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# SURGICAL MINUTIAE

## HOW TO MASTER CAPSULORHEXIS

*John Bolger*

To understand capsulorhexis best and thereby master it, consider a plain sheet of paper. If one holds it in two hands along one edge as a matador holds his cape (Fig. 1) one can get a ready idea of the strength that a continuous edge possesses. Tugging adroitly with increasing force along the line of the edge will show that considerable force needs to be applied before the edge will rip. Now repeat the experiment but first make a tear at right angles to the edge. One will find that there is almost no resistance to the tear extending even with the most gentle tugging.

### *General Principles*

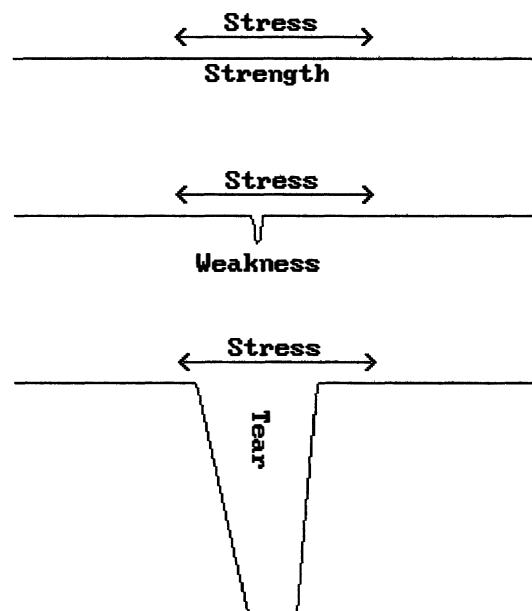
All the advantages of capsulorhexis are due to the great strength of a continuous edge. This phenomenon is utilised in packaging of goods, particularly when the packaging material is a cellophane-like wrapping. The manufacturers provide a pre-formed cut with the adjacent admonition to 'Tear Here'. Attempts to tear the packaging elsewhere are frustrated by the strength of the wrapping which, if the attempt is persisted with with increasing determination, may suddenly burst asunder spewing the contents everywhere.

The purpose of capsulorhexis is to open the capsule without a radial tear which might at any time, either during or after the operation, extend and allow the contents of the bag to shift. The tear must therefore be closed on itself. This means a circular or nearly circular opening in the anterior capsule.

Although we owe a great debt to Neuhann and Gimbel for the introduction of capsulorhexis it is Leif Corydon who has examined the parameters affecting the procedure. He has shown that a continuous torn edge has extraordinary tensile strength which is lost once there is a break in the continuity. He also showed that the tearing forces are in the surgeon's favour if the anterior capsule is flat as it is when the anterior chamber (AC) is deep. Conversely, in a shallow AC with a convex anterior capsule, the tear

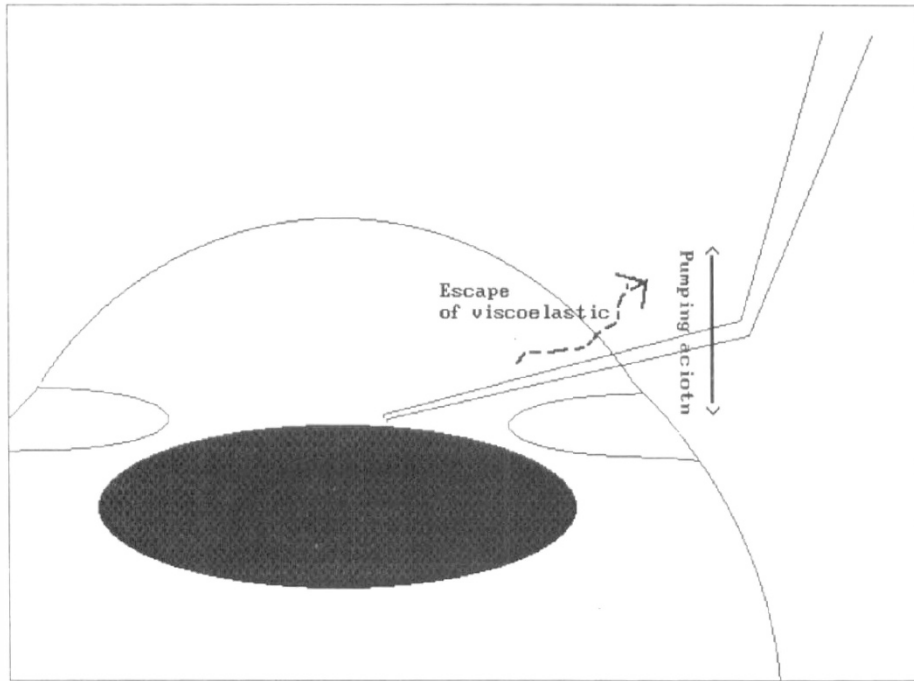
will tend to run towards the equator to the detriment of the operation.

Capsulorhexis is best executed, therefore, in a deep AC. The surgeon may use either viscoelastic and forceps, or a needle connected to the infusion bottle raised high enough to give adequate depth. A common error when using forceps and viscoelastic is that the surgeon can fail to ensure that the fulcrum of all intraocular movement is at the wound (Fig. 2). Movements about any other point will manipulate the wound and cause a pumping action to take place within the AC so that after a few strokes the viscoelastic will have left the eye with a consequent shallowing of the AC. This shallowing allows the anterior capsule to become convex thereby changing the tearing vectors to those favouring a tear towards the equator. The surgeon, concentrating on the tearing manoeuvre, usually does not notice that this change has occurred and is disappointed to find the tear running to the periphery and out of his or her control. It is very helpful, therefore, to imagine the forceps or needle as being an oar and the incision



**Fig. 1.** *The strength of a continuous edge.*

Correspondence to: John Bolger, The Cataract Clinic, Kinetic Centre, Theobald Street, Borehamwood WD6 4SE, UK.



**Fig. 2.** *The importance of the point of entry being the fulcrum of movement.*

into the eye as being the oarlock. That way all movements both antero-posterior and lateral are about the entry wound and the eye remains still and AC will not shallow.

*How To Commence a Capsulorhexis*

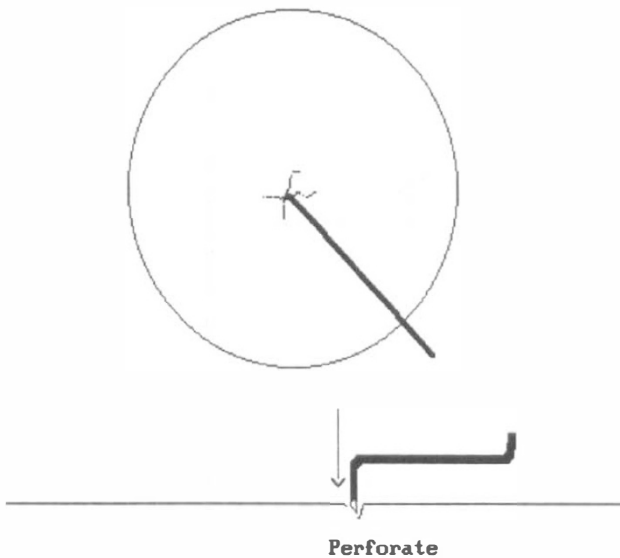
A sharp point is needed to pierce the anterior capsule. The best is the tip of a capsulorhexis needle or irrigating cystotome. Place the point in the centre of the anterior capsule and push posteriorly to penetrate into the anterior cortex (Fig. 3). Advance the needle forwards (inferiorly) about 1 mm and then, still moving the needle in the same direction, bring the tip back out of the cortex into the AC.

These movements are shown in the diagrams. The final movement is a curved slashing movement which results in a tag of capsule flapping in the AC (Fig. 4).

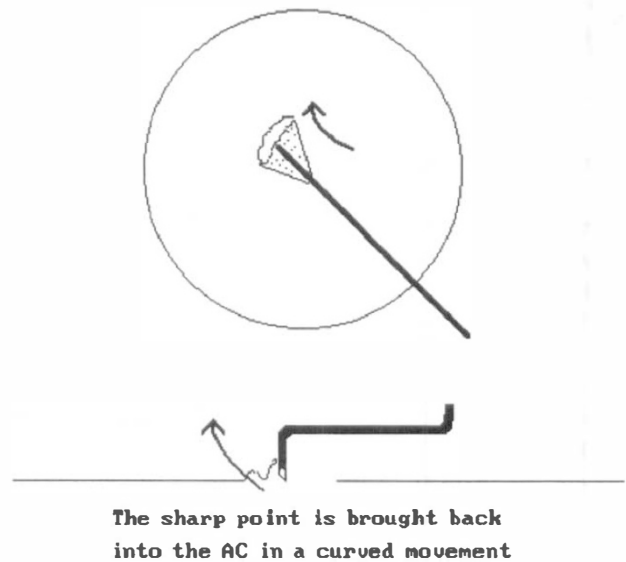
The same method of commencing a tear can be employed using a capsulorhexis forceps which have pointed ends, such as Corydon forceps.

*How To Continue the Tear*

To continue the tear, grasp the tag of anterior capsule with the forceps and fold it over in such a way that it lies almost flat on the anterior surface of the lens. The tag will lie in such a way that the anterior surface of it was originally the posterior or inner surface (Fig. 5). Concentrate on one of the two



**Fig. 3.**



**Fig. 4.**

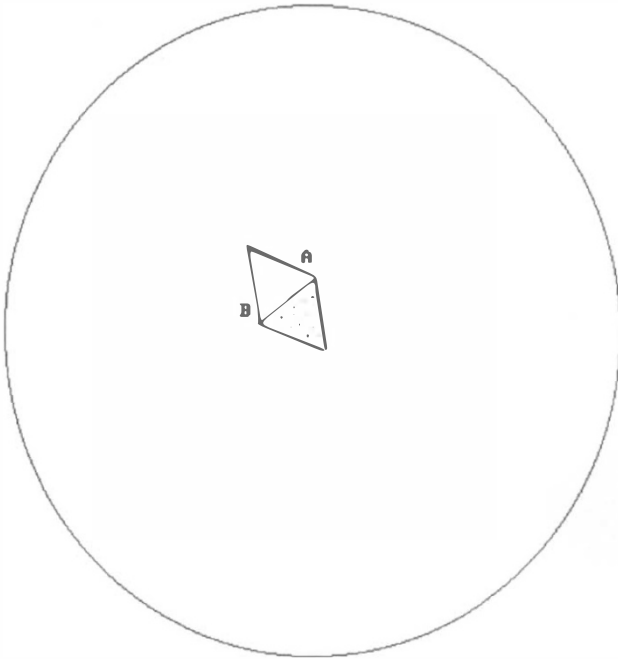


Fig. 5.

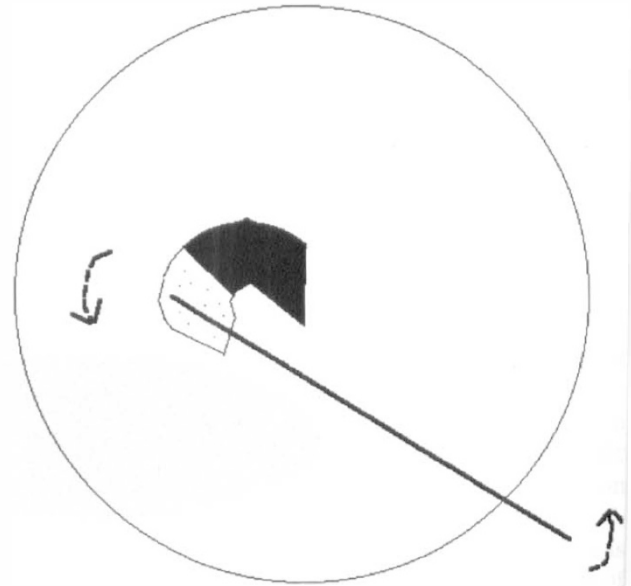


Fig. 6.

edges (A or B) of the tag and begin pulling it in the desired direction (Fig. 6). Aim for an opening of about 5–6 mm. Re-grasp the tag frequently, at least every 2 or 3 clock-hours, but before releasing it stand it up in the viscoelastic so that you may all the more easily re-grasp it. If it is flat on the anterior surface of the lens it will be difficult to get another grip on it.

It is often about half-way around that the tear begins to attempt to run to the periphery. If this happens the surgeon will do well to pause and consider the factors which can cause this. Almost

always it is because the AC has become shallow and the tearing vectors are now pulling the tear to the periphery (Fig. 7). The corrective action is to deepen the AC with more viscoelastic and to continue. The surgeon will usually find that once the AC has been re-deepened the tear will be easy to control.

If the tear has escaped far to the periphery it is sometimes safer in order to continue the capsulorhexis to unfold the flap and pull in the opposite direction. By unfolding the flap the surgeon can more easily retrieve the escaping tear and once it has

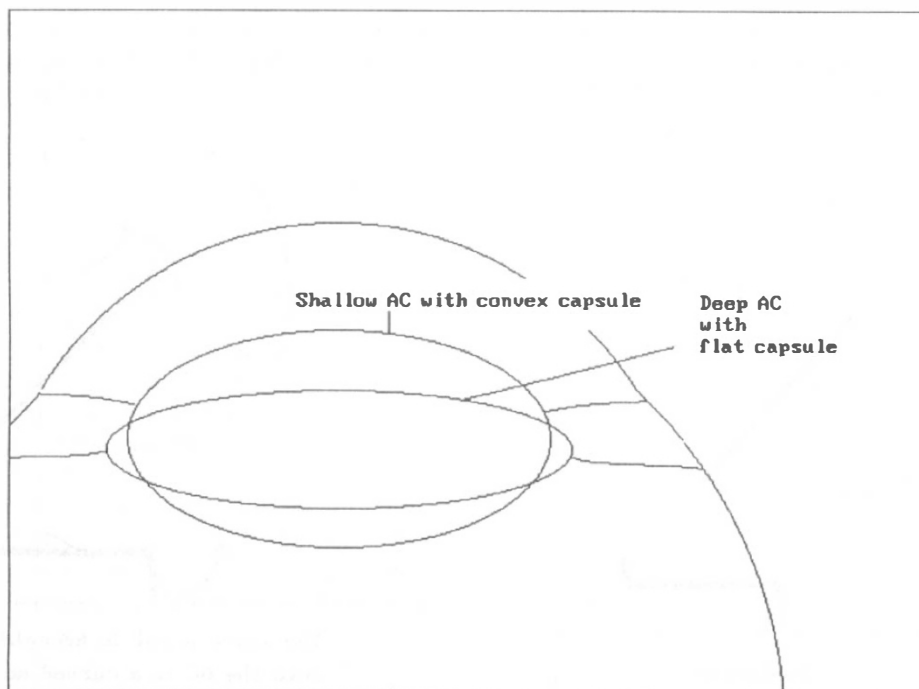


Fig. 7. The importance of a deep anterior chamber for capsulorhexis.

returned to the intended position it should be folded over again and conventional tearing recommenced.

If the tear has gone beyond what can be retrieved the surgeon can continue with a can-opener technique and safely complete the capsulotomy. The surgeon must never pull the capsule flap if he or she is not certain where the tearing point is, because it is possible for the tear to go round the back of the equator. In this situation the surgeon may unwittingly be tearing the posterior capsule with disastrous consequences.

#### *How To End the Capsulorhexis*

Ending the capsulorhexis is easy. It is important that the tear be completed from outside inwards. This avoids a potential weakness of an ending pointing to the equator. In practice the capsulorhexis tends to end easily in the correct manner but nevertheless the surgeon can never rely on too much automation. It is rarely necessary to remove the loose anterior capsule as it usually comes out during the course of the operation. However, the surgeon should check at the end of the operation that this has happened. A favourite hiding place for loose anterior capsule is either in the wound or in a paracentesis site.

#### *The Size of the Capsulorhexis Opening*

The appropriate size of the opening depends mainly on the method by which the cataract is to be removed, but also on the surgeon's beliefs about whether the optic should be covered by the anterior capsule or not.

Manual expression is contraindicated for use with capsulorhexis. This is because of the relatively high risk of inadvertent intracapsular extraction as the vitreous pressure pushes out the lens. Only viscoexpression, hydroexpression or phacoemulsification can safely utilise the advantages of capsulorhexis. For viscoexpression and hydroexpression an opening less than 5 mm is not safe while any opening greater than 6 mm will easily allow the egress of any type of cataract. Phacoemulsification can be carried out through the smallest of openings but any opening must be big enough to allow the implant easy entry to the bag. Openings of 4 mm or less risk zonular disinsertion or anterior capsule tear as the optic is forced through. Also, post-operatively, such small openings tend to fibrose in a purse-string fashion bringing the anterior capsule into the pupil area and causing symptoms. For these reasons any capsulorhexis opening needs to be between 5 and 7 mm in diameter.

#### *Capsulorhexis in Difficult Cases*

Capsulorhexis is greatly facilitated by the presence of a red reflex. For this reason it can be more difficult to perform with older microscopes where the illumination is not via a halogen source. The most recent microscopes have greatly improved the red reflex and facilitate carrying out capsulorhexis. The most difficult type of cataract in which to perform capsulorhexis is a white mature lens where not only is there no red reflex but the bright background of the lens makes visualisation of the capsule flap almost impossible. In these cases I find that I must work with full microscope illumination with the operating room lights off. Then I am just about able to see the edge of the capsule and to follow the tear. Sometimes the only clue to where the edge lies is the movement of the tearing edge itself and by watching this fixedly I can usually manage to get a complete continuous capsulorhexis. If I fail to achieve a continuous capsulorhexis I do not continue with phacoemulsification and convert to full incision surgery.

The development of the Klöti Radio-Frequency Probe has made capsulorhexis easier to achieve in a greater number of patients. The radio waves heat the tip of the probe hot enough to coagulate the capsule and by drawing a circle with it on the lens surface a continuous opening is achieved. Clinical experience indicates that the opening is not as elastic as one obtained by tearing so that less stress may be put on it safely. Nevertheless the Klöti probe allows safe capsulorhexis in difficult cases.

There is a clue to be got about the state of the zonule when starting a capsulorhexis. If the zonule is weak, as in an advanced case of pseudoexfoliation, the capsule surface will be flaccid when one attempts to puncture it. The surface will indent like a soft cushion rather than perforate like the skin of a drum. When I encounter this sign I proceed with extra caution and lower my threshold for conversion to full incision surgery.

#### *Conclusion*

The most important requirement of all for successful capsulorhexis is patience. Howard Gimbel has said that he will spend 15 minutes if necessary to get the tear right. A surgeon who is prepared to slow this part of the operation right down will master the procedure more readily than one who tries to complete the capsulotomy in the same time as their current technique. A relaxed and unhurried style will more quickly allow the surgeon to progress and master the skill of capsulorhexis. Once it is mastered, surgeons will find that new doors of surgical excellence will be opened to them.