part of the hydro-pulse surgical support system.

A hard cataract is being broken up by pulses of saline solution issuing from the tip.

The Liquid Scalpel does not injure soft tissues.

It is being used by Doctor Herbert Katzin at Manhattan Eye, Ear and Throat Hospital.

*DR. KATZIN:*

"In the eye you have to be concerned about the iris, you have to be concerned about the posterior capsule of the lens, and you have to be concerned about the posterior surface of the cornea. So you want an instrument which is not going to do damage. This is point number one.

"The liquid pulser will hit a hard lens and emulsify a hard lens, whereas hitting a soft piece of material that yields will have no effect."

*NARRATOR:*

The source of power for surgery is contained in a hydraulic pulser, which may be autoclaved and re-installed. The tip ejects pulses of saline solution in minute volume.

Total safety is the key to this device.

*DR. KATZIN:*

"It is a powerful instrument that is most powerful in the most difficult situations, and completely harmless in the situation of not injuring the tissues you want to save."

HERBERT M. KATZIN

*NARRATOR:*

After the lens is broken up, the single pulser tip is replaced with the irrigator-evacuator.

It injects a flow of saline solution, and at the same time evacuates lens material.

Should the surgeon require all three functions of pulsing, irrigating and evacuating at the same time, a threeway tip can be used.

Every task is performed under conditions of exact electronic control.

*DR. KATZIN:*

"Now all this is monitored through a transducer which is right on the board and which is connected directly to the inflow and outflow tubes. More than that, it is made of a unique plastic that can be autoclaved.

So you take the transducer of the board and take the tubes out of the transducer, autoclave them and you are ready for the next case, in a three-minute cycle, or whatever your autoclave handles."

*NARRATOR:*

The transducer guarantees constant safe balance of pressure within the eye.

It prevents the power of evacuation from building up to a point where sudden evacuation might induce collapse.

If anything occludes the tip, an indicator rises. At a set level, a warning signal sounds. The irrigation stops, the pump reverses into kick-back, to blow off the occlusion.

The tip is freed. The indicator drops. The pump resumes suction.

The hydro-pulse instrument combines many functions, under carefully programmed safety conditions.

It was designed by engineer Mark Wallach for Doctor Katzin, with the aim of giving surgeons exactly the tools they need for the problems they meet.

It can be used, without elaborate training or preparation, under normal conditions of surgery.

#### THE LIQUID SCAPEL

The initial steps are exactly those taken in a conventional operation.

But as surgery proceeds, differences begin to emerge. For example, the incision is small-three millimeters through the limbus.

The small incision is part of a total hydro-pulse concept which works to keep the eye stable during surgery.

The capsule has been opened. It is time for the first phase of the hydro-pulse operation.

The pulser tip is mounted and tested. The pulse discharge volume is in the order of two one-thousandths of a cubic centimeter.

The surgeon tests it, to judge the most desirable volume, force and frequency for the case before him.

He calls for the combination he wants. Now he is ready to break up the lens. The patient is a 45-year-old man who developed a mature cataract quickly following the onset of diabetes.

A mild force and rhythm of pulsing is pre-set, since the lens is of a type that will yield easily to the minute saline pulse.

When the lens has been broken up, it is time to change tips.

Now the irrigator-evacuator is mounted on the same system.

The change takes only a few seconds. First, irrigation begins, to maintain the anterior chamber.

Then the surgeon calls for evacuation. He continually directs the balance of saline pressure within the eye.

Always, he works with the assurance that any occlusion will be detected by the system, and the suction pump automatically reversed in one one-hundredth of a second.

When the operation approaches the end stage, the levels of irrigation and evacuation are lowered.

The pupil is becoming black.

What is left is the job of tidying up. The hydro-pulse system has been preprogrammed to give the surgeon complete control of operating conditions. It frees any surgeon to concentrate on the pathology before him.

HERBERT M. KATZIN

*DR. KATZIN:*

"We have had the instrument now for about three years in operation at the hospital, and I would say that maybe one-third of the cases were done by untrained residents. I shouldn't say 'untrained', I should say that residents who have done routine surgery but who haven't used this machine at all. Say a surgeon has done ten to fifteen cataract operations in a routine manner and is accustomed to having the responsibility of the operating room and so on.

The safety features are built in nicely, so that we don't have to be concerned that he is going to do injury to anything. More than that, it does some of his thinking for him."

*NARRATOR:*

The hydro-pulse is a multi-purpose surgical system. In addition to the liquid scalpel and the irrigator-evacuator, it also includes a closed hydraulic power drive called a 'hydro-cut'. This unique accessory can be used to oscillate the Macheimer tip or other cutting devices.

The patient is an eleven-year-old boy who suffered an eye injury. This produced an extremely tough and thick fibrous secondary membrane.

At this point, the hydro-cutter is used to sever a central piece of membrane from the rest. It is difficult to reach by other means.

*DR. KATZIN:*

"Already in our hospital it has taken over the function, for example, of doing most secondary membranes: after a cataract operation, we simply make an opening in it, nibble it away with the Macheimer tip, and we end up with nice results. We've really hit some beauties."

*NARRATOR:*

Once the secondary membrane has been cut free, it can be removed. The edges are trimmed. The remaining cortex of the cataract, which was behind the membrane, is cleared.

The result, an acceptably-shaped, black pupil, with scar tissue serving as part of the iris diaphragm.

## THE LIQUID SCAPEL

*DR. KATZIN:*

"Most of these eyes don't look operated the day after they come from the operating room. Actually, with all the safety features built into the machine, we are in a position now really fully to explore all the parameters of the Liquid Scalpel."

### SUMMARY

The author presents a new instrument of his design, whose working principle is the emission of saline pulsations, whose frequency, pressure, and volume/minute may be controlled. He describes the instrument as used in the technique of fragmentation and aspiration of hard nucleous lenses, recommending it for its absence of harmful effects to the eye.

The mentioned instrument is part of a "Hydraulic Pulsating System" (Multi-purpose), to which different heads may be coupled:

1. Liquid Scalpel.
2. Irrigator-evacuator.
3. Hydro-Cut.

The equipment may be sterilized completely and is easy to manage.

The author has been using it for 3 years.

C. B.

## CATARACT EXTRACTION BY ULTRASONIC ASPIRATION

By  
**LOUIS J. GIRARD, M. D.**  
Houston, U. S. A.

In 1966 a technique was described for the aspiration-irrigation of congenital and soft cataracts (1). The technique essentially involved the introduction of two 23 gauge needles into the anterior chamber, each being connected by a plastic tubing to a 50 cc syringe. One of the syringes, filled with balanced salt solution, is used by an assistant to keep the anterior chamber formed while a second syringe is used for aspiration. The technique has been used successfully since that time without any serious complications. The advantages of this technique are: 1) The procedure can be performed entirely at one sitting. 2) The anterior chamber remains formed during the entire procedure, thus reducing the danger of damage to the endothelium and to the posterior capsule of the lens. 3) Should the pupil contract during the procedure it can be re-dilated by adding epinephrine to the irrigating solution. 4) The incisions are so small that no sutures are required. 5) The postoperative convalescence is very short and the patient can use a contact lens within a week or two following surgery.

The technique is applicable for any case of soft cataract: congenital, traumatic, or senile, and has been utilized successfully in patients up to 72 years of age. When the nucleus is hard, however, it is not possible to fragment the nuclear material for aspiration through a 23 gauge needle. The technique of Kelman (2, 3, 4, 5) of using ultrasound to break-up (emulsify) the nucleus so that it might be aspirated was the inspiration for extending the age range to which aspiration-irrigation could be applied. By applying ultrasound to the aspirating needle it is possible to fragment

\* From the Institute of Ophthalmology, Texas Medical Center and the Center Pavilion Hospital, Houston, Texas.

LOUIS J. GIRARD

the nucleus in hard, senile cataracts so that the material may be aspirated through a 23 gauge cannula. To accomplish ultrasonic vibration of the needle, a simple solid state ultrasound unit is used\*.

The author prefers the term fragmentation to described ultrasonic breaking up of the lens nucleus. Kelman has termed the process "emulsification", which by definition is a mixture of oil and water. Ultrasound can produce fragmentation either through cavitation, much like lighting in the air, or by direct physical vibration.

*Cataract Extraction by Ultrasonic Aspiration.*- The technique can be performed either by local or general anesthesia. Maximum dilation of the pupil is desired. A beveled incision is made with a Girard knife\*\* in the superior nasal or temporal quadrant 1 mm inside the limbus (Fig. 1). The knife is dipped in fluorescein so that the tract is easily visualized. The 23 gauge irrigating needle is inserted in this opening (Fig. 2). The needle is

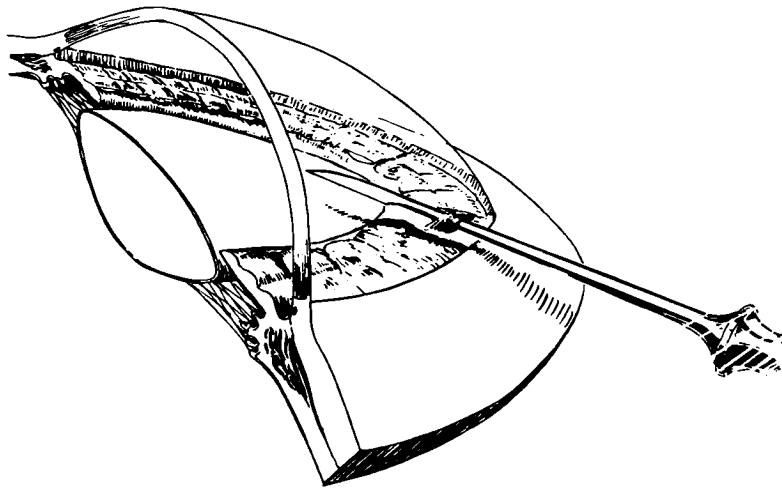


FIGURE 1

*A beveled paracentesis is made with a Girard knife in the superior quadrant, temporal or nasal, 1 mm inside the limbus.*

\* Cataract Fragmentor, Manufactured by Sparta Instrument Corporation, Fairfield, New Jersey.

\*\* Manufactured by Storz Instrument Company, New York.

## CATARACT EXTRACTION BY ULTRASONIC ASPIRATION

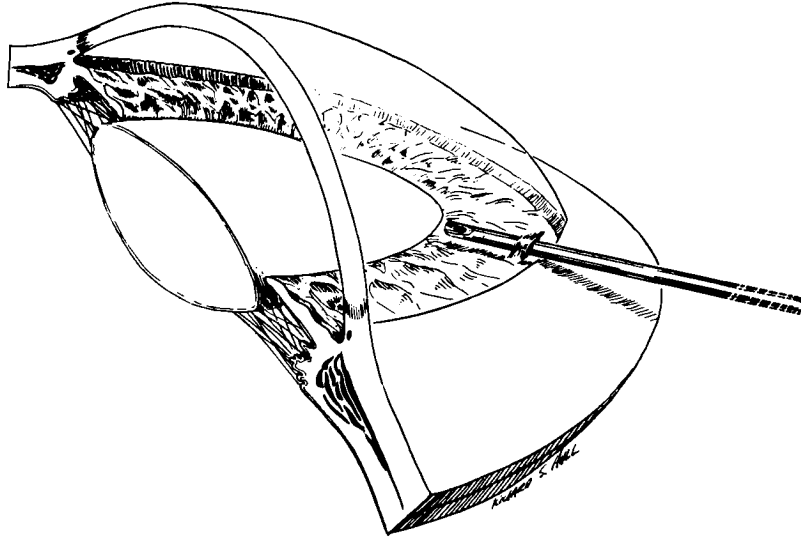


FIGURE 2

A 23 gauge needle connected by a plastic tubing to a 50 cc syringe containing balanced salt solution is used to keep the anterior chamber formed.

connected by a plastic tube to a 50 cc syringe filled with balanced salt solution\*. A second incision is made in the opposite superior quadrant. The knife needle is used to make a large 360 capsulotomy (Fig. 3), while the depth of the anterior chamber is kept formed with the irrigating cannula. The knife is replaced with a special 23 gauge aspirating needle connected by a plastic tube to an empty 50 cc syringe (Fig. 4). This needle is attached to an ultrasonic vibrating handle (Figs. 5 and 6)\*\*. The lens material is then aspirated while the anterior chamber is kept formed with irrigation (Fig. 7). The anterior lens capsule and the cortical material are easily aspirated *without* ultrasonic vibration. When a hard nucleus is present it is prolapsed into the anterior chamber either using the aspirating needle or withdrawing the needle and using a spatula (Fig. 8). The hard nucleus is broken-up by first bringing the aspiration needle in contact with the nucleus, aspirating the material against the needle and then using short

\* Manufactured by Alcon Laboratories, Fort Worth, Texas.

\*\* Manufactured by Sparta Instrument Company, Fairfield, New Jersey.



LOUIS J. GIRARD

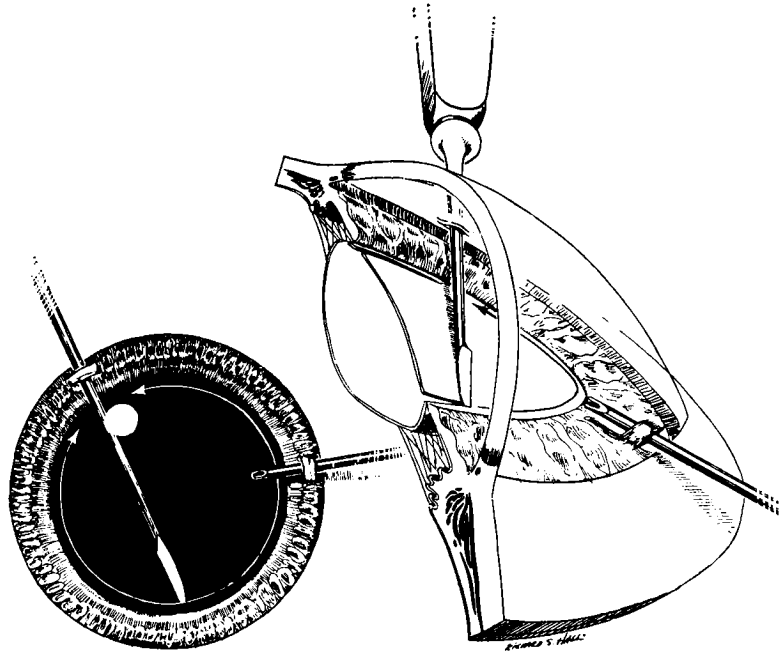


FIGURE 3

*A large 360° capsulotomy is made.*

applications of ultrasonic vibration to fragment the nucleus (Fig. 9). Aspiration of the material is then possible. The nucleus should not be pushed against the endothelium of the cornea or against the posterior capsule. It can be pushed against the iris or the irrigating cannula while pressure is applied to the nucleus with the aspirating needle.

The operating room microscope is essential to this technique. The author has designed an arrangement for a surgeon's scope and two assis-

CATARACT EXTRACTION BY ULTRASONIC ASPIRATION

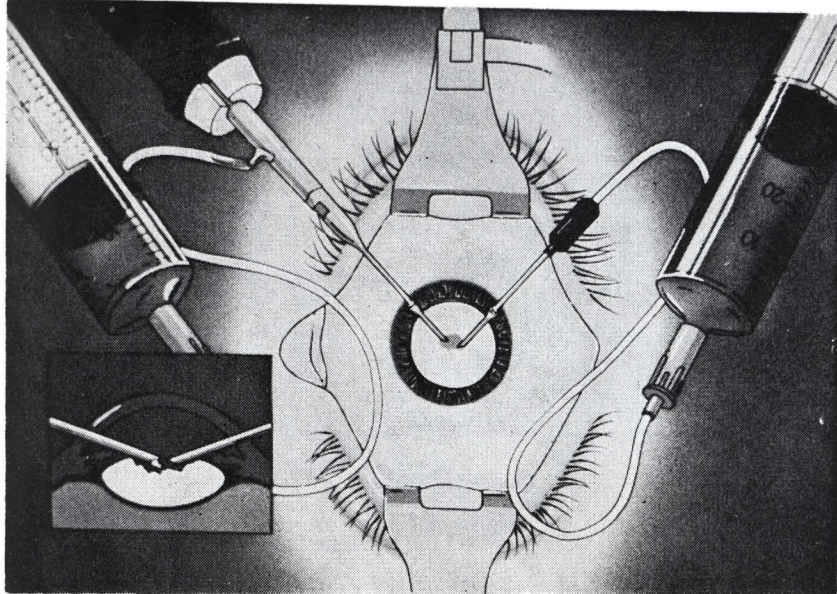


FIGURE 4

*Aspirating and irrigating cannulas are inserted into the anterior chamber.*

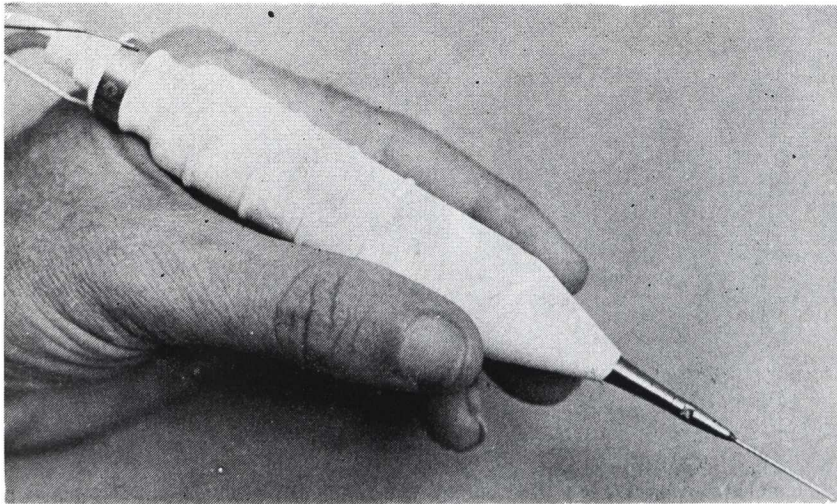


FIGURE 5

*The aspirating needle is attached to an ultrasonic vibrating handle.*

LOUIS J. GIRARD

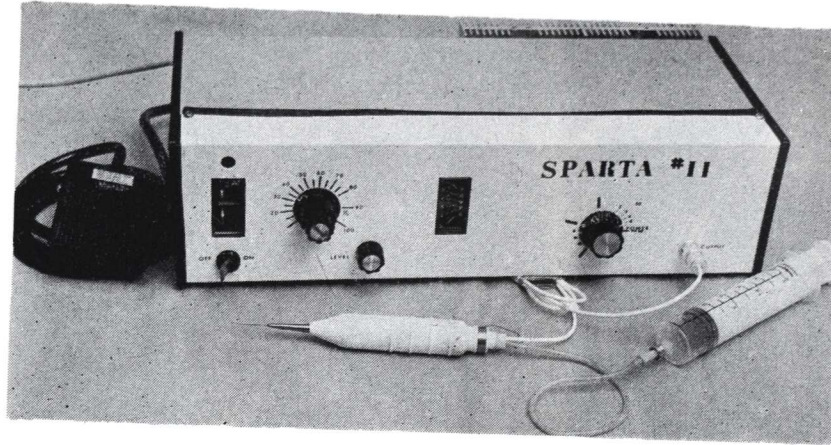


FIGURE 6

*Ultrasonic vibration is accomplished by a simple solid state ultrasonic unit. The unit and other instruments needed are show.*

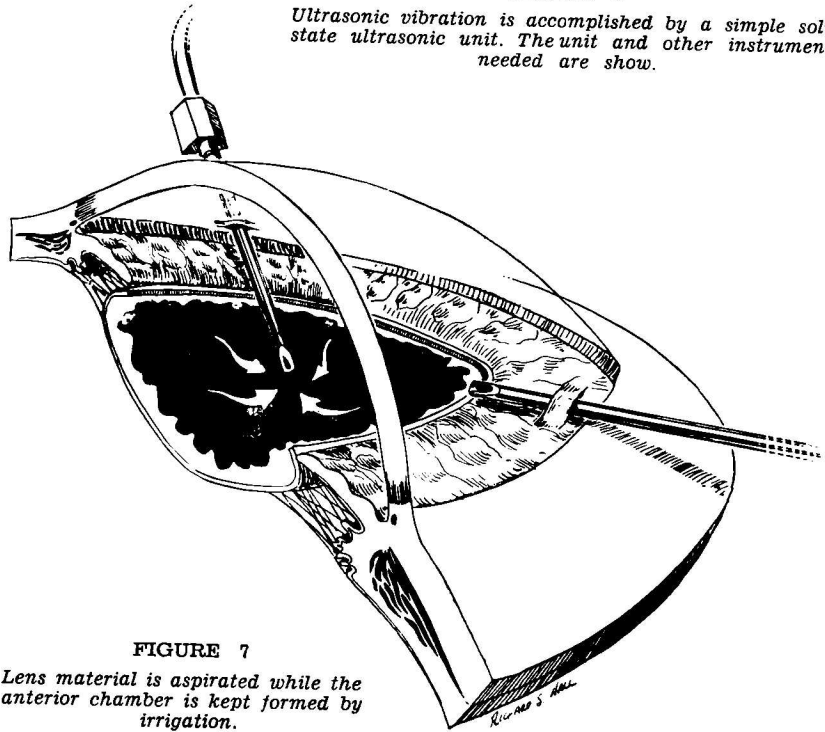


FIGURE 7

*Lens material is aspirated while the anterior chamber is kept formed by irrigation.*



CATARACT EXTRACTION BY ULTRASONIC ASPIRATION

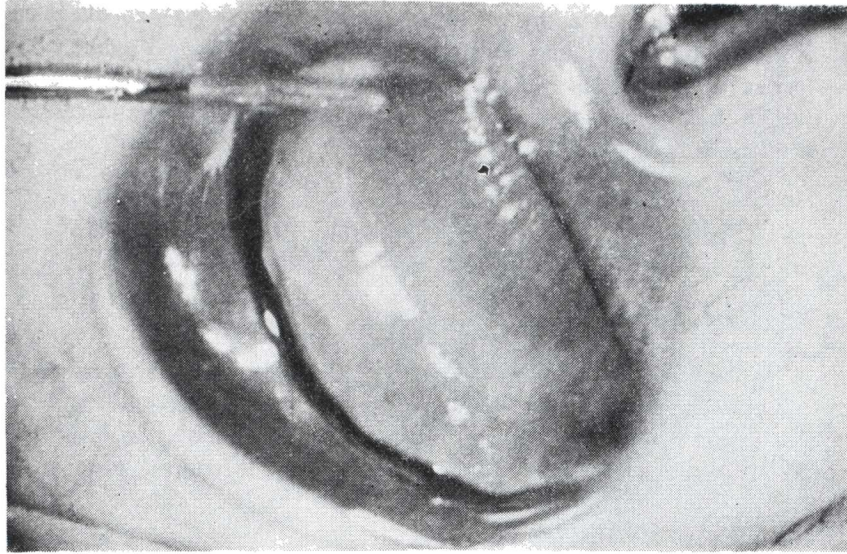


FIGURE 8

*Hard nucleus is prolapsed into the anterior chamber.*

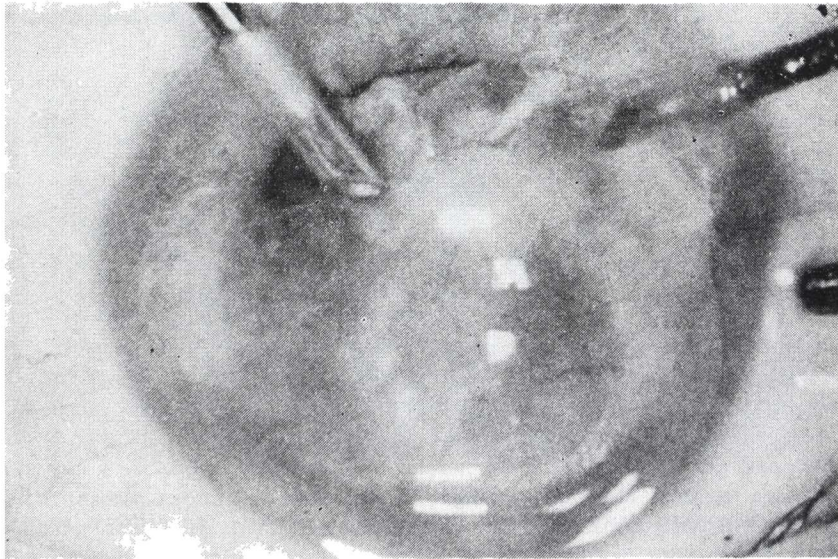


FIGURE 9

*Ultrasonic fragmentation and aspiration of a hard nucleus.*

LOUIS J. GIRARD

tant's scopes (Figs. 10 a, b) \*\*\*. The surgeon's microscope should have co-axial illumination so that the procedure can be performed against the red reflex of the fundus. Co-axial illumination is particularly important in viewing the clarity of the posterior capsule after the nuclear and cortical material have been aspirated.

After the nucleus has been fragmented and aspirated the pupil usually requires re-dilation. This can be performed by the instillation of epinephrine 1: 1000.

Residual cortex under the iris is carefully aspirated.

If a posterior subcapsular opacity is present, this can be removed in the following manner (Fig. 11). The edge of the opacity is elevated with a spatula. Using a 23 gauge aspirating needle, the edge of the opacity is drawn against the aspirating cannula, rolled-up and stripped away from

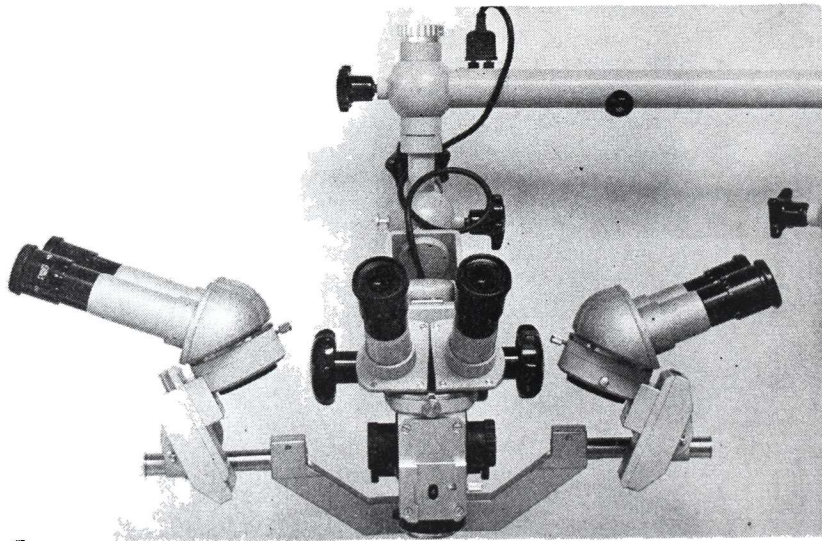


FIGURE 10

*a, b, A microscope cluster consisting of surgeon's scope and two assistant scopes*

\*\*\* Manufactured by Storz Instrument Company, New York, New York.



## CATARACT EXTRACTION BY ULTRASONIC ASPIRATION

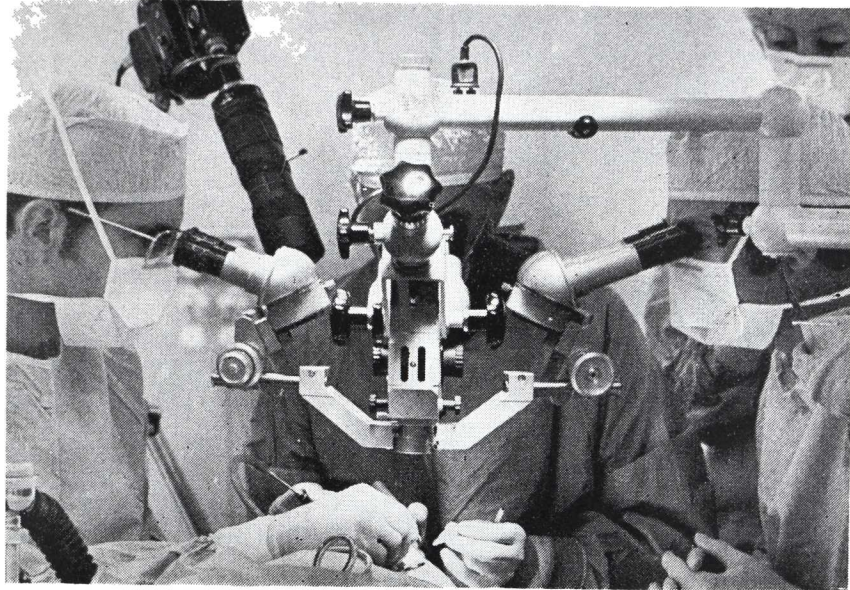


FIGURE 10 B

the posterior capsule (Figs. 12 a, b,). The material can be aspirated or at least held by the aspirator while being removed from the anterior chamber. Some posterior subcapsular opacities are simple flakes and can be freed from the posterior capsule with the spatula and then aspirated.

At the end of the procedure the aspirating and irrigating needles are withdrawn and the anterior chamber formed with balanced salt solution and a small amount of air.

*Iridectomy.*- The technique of aspiration-irrigation has been performed in over 150 children and adults without any type of iridectomy or iridotomy. Only one case developed pupillary block when mydriatics were discontinued early during the postoperative period. It is still undetermined at this point whether a peripheral iridectomy or iridotomy is necessary with the technique of ultrasonic aspiration irrigation. If the surgeon feels strongly that an opening in the iris should be made, this can be performed at the end of the procedure by transfixation of the iris with either the irrigating or aspirating needle.

LOUIS J. GIRARD

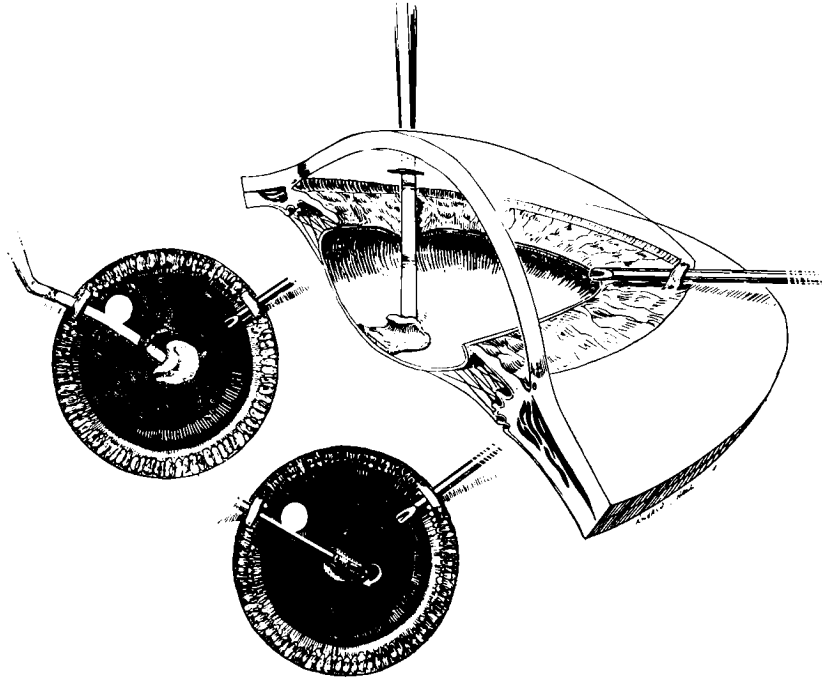


FIGURE 11

*Extraction of posterior subcapsular lens opacity. The edge of the opacity is elevated with a spatula, drawn against the aspirating cannula, rolled up and stripped away from the posterior capsule.*

*Postoperative Care.*- Atropine is instilled and the eye is bandaged. The patient can ambulate as soon as the effects of sedation or general anesthesia have worn off. The bandage can be removed on the first postoperative day. The pupil should be kept dilated until all evidence of activity in the anterior chamber has disappeared. The patient may be fitted with a contact lens within four or five days after the procedure.

#### **RESULTS**

The results of cataract extraction with ultrasonic aspiration have been variable with the hardness of the nucleus and hence the length of time

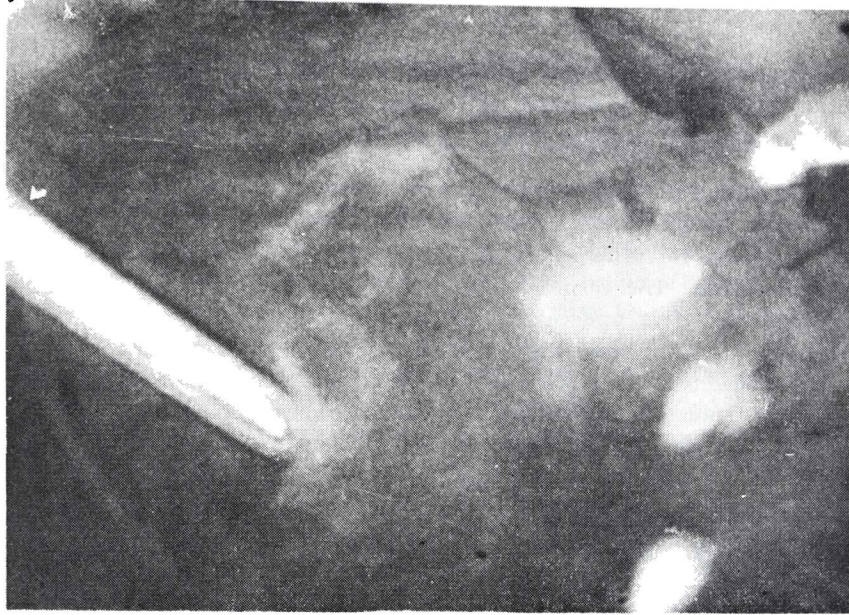


FIGURE 12

*a) The edge of the opacity is elevated with a spatula.*

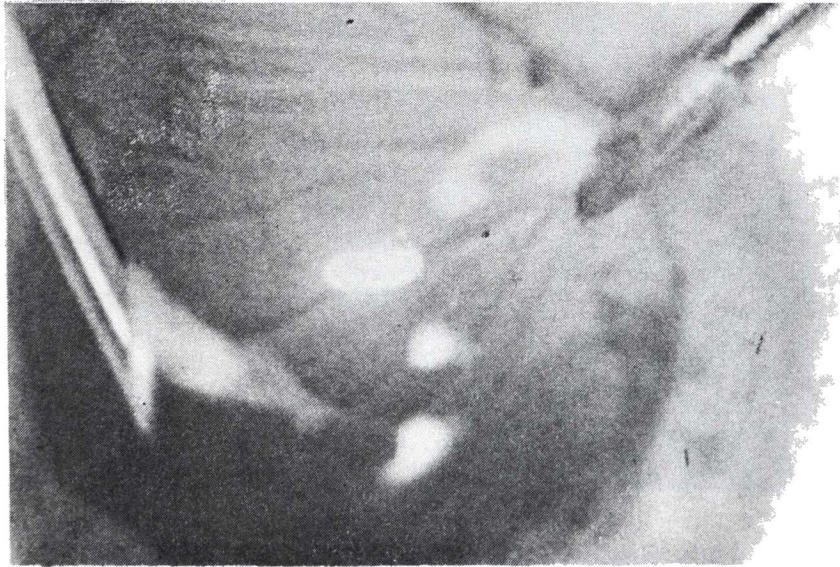


FIGURE 12

*b) The edge of the opacity is drawn against the aspirating cannula, rolled-up and stripped.*



#### CATARACT EXTRACTION BY ULTRASONIC ASPIRATION

a week after the surgery. Many times the vision is 20/20 within 24 to 48 hours postoperatively.

The complications that can occur with ultrasonic aspiration are as follows:

*Keratitis.*- The appearance of striate keratopathy within 24 hours after the procedure indicates trauma to the endothelium by the ultrasound or the touching of the hard nucleus to the endothelium (Fig. 14). Simple irrigation does not produce keratitis. Keratitis may be minimal or severe. It can consist of simple striate keratopathy which disappears in 48-72 hours or it can include stromal and epithelial edema which may last several months. The treatment is the use of cycloplegics and local or systemic steroids, or both. Thus far no case has had permanent corneal opacification.

*Uveitis.*- Uveitis produced from ultrasonic aspiration consists of an iridocyclitis with demonstrable cells and flare in the anterior chamber. It

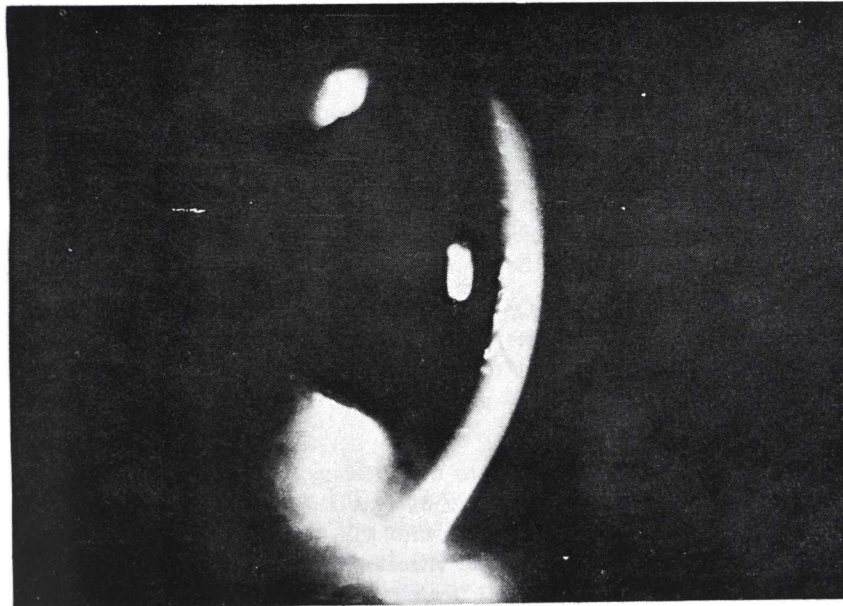


FIGURE 14

*Keratitis may be a complication of ultrasound.*

LOUIS J. GIRARD

must be remembered that the procedure is actually an extracapsular extraction and undeniably there will be some remnants of lens material left in the anterior chamber, which cause cells and flare. Unless the cells and flare accompany other evidence of uveitis, such as keratitic precipitates, keratitis, etc., then the cells and flare should be considered a reaction to the lens material and should not be treated with steroids, but simply with a cycloplegic and hot compresses.

*Loss of Pigment Epithelium of the Iris.*- When the ultrasonic vibrator comes in contact with the iris it can cause the loss of pigment epithelium. The de-pigmentation of the iris is in evidence on transillumination of the globe. There is no treatment of the condition and it is usually nonsignificant.

*Rupture of the Posterior Lens Capsule.*- Rupture of the posterior lens capsule can occur as a result of pressure on the nucleus or the inadvertent incision of the posterior capsule with the aspirating or irrigating needle. When rupture of the lens capsule occurs early, before a majority of the lens material is aspirated, vitreous invades the anterior chamber and becomes mixed with lens material and aspiration becomes difficult to perform. With ultrasound, it is possible to continue the aspiration of the lens material as well as performing an anterior vitrectomy.

If rupture of the posterior capsule occurs after aspiration of the nucleus and cortex, the surgeon is faced with having vitreous in the anterior chamber and possible adherence to the wound. This can be managed in the following way. The ultrasound can be used to perform an anterior vitrectomy following which air is instilled into the anterior chamber and any remnants of vitreous attachments to the wound are carefully removed with a spatula.

*Extremely Hard Nucleus.*- In brunescant cataracts and some mature cataracts the nucleus is too hard even to cut with a knife. The ultrasound can fragment the nucleus but this requires such energy and complications that it is advisable to halt the procedure and convert to an extracapsular extraction.

*Dislocation of the Nucleus Into the Vitreous.*- When the posterior lens capsule is ruptured and before the nucleus has been aspirated all or in part, the lens material may be lost into the vitreous cavity. This can be handled in two ways. 1) A subtotal vitrectomy may be performed with the ultrasound and the lens material floated into the anterior chamber where it can be further attacked with the ultrasound. 2) The procedure may be halted and a scleral expander applied and the dislocated lens removed by the open sky technique. (8, 9, 10).

#### CATARACT EXTRACTION BY ULTRASONIC ASPIRATION

Remnants of nuclear material may be lost in the vitreous and appear later in the anterior chamber in the postoperative period (Fig. 15). Such remnants may be tolerated and eventually absorbed or they cause a phacoanaphylactic reaction manifested by keratitis, uveitis, and secondary glaucoma. In the latter case, the lens remnants should be aspirated.

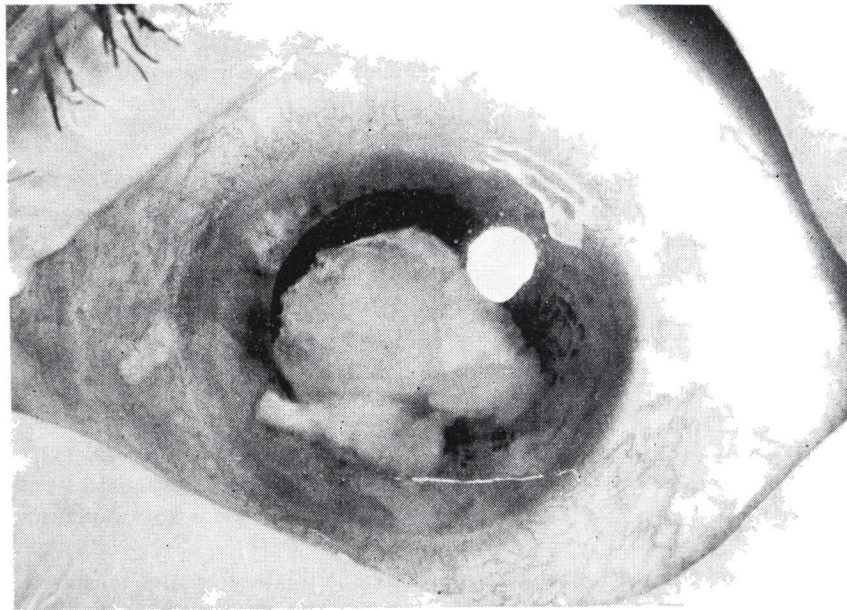


FIGURE 15

*Remnants of lens nucleus lost in the vitreous during surgery may appear in the anterior chamber in the post-operative period.*

#### DISCUSSION

The intracapsular cataract extraction has been the operation of choice for many years. In spite of the many refinements that have produced the present level of sophistication of intracapsular cataract extraction, there are still many complications which do occur postoperatively and are a direct result of a large incision and of vitreous entering the anterior chamber. One possible step in the progressive development of cataract surgery is an extremely fine incision and an extracapsular cataract extrac-

LOUIS J. GIRARD

tion which would produce a barrier between the vitreous and the anterior chamber thus preventing late rupture of the hyaloid with adhesions of the vitreous to the cornea, particularly the incision. Late complications such as anterior synechiae, bullous keratopathy, secondary uveitis, secondary glaucoma, cystoid macular edema, retinal holes and detachment could be prevented. In the opinion of the author the average span of life has increased so patients are living longer following cataract surgery, therefore, more and more patients are showing these complications of intracapsular cataract extraction. Many of these complications can be prevented by the extracapsular extraction, but an extracapsular extraction that does not involve a large incision requiring sutures.

It is impossible to judge the results of this technique at the present time. It must be remembered that the intracapsular cataract extraction was a very hazardous procedure for many years and has only changed to a high rate of success within the past twenty years. Also, it is important to be honest about the results with the use of the ultrasound, to report the complications openly and frankly and to see if a method might be found to avoid complications.

Houston-Texas.

SUMMARY

Based on the technique of aspiration of soft cataracts, and considering the advantages of the "Technique of aspiration and extracapsular extraction of the lens" the author explains and proposes a technique for the aspiration of the hard nucleus cataract fragmenting the nucleus with ultrasounds, followed by its aspiration, according to Kelman's technique.

He refers to his personal experience and shows photographs and a film on the subject.

He uses the conventional aspiration technique in all cases of soft cataracts, using ultrasounds only for hard nucleus cataracts.

He prefers to use the word "fragmentation" to describe the nucleus breaking produced by ultrasounds, to the word "emulsification" (Kelman's) whose definition would be "a mixture of oil and water."

In the surgical technique using ultrasounds he uses local or general anesthesia, maximum pupillary dilatation, two bevelled incisions performed

## CATARACT EXTRACTION BY ULTRASONIC ASPIRATION

with the Girard knife 1 mm. inside the limbus, each of them in one of the upper quadrants. The first incision serves to introduce the irrigation cannula N° 23, and the second one to introduce the aspiration cannula or the ultrasonic handle.

360° anterior capsulotomy.

Cortical material aspirated without ultrasounds.

When the nucleus is too hard, he prolapses it into the anterior chamber.

He believes the microscope is mandatory, preferably with co-axial illumination in order to visualize the transparency of the posterior capsule after the mass aspiration.

If there are subcapsular posterior opacities, they are removed by lifting one of the edges of the opacity with a spatula and, with the aid of the irrigation cannula, they are drawn up against the aspirating cannula, pulling them out softly from the posterior capsule.

At the end of the surgery the chamber is reformed with saline and an air bubble. Re-dilatation of the pupil with instilled 1: 1.000 epinephrine if necessary.

Patients may ambulate sooner. Atropine administered until the iritis has disappeared. Contact lens 5 days later. Particularly quiet eye in uncomplicated cases.

### COMPLICATIONS

1. *Keratitis*. Of a grooved aspect, it appears 24 hours after surgery and is due to the contact of the nucleus with the corneal endothelium. Usually, it disappears 4 to 72 hours later, although there are more severe cases in which it lasts for several months. No cases of permanent opacity. Treatment with cycloplegics and local corticoids.

2. *Uveitis*. It is a slight iridocyclitis.

3. *Dispersion of iridian pigmentation*. Not important.

4. *Rupture of the posterior capsule*.

5. *Dislocation of the nucleus in the vitreous following a capsular rupture*. It may be treated in two ways:

a) Sub-total vitrectomy until the lens material is aspirated.

LOUIS J. GIRARD

- b) Halting the procedure and, after applying a scleral expander, removing the dislocated lens with open sky technique.

The results of the technique of the cataract extraction with ultrasounds vary according to the hardness of the nucleus and, therefore, according to the time required to use the ultrasounds (the harder the nucleus, the longer the length of time of ultrasounds needed).

DISCUSSION

The author believes that the problems which follow an intracapsular extraction are due to a large incision and to the entry of vitreous into the surgical wound. These problems may be solved using a technique in which two small incisions are performed and the posterior capsule is kept. The long-term results of this technique may not be judged yet.

C. B.

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## COMPARISON OF CONVENTIONAL INTRACAPSULAR EXTRACTION AND PHACO-EMULSIFICATION FOR REMOVAL OF THE CATARACTOUS LENS

By

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With the use of good general anaesthesia, the operating microscope, fine atraumatic sutures and the newer micro-surgical instruments the conventional cataract procedure has become very safe with the very minimal% of complications. With adequate suturing and reconstitution of the anterior chambre, the patient can be immediately mobilised and discharged from hospital that same day. (Slides shown). Inherent in this technique are certain post-operative conditions which it is almost impossible to eliminate. With even the small 90° incision a certain degree of astigmatism is liable to arise and the sutures cannot safeguard the eye from rupture of the section if postoperative trauma should occur. The hyaloid face of the vitreous even if intact may subsequently herniate into the anterior chambre and in many cases ruptures with or without late degenerate changes in the anterior vitreous. With the total removal of the lens the scaffolding effect of this structure of the vitreous has been lost, hence the 2% of aphakic detachments. While the zonule of the lens and the lens capsule are semi impermeable to the passage of aqueous the hyaloid face of the vitreous is not; the permeation of aqueous with prostaglandins, released from a traumatised iris or ciliary body, through the vitreous to the macula may be one cause for the Irvin-Cass syndrome. (Prolonged operative and postoperative hypotony and vitreous traction on the macula are other possible causes of macula oedema).

Since even the perfectly performed intracapsular extraction can be followed by a poor visual result due to inherent defects in the procedure alternative techniques have been introduced. At the present time the

**ERIC J. ARNOTT**

K.P.E. operation is the most satisfactory alternative. In the congenital, infant or young cataract the procedure is essentially very simple and satisfactory. (Slides shown). In many of these cases ultrasonics are not required, the Kelman-cavitron machine being used for simple irrigation and aspiration. Even with the 25in. Hydrostatic pressure of the irrigating fluid used with this instrument it may be sometimes difficult to form the A.C. to insert the instrument, due to the natural elasticity of the infants sclera. In these cases a small iris reposer may be first introduced into the section to hold back the iris and the cavitron instrument can then be inserted into the pupillary area by sliding it over the reposer.

The K.P.E. technique in the adult cataractous eye is by no means such a simple performance and requires the skills of a dextrous specially trained micro-surgeon.

The major surgical steps of phacoemulsification of the senile cataract are well known and have been outlined today by the originator Dr. Charles Kelman.

They include:

- a) Limbal incision 3.1 mm in length.
- b) Anterior capsulotomy.
- c) Prolapse of lens mass into anterior chambre.
- d) Phacoemulsification of the nucleus.
- e) Removal of cortical remnants from behind the iris.
- f) Cleaning of the posterior capsule or opening it.
- g) Peripheral iridectomy.
- h) Closure of incision and injection of Miochol.

While problems may occur at each stage careful established technique or simple modifications at each stage of the procedure should entail a satisfactory outcome. If at the commencement of the procedure it is noticed that the eye is sunken a retrobulbar injection of 1% lignocaine may help to slightly proptose the eye. A pupil size of less than 8 mm. should make the surgeon consider an alternative technique as almost certainly the pupil will further constrict once the eye is opened. The incision should be tailor made exactly 3.1 mm in size and horizontally placed through the surgical limbus into the anterior chambre of the eye using a razor blade fragment, Sinskie keratome or diamond knife. The capsulotomy may be made with



#### COMPARISON OF CONVENTIONAL INTRACAPSULAR EXTRACTION

the cystitome christmas tree style with enlargement or if no christmas tree appears in the anterior capsule, the can opening technique of Sinskie may be employed. In this modification small nicks are made around the whole circumference of the capsule some 2.5 mm. from the equator of the lens. Prolapsing of the nucleus into the anterior chambre is the most difficult part of the procedure. The see-saw in the 3 o'clock and 9 o'clock meridians gives usually the most satisfactory results. Using the cystitome the nucleus is rocked and torted into the anterior chambre; the torsional movement of the nucleus helps to strip the nucleus from the posterior cortex, which may be impeding its progress into the anterior chambre. If the nucleus cannot be prolapsed into the anterior chambre a conversion may be considered. The harder nucleus is most easily prolapsed. Removal of the nucleus if soft, may be carried out in the posterior chambre as long as certain rules are observed. The nucleus must be lying free in the posterior chambre and not attached to posterior capsule. With low ultrasonic power the anterior part of the nucleus is scalloped away after which it will tend to spontaneously roll into the anterior chambre for its final removal. The handpiece tip must at all times be kept horizontal and not be tilted downwards onto the nucleus which may then inadvertently be pushed into the vitreous. Ultrasonic removal of the nucleus in the anterior chambre may be time consuming but presents little difficulty as long as the tip is kept horizontal and moved gently to and fro into the lens in the mid-pupillary zone. If the nucleus tends to bounce off the tip less power is required.

Once the cortex has been removed the posterior capsule can be gently polished with the Kratz scratcher. Only if the posterior capsule is very thickened do I consider a posterior capsulotomy to be necessary.

The selection of cases requires some care. If a cataract has been present for over seven years the nucleus will tend to be hard (Little).

One of the merits of the K.P.E. procedure is the ease with which an intraocular lens can be inserted. At one sitting the lens can be inserted by enlarging the incision to 8 mm after the K.P.E. procedure has been completed. A variety of suitable lenses are available. The Binkhorst irido-capsular lens can be inserted with the upper and lower wings fitting between the posterior capsule and the remnants of the anterior capsule. A lens can also be inserted as a secondary procedure at a later date. This will entail a modification of its insertion since the anterior capsular remnants will have fused with the posterior capsule. If a Binkhorst iridocapsular lens is now used it will require suturing to the iris. A satisfactory alternative which we have

ERIC J. ARNOTT

used is the Choice mark 8 with peripheral anterior chambre support which is easily introduced.

The final benefits of the K.P.E. as compared to conventional cataract surgery will take some years to be known. With careful operating the K. P. E. technique has been found to have compramable operative complications to the Intra-capsular cataract operation. It is to be hoped that by limiting the operation to the anterior segment of the eye and keeping the capsular face intact, posterior segment complication may be reduced. The hoped for results may not be attained until furthur refinements to the technique are found which will reduce the posterior capsular thickening which occurs in a fair percentage of cases, particularly the younger patients.

SUMMARY

The author believes that even though the complications of the conventional procedure of the intracapsular extraction of the cataract have been reduced to a minimum, due to the creation of the surgical microscope and the instruments for microsurgery, certain postoperative conditions persist, which are inherent to its technical characteristics, such as astigmatism, opening of the wound, hyaloid rupture and its following sequela, retinal detachment, and Irving-Cass syndrome. On account of this, alternative techniques have been searched, among which the most satisfactory, at present, is Kelman's phacoemulsification (K.P.E.).

The author also believes that in soft cataract cases ulstrasounds are not necessary.

In cases of hard nucleous cataracts, Kelman's technique must be performed practising:

- a) Total dilatation of a pupil.
- b) Only one incision, 3.1 mm wide, practiced horizontally through the surgical limbus, using a razor blade, a Sinskie Keratome, or a diamond knife.
- c) He thinks the most difficult step of the technique is the prolapse of the nucleous in the anterior chamber. He performs the dislocation using a cystitome. The harder the nucleous, the easiest it is to dislocate it.

**COMPARISON OF CONVENTIONAL INTRACAPSULAR EXTRACTION**

- d) When the nucleus is softer it may be fragmented and aspirated in the posterior chamber.
- e) Cleaning the posterior capsule with Kratz' scratcher.
- f) One of the advantages of the K.P.E. is the ease with which intra-ocular lenses may be inserted. He refers to the Binkhorst Iridocapsular Lens during the same operatory step, including the upper and lower lens wings between the anterior and posterior capsule remnants. If a lens is inserted later, it must be sutured to the iris.

The long-term results of this technique may not be judged yet.

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## L'INCISION CORNEENNE COURTE PUREMENT CORNEENNE ET A BISEAU INVERSE DANS L'OPERATION DE LA CATARACTE

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Les incisions employées classiquement, même sous contrôle microscopique, sont dérivées directement des incisions de l'ancienne chirurgie sans microscope. Elles en ont les avantages et les inconvénients. Les perfectionnements portent sur la longueur de l'incision et sur la direction, les buts recherchés sont la rapidité de cicatrisation et la parfaite étanchéité.

### I. LES INCONVENIENTS DE L'INCISION DE 180° A BISEAU CLASSIQUE

#### 1) *Longueur de l'incision*

Une grande incision de 180°, et même plus, était conseillée pour permettre une manoeuvre intraoculaire plus facile au cours de l'extraction du cristallin à la pince ou à la ventouse.

Ce point de vue était justifié par le volume des instruments qui pénétraient dans la chambre antérieure, et par la relative complexité de la rotation du cristallin en voie d'extraction.

L'inconvénient était le nombre plus élevé de sutures nécessaires à la fermeture, et la lenteur de cicatrisation proportionnelle à la longueur de l'incision.

#### 2) *Direction de l'incision*

L'incision classique est oblique en bas et en avant. Elle forme ainsi une valve qui présente deux inconvénients:

—un bec scléral qui gêne pour pratiquer une iridectomie basale;

—et surtout un manque d'étanchéité à la pression intra-oculaire qui tend à ouvrir la cicatrice.

JACQUES CHARLEUX

De ce fait, elle expose à la fuite d'humeur aqueuse, à l'adossement de l'iris ou même à la hernie de l'iris. Cet inconvénient est accentué par la longueur d'une incision à 180°.

II. *LES AVANTAGES DE L'INCISION COURTE A BISEAU INVERSE*

Si l'on pratique une incision oblique en bas et en arrière, on obtient une valve qui présente deux avantages:

—absence de bec scléral et accès directe sur la racine de l'iris, permettant une iridectomie basale contrôlée.

—et surtout une excellente étanchéité à la pression intra-oculaire qui tend automatiquement à fermer la cicatrice. C'est l'application à l'oeil d'un système de physique hydraulique simple. De plus la faible longueur de l'incision augmente l'efficacité du système.

III. *TECHNIQUE OPERATOIRE DE L'INCISION*

L'incision purement cornéenne nécessite des lames à grand pouvoir de coupe. Elle se pratique en trois temps:

1° *Incision non perforante*

On utilise une lame de rasoir pointue.

Le globe oculaire est fixé au voisinage du limbe à l'aide d'une pince à fixer type Barraquer, du côté gauche.

L'incision se fait de droite à gauche:

Le manche de la lame de rasoir est tenu comme un crayon de la main droite, la lame attaque la cornée suivant un angle d'environ 30°. Elle est placée sur l'épithélium cornéen immédiatement en avant des dernières arcades vasculaires limbiques, et son plan est incliné obliquement vers l'angle iridocornéen.

Afin de contrôler parfaitement la coupe, le grossissement du microscope est réglé à au moins x 16. L'incision est parallèle au limbe et non perforante, elle s'étend sur environ 120°. On peut varier cette longueur suivant le volume prévu du cristallin.

2° *Approfondissement de l'incision*

On utilise une micro-lame Beaver N° 53, à bout arrondi tranchant. Cette lame est engagée dans le sillon cornéen créé par la lame pointue et approfondi l'incision toujours dans la même direction oblique, le plus profondément possible, sans ouvrir la chambre antérieure.

## L'INCISION CORNEENNE COURTE PUREMENT CORNEENNE

### 3° *Ouverture de la chambre antérieure*

On utilise encore la lame Beaver N° 53 :

Ouverture de la chambre antérieure dans la partie droite de l'incision sur une faible longueur, mais jusqu'à l'extrémité droite.

On complète alors l'ouverture à l'aide de ciseaux mousses à cornée de la droite vers la gauche, ce qui est le plus facile pour un opérateur droitier. Afin d'éviter une coupe angulée, il faut soulever la berge cornéenne pour que les lames des ciseaux soient placées correctement au fond de l'incision que l'on doit voir, et tenir les ciseaux en position inverse pour rester dans le même plan.

On obtient ainsi une incision pourvue d'une valve d'étanchéité, la chambre antérieure reformée par de l'humeur aqueuse artificielle reste profonde et si l'on appuie sur le centre de la cornée, la valve fonctionne, et l'humeur aqueuse ne s'échappe pas.

## IV. *TECHNIQUE DE L'EXTRACTION DU CRISTALLIN*

L'incision courte nécessite une technique d'extraction adaptée :

—utilisation presque systématique de la zonolyse enzymatique par l'*x-chrymotrypsine*.

—extraction lente à l'aide de la cryode fine, l'opérateur soulevant la cornée, et l'assistant réclinant l'iris. Le cristallin est extrait progressivement par oscillations successives droites et gauches. Il doit se déformer légèrement par allongement et présenter sur son équateur les marques d'appui des oscillations.

## V. *SUTURE DE L'INCISION*

L'incision est suturée à l'aide de monofilament de nylon 10 - 0 utilisé couramment dans la kératoplastie.

Nous utilisons habituellement la technique par points séparés radiaux au nombre de 3 à 6 (4 en moyenne).

### 1° *Mise en place de la suture*

Chaque suture est placée de la façon suivante :

—fixation de la berge cornéenne à la pince de Bonn.

—introduction de l'aiguille perpendiculairement au plan dans la cornée très près de la berge. (2 à 3/10 de mm).

—trajet de l'aiguille très profond et sortie au ras de la membrane de Descemet.

—introduction horizontale dans la seconde berge à la même profondeur.

JACQUES CHARLEUX

—sortie transconjonctivale éloignée de la berge sclérale (1,5 mm) 3 à 6 sutures radiales sont ainsi placées (on peut placer deux sutures avant l'extraction du cristallin).

2° *Serrage des sutures*

Le serrage des sutures est très important en ce qui concerne l'astigmatisme postopératoire, et nécessite une technique particulière:

—premier noeud coulissant:

On fait deux demi-clés inversées, exactement comme pour exécuter un noeud plat, mais sans serrer les fils, puis on tend le fil distal (côte cornéen) des deux demi-clés s'enroulent automatiquement autour du fil tendu. On les serre et on obtient un noeud coulissant qui permet de régler avec précision la force de tension de la suture.

En effet ce noeud se relâche pas spontanément.

Si la suture est trop serrée il faut introduire un crochet à iris pour le desserrer.

Afin d'obtenir un astigmatisme le plus faible possible, il suffit de serrer le noeud jusqu'au simple affrontement des berges, sans compression des tissus.

—second noeud de verrouillage:

Une fois les berges de l'incision affrontées on fait une troisième demiclé en tendant le fil proximal (côte scléral) afin de verrouiller la suture.

3° *Enfouissement du noeud*

Les fils sont sectionnés très près du noeud et l'on procède à l'enfouissement du côté cornéen par rotation, soit à l'aide d'une pince à monofilament de Troutman, soit à l'aide d'une pince de Bonn tenue horizontalement.

4° *Reconstitution de la chambre antérieure*

La chambre antérieure est reconstituée avec de l'humeur aqueuse artificielle, elle réste étendue, il est inutile d'introduire une bulle d'air.

VI. *CONSEQUENCES POST-OPERATOIRES*

Le globe oculaire étant fermé et étanche, les suites opératoires sont extrêmement simplifiées:

1° *Coque protectrice monoculaire*

Il est inutile de mettre un pansement avec de la gaze. Une simple coque métallique perforée suffit à assurer une protection contre un traumatisme divers accidentel, seul dangereux pendant les premiers jours.

## L'INCISION CORNEENNE COURTE PUREMENT CORNEENNE

### 2° *Lever précoce*

L'opéré peut se lever dès son réveil, manger à table et faire sa toilette.

### 3° *Hospitalisation courte*

L'hospitalisation peut-être résuite à deux ou trois jours, l'opéré étant contrôlé deux fois dans la semaine qui suit, la pupille est dilatée une fois. Cependant, on conseille de garder une coque protectrice pendant 10 jours.

### 4° *Correction optique*

Plusieurs cas se présentent :

Si le second oeil a une vision suffisante la correction est donnée au bout de 5 semaines.

Si le second oeil est déjà aphaque, correction optique provisoire le 10ème jour.

S'il s'agit d'un oeil unique, le malade est équipé d'une lunette.

Pansement spéciale entre le deuxième et le quatrième jour, puis de lunettes provisoires de loin et de près le 10ème jour.

Dans tous les cas on peut prescrire une lentille cornéenne au bout de 5 semaines.

L'astigmatisme dans l'incision cornéenne courte et inverse suturée au nylon peut être important si les sutures sont trop serrées. Il est toujours conforme à la règle car la tension des fils augmente la courbure verticale.

Une étude statistique portant sur les 100 premiers cas montre que l'astigmatisme peut atteindre 6 D, avec une moyenne de 2.2 D. Ceci étant dû uniquement à des sutures trop serrées.

Une statistique portant sur 100 cas plus récents révèlent que la moyenne de l'astigmatisme revient à moins de 1 D, le serrage des sutures ayant été mis au point comme nous l'avons décrit.

En conclusion, les avantages de l'incision courte et inverse dans l'opération de la cataracte sont multiples :

- disparition des complications liées à l'incision.
- disparition de tout phénomène inflammatoire et douloureux.
- hospitalisation courte.
- retour rapide à l'activité normale avec une correction optique par lunettes ou lentille cornéenne.



JACQUES CHARLEUX

SUMMARY

The drawbacks of the incision at 180° are described in relation to the length and direction of the incision. At the same time the advantages of the inverse bevelled incision without a scleral spur are presented. This incision provides easy access to the root of the iris as well as unchanging intraocular pressure.

The surgical technique, based in three times, is described, beginning with a non-perforating incision, deep penetration of the incision, and opening of the anterior chamber with a razor blade and N° 57 Beaver microblende. The extraction of the lens is performed with a fine cryo-pencil and in all, or almost all the cases, zonulises enzymatic is used. The incision is sutured with Nylon 10-0 with 3 radial sutures. Advantages such as absence of complications related to the incision, absence of all inflammatory and painful phenomena, short hospitalization, and quick return to normal activity with optical correction are described.

The resulting astigmatism is always according to the ruler with a median of 2.2 D and deviation of 1 to 6 D, depending upon the tension used in the sutures.

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## THE PATHOPHYSIOLOGY OF CORNEAL ASTIGMATISM AFTER CATARACT SURGERY

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**Miami Beach, U. S. A.**

Although the ophthalmic surgeon has concerned himself with postoperative corneal astigmatism, since it is an integral part of the postoperative refractive error in aphakia, there has been much confusion in explaining the pathophysiology of postoperative changes in corneal curvature.

Since the turn of the century, it has been observed that astigmatism after cataract extraction is generally of the against-the-rule variety. This is caused by some degree of flattening of the corneal meridian perpendicular to the direction of the incision. This observation was valid in the days of unstured incisions and remained so after popularization of corneoscleral sutures. A radical change has occurred during the past 10 years. A variety of new suture materials have been introduced and innovative suture techniques have been described. A characteristic change in corneal curvature is associated with each of these techniques. The purpose of this presentation is to explain these changes on the basis of carefully controlled observations.

**SLIDE:** For orientation, this illustrates that the vertical corneal meridian is more steeply curved than the horizontal in astigmatism with-the-rule. The opposite is true in astigmatism against-the-rule. In an eye whose cornea requires a plus correcting cylinder at  $45^\circ$ , the  $45^\circ$  meridian is more steeply curved than the  $135^\circ$  meridian.

In order to evaluate the change in corneal curvature induced by a particular technique, it is mandatory to perform pre and postoperative keratometry and to quantitate the difference between these 2 measurements. If you are unconvinced of the importance of making both measurements, consider this **SLIDE** which shows relatively large amounts of postoperative

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corneal astigmatism (center column) with a variety of suture techniques, but when the difference between pre-and postoperative keratometry is mathematically calculated, we find that the amount of corneal astigmatism induced by the surgery (last column) is much less. Conversely, on this SLIDE, the postoperative Readings are much less than the actual changes in corneal curvature induced by the surgery.

This is not the appropriate forum for describing trigonometry but that is what was used in making all the calculations in my series of cases. SLIDE.

The series on which I based my conclusions consisted of 1,557 cataract extractions utilizing a variety of suture materials and techniques of incision and closure.

SLIDE: The following suture techniques were employed. Four types of continuous sutures. SLIDE: The Troutman suture commences at the horizontal termination of the incision and continues in non-locking fashion to 12 o'clock where the 2 halves are tied to each other. The Willard suture commences with a horizontal bite at 12 o'clock with one arm continuing to the right and one to the left. SLIDE: The over and over suture commences on the nasal side and terminates temporally in each eye. SLIDE: There were also a variety of interrupted suture techniques. There were 2 types of interrupted 10-0 nylon and 9-0 silk series, one with a relatively posterior incision and sutures inserted to about half the depth of the wound and another with a more anterior incision and more deeply inserted sutures. There were also series using 7-0 silk, 7-0 chromic catgut, and 7-0 chromic collagen. A fornix-based conjunctival flap was used in all series except for 7-0 collagen which was covered by a limbus-based flap.

SLIDE: In each series, the calculated induced surgical change was classified as with-or against-the-rule. This summary slide reveals that there was a characteristic with-or against-the-rule astigmatism induced by a particular technique. The Troutman suture induces with-the-rule change in a ratio of 6:1 while the Willard suture induces against-the-rule change in a ratio of 2:1. How do we explain this with 2 seemingly similar sutures? Most surgeons tend to pull up and tighten a continuous suture greatest near its termination. For the Troutman suture, this is 12 o'clock. Therefore, the greatest wound compression occurs here. The Willard suture is terminated at the horizontal extremities of the wound; therefore the greatest wound compression occurs horizontally. What does wound compression have to do with corneal curvature? Wound compression tends to shorten the circumference of the globe in that meridian, thus steepening the curvature.

### THE PATHOPHYSIOLOGY OF CORNEAL ASTIGMATISM

There is also a compensatory flattening of the opposite meridian, but to a lesser degree. Therefore, it is not surprising that the Troutman suture induces with-and the Willard suture against-the-rule astigmatism. If this thesis is correct, we should be able to apply it to the over and over series. SLIDE: Since this suture is always terminated on the temporal side of the incision, we should expect the steepest corneal meridian to be temporal to 90° in most cases. SLIDE: This proved to be the case in 16 of 20 right eyes and 28 of 32 left eyes.

How do we explain the tendency of large sutures such as 7-0 silk and 7-0 catgut to cause against-the-rule astigmatism? 7-0 silk is usually removed in 3-4 weeks thus permitting some wound gape. 7-0 catgut, especially when covered only by a fornix-based flap tends to disintegrate early allowing some wound gape. What does wound gape do? SLIDE: This lengthens the circumference of the globe in the meridian of the suture, thus decreasing curvature in this meridian. There is a compensatory steepening of the opposite meridian, but to a lesser degree.

What about the series where fine, interrupted, permanent sutures were employed? SLIDE: Note that in each case when the incision was further away from the cornea and the sutures inserted less deeply, the type of astigmatism was evenly distributed. When the incision was moved closer to the cornea and the sutures inserted more deeply, there was a decided shift toward astigmatism with-the-rule for both 10-0 nylon and 9-0 silk.

The theory of wound compression being associated with steepening of the corneal curvature is adequately defended in my experience by the effect of cutting a suture in the steepest corneal meridian. SLIDE: Note in the first column that a Troutman suture caused 12 diopters of with-the-rule astigmatism. This was completely eliminated by cutting the suture at its termination, 12 o'clock. SLIDE: Note in the second column that interrupted 9-0 silk sutures caused 6 diopters of with-the-rule astigmatism which was more than completely eliminated by removing 3 sutures at 11, 12, and 1 o'clock. Similar dramatic changes were observed with other types of sutures in this series but I will dwell on these no further. The change in corneal curvature as a result of removing a suture is usually dramatic, especially when removing nylon sutures.

I would like to emphasize a few points. SLIDE: The closer the incision is to the cornea the greater the astigmatism, whether due to wound gape or wound compression. SLIDE: The following factors favor wound compression. 1. fine sutures such as 10-0 nylon and 9-0 silk used to close relatively

**NORMAN S. JAFFE**

anterior incisions 2. deeply inserted fine sutures 3. wide suture bites 4. tightly tied sutures 5. greater number of sutures 6. overlapping of the wound SLIDE: Wound compression may be minimized by repressurizing the eye with air after the lens extraction. This lessens the tendency to compress the wound margins with the sutures. SLIDE: Remember when attempting to reduce astigmatism by cutting a suture, always cut the suture in the highest plus meridian.

The clinical application of these findings point to the control of post-operative astigmatism. The study suggests that the surgeon may choose from a variety of suture techniques one which will not exaggerate a pre-existing corneal astigmatism and one which might reduce it. Troutman has certainly re-emphasized the use of a wedge resection in the flattest corneal meridian to neutralize a pre-existing corneal astigmatism.

As you can well imagine, a study such as this requires tons of paper work SLIDE: but no job is finished until all the paper work is done.

**SUMMARY**

Since the turn of the century it has been observed that the postcataract corneal astigmatism is of the against-the-rule type, caused by a certain degree of flattening of the corneal meridian perpendicular to the direction of the incision. This observation was valid in the days of the unsutured incision, remaining so after the popularization of corneo-scleral sutures. In the past 10 years there has been a radical change due to new techniques and new sutures which caused changes in the corneal curvature. To evaluate this change, it is mandatory to perform pre and post-operative keratometries and to quantitate the difference between these two measurements.

For this study the author chose 1557 cataract extractions, using a variety of sutures as well as incision and closure techniques (slides).

Four types of continuous sutures were used: the Troutman suture, the Williard suture, the over and over suture, and the interrupted suture, using 10-0 nylon and 9-0 silk. There were also series using 7-0 silk, 7-0 chromic catgut, and 7-0 chromic collagen, buried under a conjunctival flap. The Troutman sutures induced with-the-rule changes in a ratio of 6:1, while the Williard sutures induced against-the-rule changes in a ratio of 2:1.

#### THE PATHOPHYSIOLOGY OF CORNEAL ASTIGMATISM

This may be explained by the fact that there is a tendency to pull up and tighten a continuous suture near its end; in the Troutman suture this happens at 12 and in Willard's near its termination.

Large sutures using 7-0 silk and 7-0 catgut caused an against-the-rule astigmatism. This is caused by the wound gape which takes place when removing the silk suture in 3-4 weeks and by the early desintegration of the catgut.

The compression of the wound tends to shorten the corneal diameter in that meridian, thus increasing the curvature; there is also a compensating flattening of the opposite meridian. The wound opening would increase the corneal meridian, thus decreasing the curvature in this meridian; there is also a compensating deviation of the opposed meridian, but in a lesser degree.

The theory of wound compression associated to a modification of the corneal curvature was proved when a change of curvature was achieved after cutting the corneal suture in the corresponding meridian.

The clinical application of these findings make possible to control the post-operative corneal astigmatism, allowing the surgeon to choose a technique with which a pre-existing corneal astigmatism is not exaggerated, or another one with which he may actually reduce it.

J. R.

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