Successful Conversion to Phacoemulsification

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This is for the ophthalmologists beginning phacoemulsification. Many of the techniques have evolved over the past 14 years through teaching students at the Foundation for Ophthalmic Education in Santa Monica and in learning from our colleagues and from our mistakes. For acquiring finesse, nothing can replace experience and a good measure of self-criticism. A step-by-step approach of my technique will be demonstrated and one of the ways I have taught ophthalmologists, especially the experienced cataract surgeons converting to phacoemulsification is to start by sculpting the nucleus to obtain the feel for the lens, the feel for the phacoemulsification and the various hardness of the nucleus. It is generally advisable to convert to extracapsular cataract extraction after sculpting the centre of the nucleus. With each additional case, a little more of the nucleus is removed. This enables the surgeon to gain confidence with the use of the phacoemulsification machine. This step-wise learning teaches the surgeon the finer points of cataract surgery with a new approach. I have always emphasised the importance of good result. I am particularly concerned with patients with high myopia, especially because of retinal breaks and macular changes.

One way of evaluating the retina is to have a good look with the indirect ophthalmoscope at the retinal periphery and the macula. To predict potential vision, macular function test can be done. Although all these tests have limitations. When the view of the retina is not clear, B-scan ultrasonography is useful. Macular diseases can give poor visual results and this must be brought to the attention of the patients so that a realistic operative expectation can be established between the surgeon and the patient. Another important consideration is the corneal endothelium so that surgeon can warn patients of the danger of corneal decompensation after surgery.

I want to emphasise that intraocular lens calculation is mandatory and this should be accurately done with the A-scan ultrasonography combined with keratometry. There are various formulae used and very much depends on the individual surgeon. It is important to make the patients slightly myopic. I will now go on to phacoemulsification and explain the technique that I used with which I have had excellent result and I have taught this technique to hundreds of ophthalmologists. I wish to emphasise that different surgeons will have different techniques.

Incision

A small fornix-based conjunctival flap is made. Exceptions are cases where the cataract incision is placed in the cornea when a filtering bleb is present or where the limbal area has been scarred such as following a scleral buckle. I make my wound usually in the midlimbus with a precise 3.5 mm incision with a special blade. If a non-foldable is contemplated, the approximate length should be measured and the enlargement made with a corneal scissors or a sharp microsurgical knife. Viscoelastic material is useful to deepen the angle and to push the iris away, especially when a sharp knife is used.

Anterior Capsulotomy

Although capsulorhexis is popular and has the advantage of a smooth edge, the can-opening anterior capsulotomy is just as effective and I have used this approach for most of my cases.

Posterior Chamber Phacoemulsification

In my opinion, posterior chamber phaco-emulsification is the method of choice for cataract extraction. There are 2 approaches: the one-hand technique utilizing the ultrasonic needle alone and the two-hand technique utilizing a second instrument which can be the cyclodialysis spatula. It is important for the beginner to work with and observe the techniques of experienced phacoemulsification surgeons.

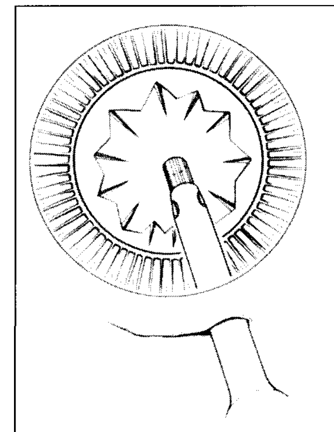

Figure 1

The One-Hand Technique

(1) Introduce the ultrasonic tip, with the bevel down, into the anterior chamber (Figure 1)

(2) Ultrasonic needle is rotated so that the bevel faces anteriorly, once it is in the anterior chamber (Figure 2).

(3) Begin sculpting the central nucleus and continue until a thin central layer remains (Figure 3)

(4) Once sufficient central nucleus is removed, loosen the nucleus from

the underlying cortex by deactivating the machine. There will be a gradual shallowing of the anterior chamber. The nucleus will be pushed anteriorly by the vitreous pressure and the nucleus is separated by the cortex.

(5) Once the cortex can be freely rotated in the posterior chamber (Figure 4), further emulsification of the nucleus shelf is made. The peripheral nucleus is now at the plane of the pupil where it can be safely emulsified away.

(6) The central plate can then be removed.

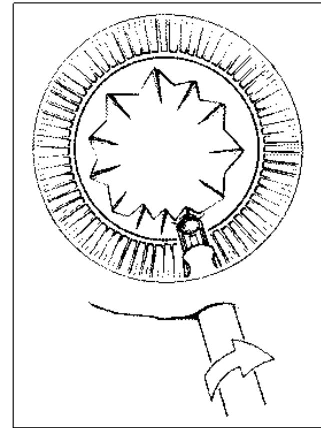

Figure 2

The Two-Hand Technique

(1) A stab wound is made at 2 o'clock with a sharp microsurgical knife.

(2) The central nucleus is sculpt as with the one-hand technique.

(3) Use the cyclodialysis spatula to push the inferior pole of the nucleus downwards and inferiorly. At the same time, the phacoemulsification needle engages the superior pole of the nucleus. With activation of irrigation and aspiration, the solution dissect the nucleus from the cortex.

(4) Once the superior pole of the nucleus is engaged with the ultrasonic needle the peripheral nucleus is sculpt. By rotating the nucleus, it can be removed with phacoemulsification

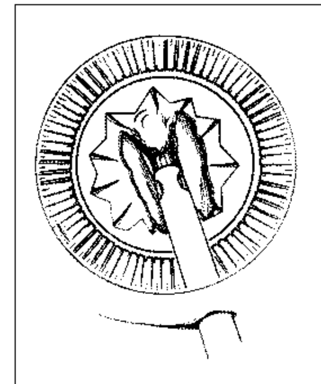

Figure 3

Cortical Removal

(1) With a 0.3 mm irrigation-aspiration needle inserted into the eye, begin cortical removal at 6 o'clock.

(2) Activate irrigation-aspiration (I/A) and aspirate cortex by occluding the port of the needle. Then strip it towards the centre. Watch the posterior capsule for striae, which indicates that the posterior capsule is occluding the aspiration port.

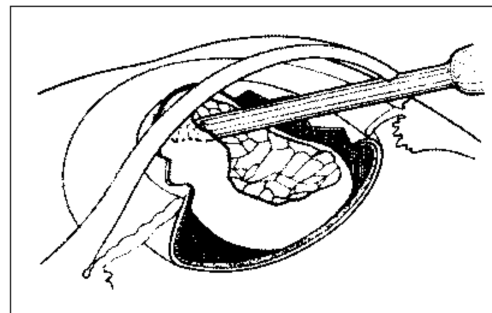

Figure 4

(3) After the rest of the cortex is removed, the cortex at 12 o'clock is tackled. Direct the port of the irrigation-aspiration hand piece posteriorly and activate I/A. Once the port is occluded, rotate the needle in an ice-cream scoop fashion, simultaneously advancing the needle towards the center of the anterior chamber and stripping cortex from the capsular fornix. Small amount of cortical material left superiorly that cannot be removed after a few attempts should be left in situ for the beginner without employing heroic measures.

(4) Inadvertant aspiration of posterior capsule results in the appearance of a star-fold. Recognition of this is important and immediate release of the foot pedal to deactivate aspiration should be done.

Problems During Phacoemulsification

(1) The inexperienced surgeon using phacoemulsification is often confronted with the problem of knowing how deep to sculpt the nucleus prior to loosening it from cortex. A cataract with a dense nuclear sclerotic center is usually sculpted until the red reflex brightens and intensifies. The different layers of the central nucleus are removed by shaving the core in a lamellar fashion and these layers are maintained in clear view by fine-focusing the microscope. If there is uncertainty about the depth of the sculpt, it is prudent to defer to the surgeon's fear of breaking or rupturing the posterior capsule.

(2) The anterior chamber may tend to shallow during the phacoemulsification process. The most common cause for this is gaping of the wound due to inadvertent lifting of the anterior lip of the incision with the ultrasonic needle. Other possible causes are positive vitreous pressure, pinched outer silicone sleeve of

the ultrasonic needle, decreased flow of irrigation fluid, a depleted reservoir bottle, or widening of the wound due to dehiscence (especially with scleral pocket incision).

(3) Traumatization of the iris and anterior chamber structures can occur during phacoemulsification. If the entire port of the ultrasonic needle is occluded by burying it in the nucleus while the phacoemulsification process continues, the needle will break through the nucleus, causing the adjacent structure (such as the iris, anterior or posterior capsule) to be aspirated and traumatized. The tip of the ultrasonic needle should be used to shave the nucleus, rather than to gouge it. Other causes for trauma to anterior segment structures are inattention to the adjacent structures, use of high power, and inability to bring up the nucleus into the iris plane during piecemeal removal of the peripheral nucleus.

(4) Occasionally it is not possible to prolapse the nucleus into the pupillary plane because the lens has not been sufficiently sculpted centrally to allow the nucleus to become malleable and to fold onto itself.

(5) With a dense, hard, cataract, the ultrasonic tip may be buried into the nucleus or the nucleus might have been impaled through and through, making it difficult to disengage the nucleus from the ultrasonic needle. This problem is easily solved by introducing a second instrument through the stab incision at 2 o'clock using the two-hand technique or through the stab incision using the one-hand technique and pushing the nucleus away.

(6) A hard remaining fragment may not feed into the ultrasonic needle at high power settings. Instead, it will chatter against the ultrasonic needle each time emulsification is attempted. It is then necessary to lower the power setting to emulsify the nucleus.

(7) If a surgeon finds disengagement of the nucleus from cortex difficult, then it is prudent to remove the ultrasonic needle from the eye and inject sodium hyaluronate between the anterior capsule and the nucleus, subsequently creating a dissecting plane between cortex and nucleus, and allowing the nucleus to be freed.

(8) Removal of a soft cataract with the two-hand technique may not be satisfactory because the spatula will macerate the cataract. To prolapse the superior pole, the peripheral nuclear shelf has to be hard enough to translate the pressure of the spatula against it. Similarly, with the one-hand technique, sculpting of the central core of the nucleus should be kept to a minimum because rotation of the lens may be more difficult once the bulk of the cataract has been removed.

(9) The surgeon may find the view of the anterior segment is obstructed by corneal striae due to distortion caused by the cyclodialysis spatula or the placement of the cataract incision anteriorly in limbus or clear cornea. Occasionally, this problem can be alleviated by raising the intraocular pressure by increasing the height of the irrigation bottle.

(10) After about Vz to Vs of the nucleus is removed, the nucleus may tumble. The sharp peripheral edges, if any, may tear the posterior capsule. If at all possible, tumbling should be avoided.

Problems During Cortical Removal

(1) Failure to occlude the port of the irrigation-aspiration needle, thereby failing to achieve sufficiently high vacuum for aspiration.

(2) Timidity of the surgeon in sweeping the capsular fornix to engage cortex and thereby occlude the aspiration port.

(3) Accidentally engaging the anterior capsular flap while sweeping the capsular fornix to remove cortex.

(4) Failure to immediately recognize aspiration of the posterior capsule. The star pattern around the aspiration needle is pathognomic of this problem. The problem can be avoided by restraining one's zeal in removing cortex or vacuuming the posterior capsule, recognizing a thin, fragile posterior capsule (so-called floppy posterior capsule), and properly focusing the microscope on the posterior capsule during removal of cortex.

(5) Difficulty removing cortex at 12 o'clock. If cortex cannot be removed easily, leave it in situ, instead of making heroic aspiration attempts. The cortex may possibly be removed at the 12 o'clock position by introducing a second instrument under the irrigation-aspiration needle and retracting the iris toward the incision and exposing the area. The second instrument may be introduced laterally through the stab incision if the two-hand technique of phacoemulsification is used.

(6) Tenancious cortex is occasionally encountered and is difficult to remove, even in the best hands.

I hope that this description of my technique which has been used for many years on hundreds of patients you can start phacoemulsification and with time develop your own technique. Let me conclude by saying that cataract surgery gives excellent result. Phacoemulsification can give even better results once you have mastered the approach. I would advise that you learn my technique as it will give you a strong concept of how the phacoemulsification machine works. There are many new ideas of how phacoemulsification should be done. You will have to decide which technique you would prefer. There are also new phacoemulsification machines, each with their own characteristics and advantages.

If you learn phacoemulsifiation carefully, step-by-step, with a good teacher you will enjoy the technique and your patients will benefit from the excellent result with little astigmatism.