

CATARACT EXTRACTION BY ULTRASONIC ASPIRATION

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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

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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

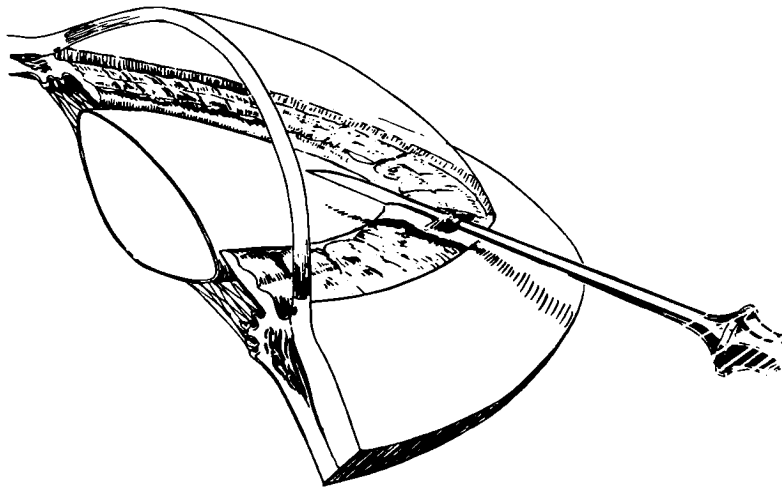


FIGURE 1

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.

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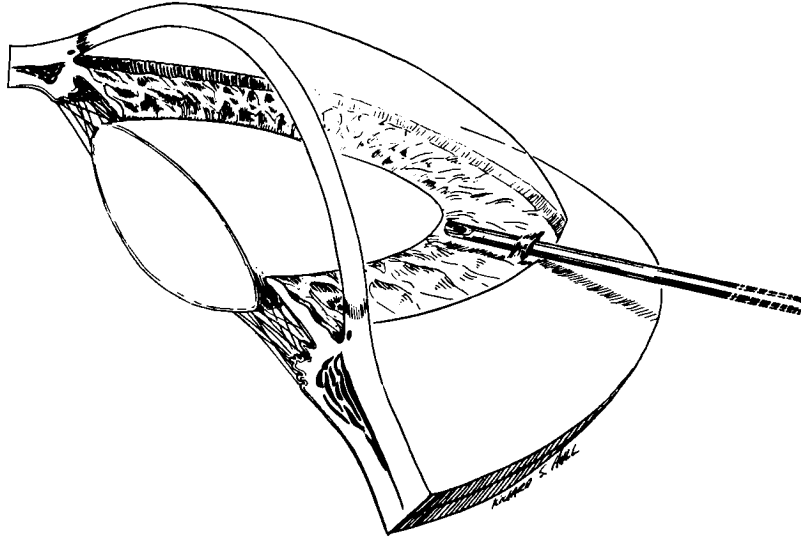


FIGURE 2

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.

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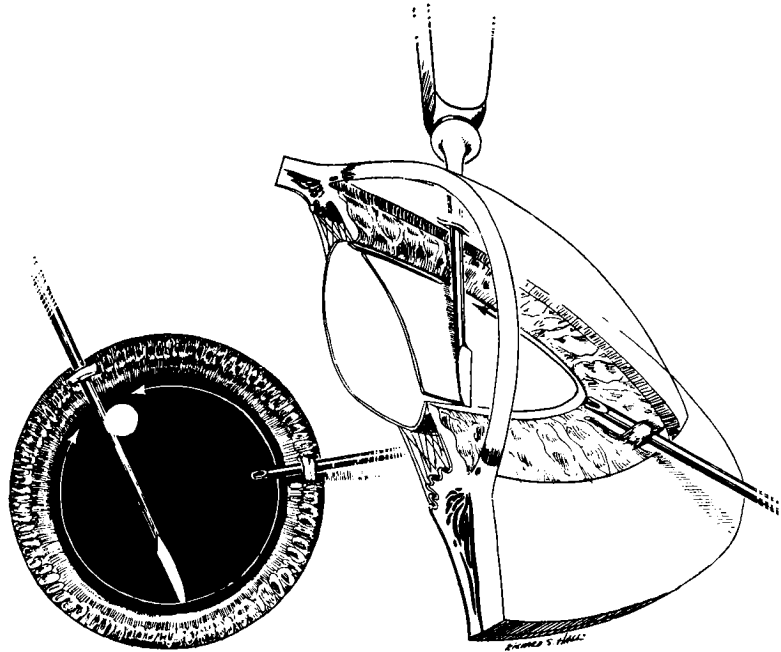


FIGURE 3

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-

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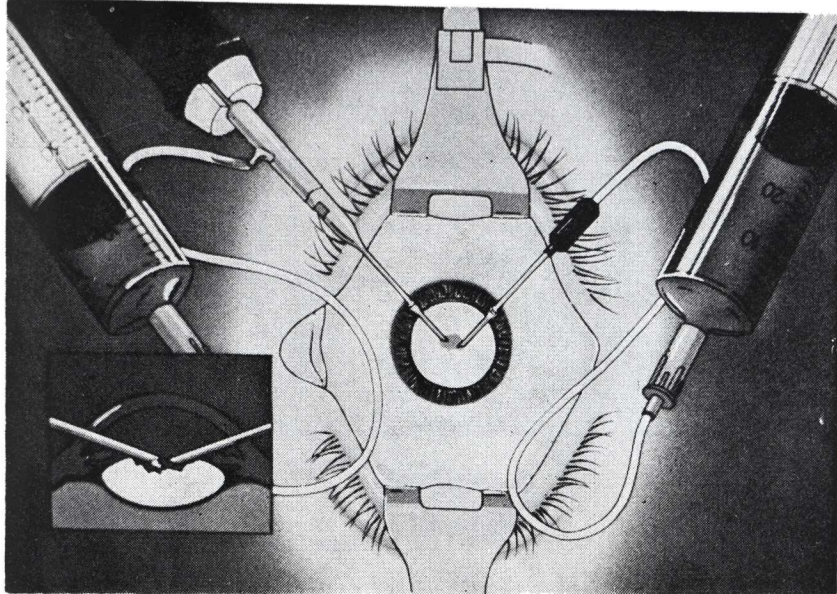


FIGURE 4

Aspirating and irrigating cannulas are inserted into the anterior chamber.

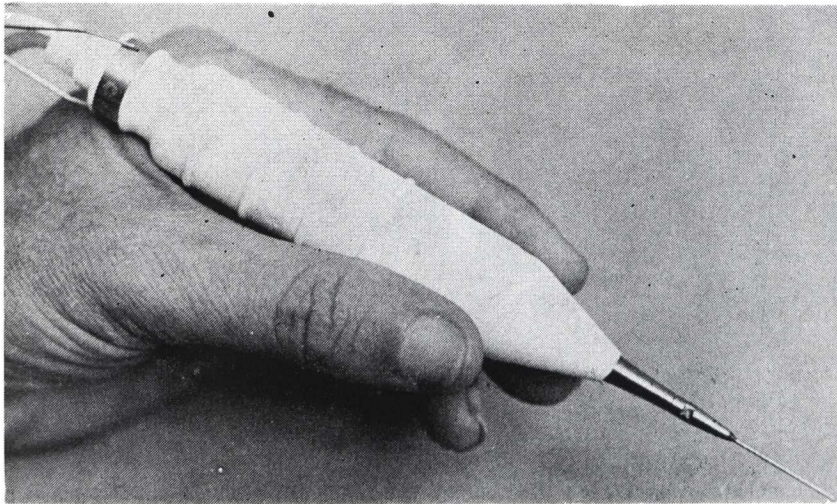


FIGURE 5

The aspirating needle is attached to an ultrasonic vibrating handle.

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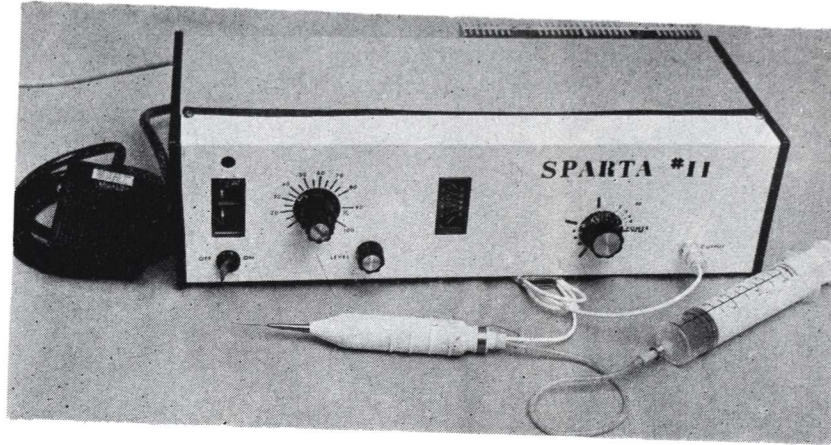


FIGURE 6

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

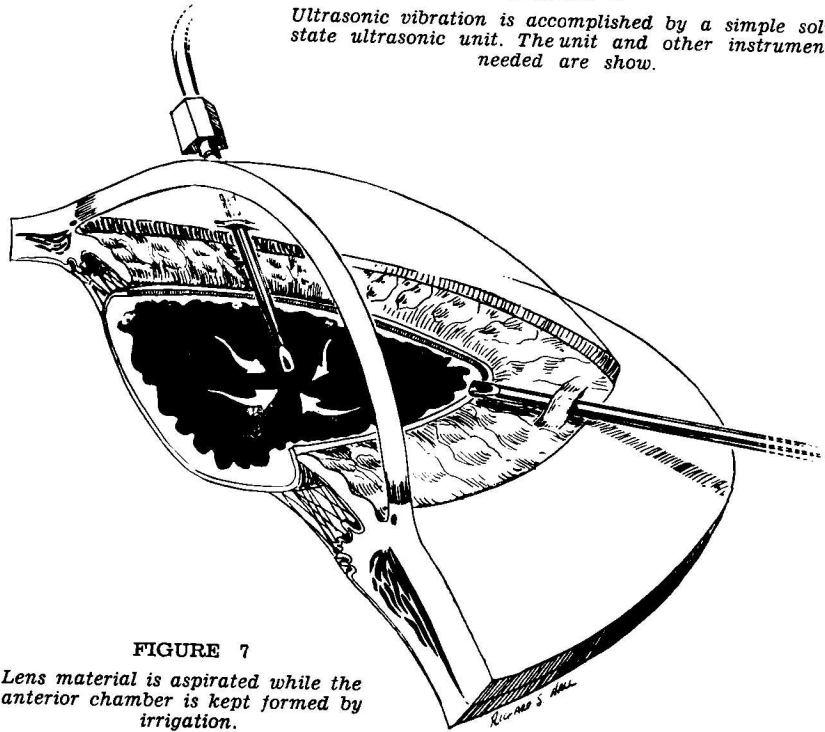


FIGURE 7

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

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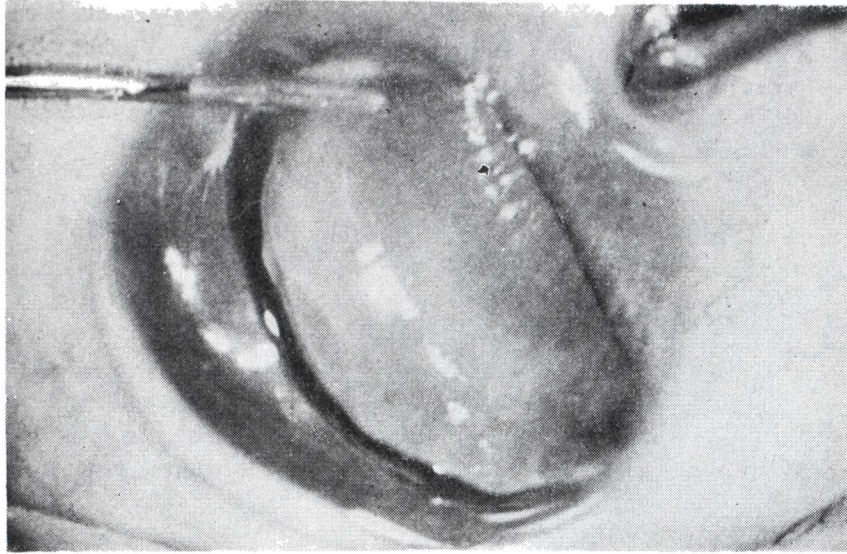


FIGURE 8

Hard nucleus is prolapsed into the anterior chamber.

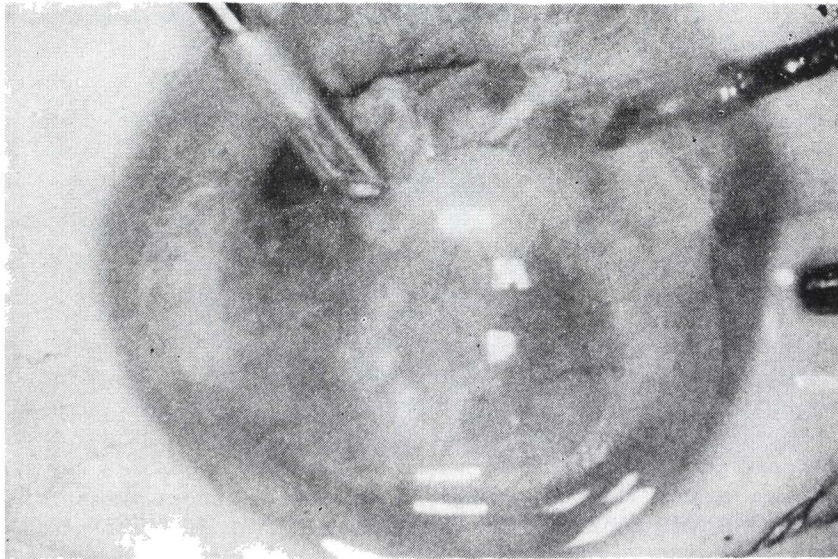


FIGURE 9

Ultrasonic fragmentation and aspiration of a hard nucleus.

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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

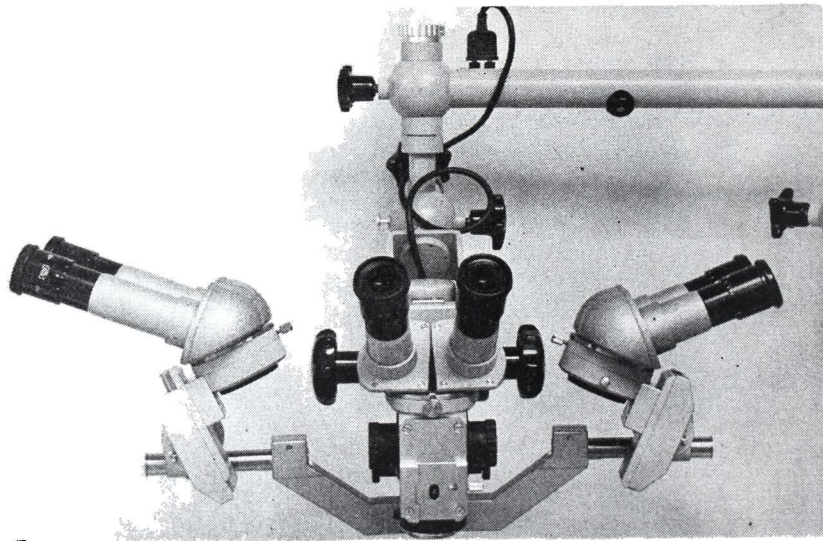


FIGURE 10

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

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

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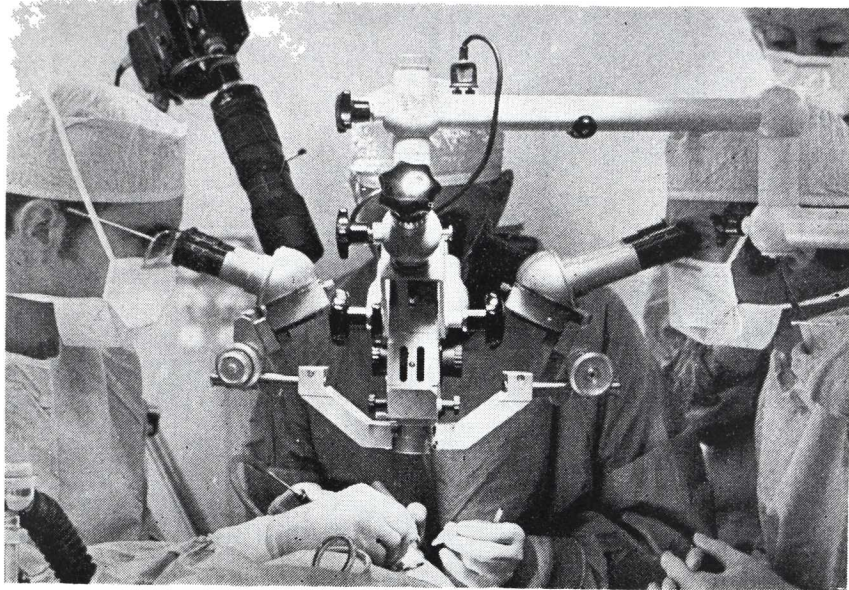


FIGURE 10 B

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.

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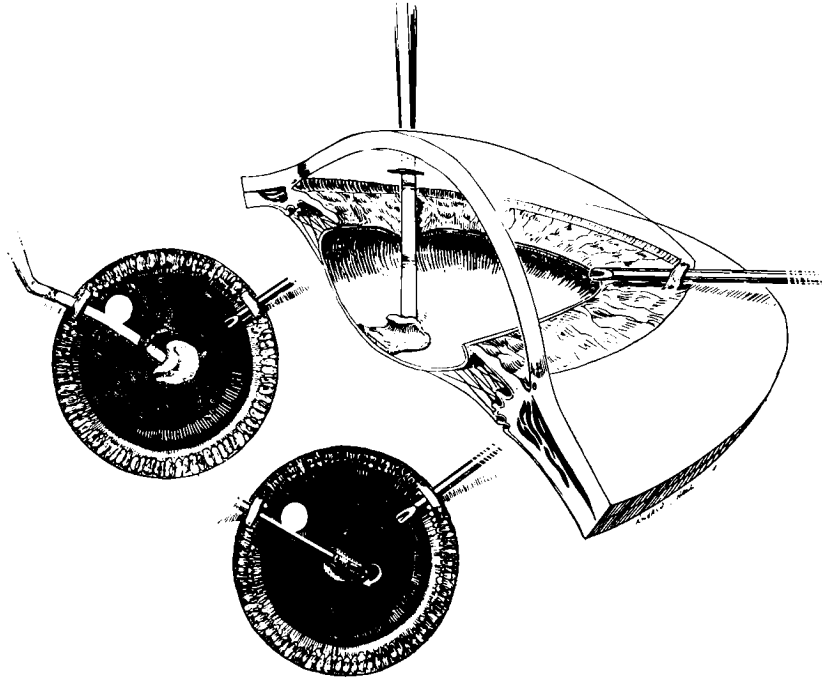


FIGURE 11

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

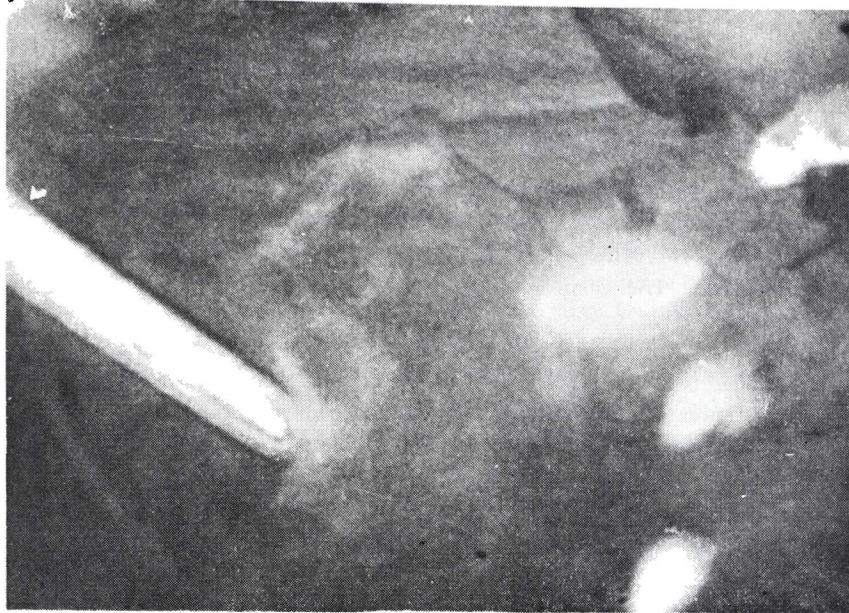


FIGURE 12

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

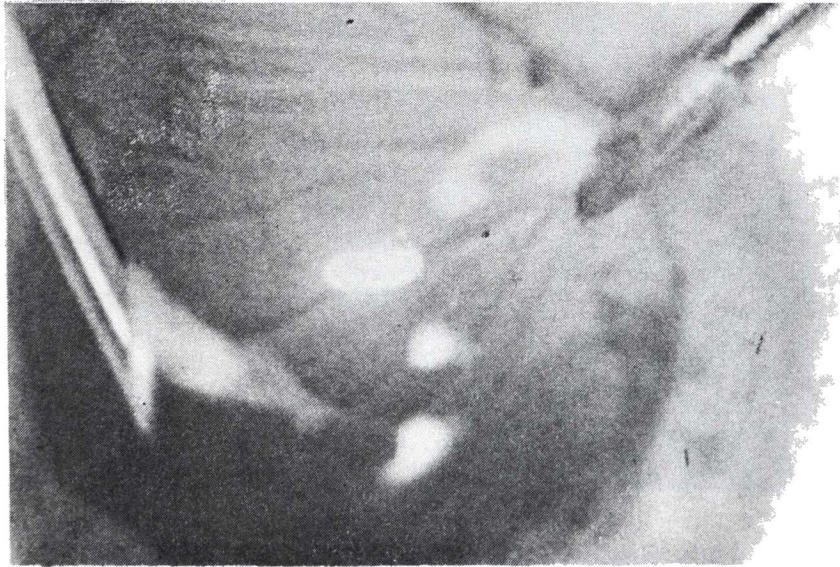


FIGURE 12

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

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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

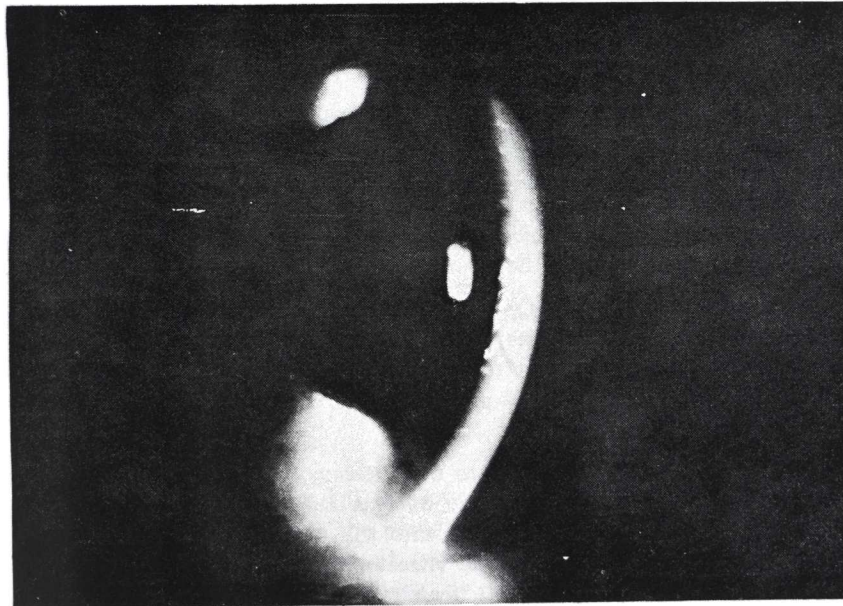


FIGURE 14

Keratitis may be a complication of ultrasound.

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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).

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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.

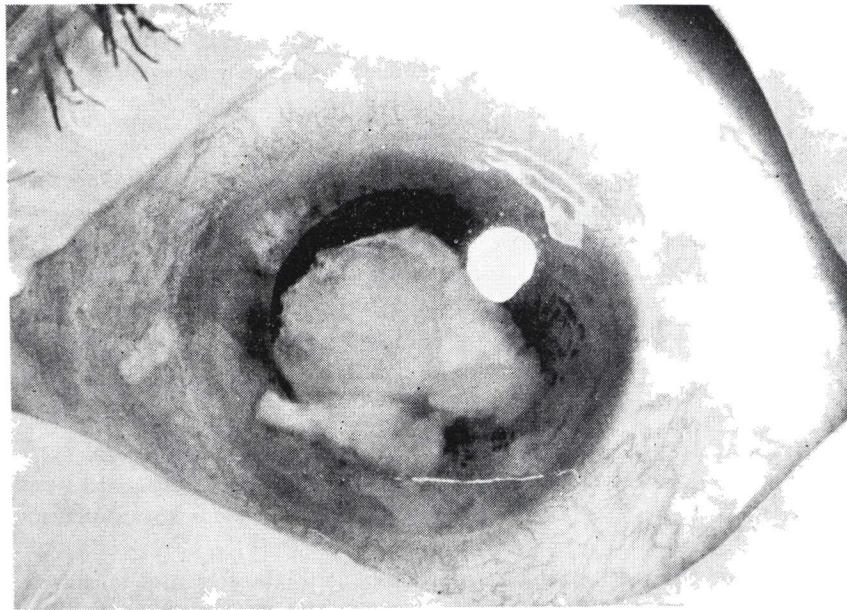


FIGURE 15

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-

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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 nucleous cataract fragmenting the nucleous 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 nucleous cataracts.

He prefers to use the word "fragmentation" to describe the nucleous 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

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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.

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- 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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