Ultrasonic Capsule Polisher: A New Instrument and Technique
Terence M. Devine, M.D.

ABSTRACT
An ultrasonic I/E capsule polisher is described. The instrument is capable of safely removing dense cortical plaques which could not be removed with conventional instruments. Its use for both capsule polishing and cortical clean-up is discussed.

With improved instrumentation and technique, cortical clean-up has become a controlled and generally meticulous step in extracapsular surgery. When it comes to polishing the posterior capsule, however, the surgeon’s efforts are occasionally frustrated by the presence of a dense plaque or cortical precipitate which cannot be removed with conventional instruments. While these plaques may not progress postoperatively, they can have a significant visual effect if present in the visual axis and, therefore, may necessitate a capsulotomy. An ultrasonic I/E capsule polisher has been developed which can remove the densest capsule plaques safely and simply.

DESCRIPTION
The instrument consists of a modified ultrasonic I/E hand piece as originally described by Keates.1 It is designed for use with the Heslin/MacKool Ocusystem with modifications in the instrument tip as well as in the console controls.

The instrument tip (Figure 1) utilizes the standard rigid infusion sleeve which is essential for optimum operation within a closed system. This allows precise control of anterior chamber depth at changing evacuation pressures while maintaining a constant selected evacuation rate. The evacuation port has been moved anteriorly and angled toward the tip to allow easy approximation to the posterior capsule as well as improved visualization. The port is camphored and polished to eliminate sharp edges during the capsule cleaning technique.

The console has been modified to allow control of ultrasonic power between 0 and .1 in increments of .01. (Between .1 and 1.0 the power is controlled in increments of .1 as usual.) The evacuation pressure has been reduced to provide a minimum setting of −32 mm Hg.

SURGICAL TECHNIQUE
The ultrasonic I/E capsule polisher can be used for cortical clean-up as well as capsule polishing.

For cortical clean-up, the evacuation rate is initially set at 4 cc/min and the evacuation pressure at −150 mm Hg. At this evacuation rate, there is little tendency to draw material to the evacuation port, and the tip can, therefore, be easily maneuvered beneath iris and anterior capsule to engage equatorial cortex. The evacuation pressure of −150 mm Hg is sufficient to hold cortex without pulling it into the tip and, therefore, allows controlled stripping. Should iris or capsule become inadvertently captured, there will be no damage at this pressure, and the surgeon can disengage by returning to pedal position one (infusion). This automatically vents the tip to the higher reverse flow bottle, eliminating suction. If material has been substantially drawn into the tip, it can be regurgitated with the reverse flow pedal.

From the Department of Ophthalmology, Guthrie Medical Center, Sayre, Pennsylvania.

The author has no financial interest in this device.

Manuscript received July 24, 1984. Accepted for publication October 26, 1984.

Requests for reprints should be addressed to Terence M. Devine, M.D., Department of Ophthalmology, Guthrie Medical Center, Guthrie Square, Sayre, Pennsylvania 18840.
In situations where it is desirable to bring material to the tip, the evacuation rate should be increased. For example, when performing a capsulotomy for “in-the-bag” lens placement, the author prefers to maintain a prominent anterior capsular cuff at 12 o’clock position (Figure 2). This allows direct visualization of superior haptic placement within the bag. Such an arrangement requires a variation in cortical clean-up technique. Rather than maneuvering the tip to the equator as is done in other quadrants, the tip is placed beneath the anterior capsule cuff with the evacuation port facing posteriorly (Figure 3). This is facilitated by raising the infusion bottle to deepen the anterior chamber and using only infusion until the tip is properly positioned. Evacuation rate is then increased to 6-8 cc/min, and cortical remnants will be drawn to the stationary port (Figure 4). When occlusion is complete, stripping proceeds as usual.

Once a large cortical remnant is adequately stripped, ultrasound is utilized to “draw” the material into the tip. The ultrasonic power should be adjusted to the minimum level that will evacuate the occluded port without “cutting loose” the engaged cortex. This avoids having to chase and re-engage loose cortical ends. The proper setting with the author’s handpiece is approximately .07.

To remove dense capsule plaques the evacuation rate is set at 1 cc/min. The infusion bottles are adjusted to produce an intraocular pressure of 25 mm Hg, as discussed in a later section. Evacuation pressure is reduced to −32 mm Hg, and ultrasonic power is set at .1. The capsule is then engaged in the evacuation port, and a vacuuming procedure is initiated. Attention must be directed to the apposition of capsule to the evacuation port. At the given settings, there is little tendency to draw capsule into the port and create the dramatic “spider” or “star” pattern which occurs with excessive traction (Figure 5). Capsule should be gently approximated to the evacuation port, yet still produce complete occlusion as indicated by the audible feedback (repetitive beeping). The tip is kept in a slow
continuous movement, and only a faint “spider” pattern should be created (Figure 6). When this condition is obtained, ultrasound is engaged, and the power is slowly increased by the console operator until the plaque begins to peel away from the capsule. This is generally accomplished between ultrasonic power settings of .1 and .3.

DISCUSSION

The ultrasonic I/E capsule polisher has been used to remove capsule plaques for over six months at the Guthrie Medical Center. In all instances, the plaque removal was initially attempted with persistent use of a Kratz scratcher. When this was unsuccessful, the ultrasonic I/E capsule polisher was used and successfully removed all plaques with two exceptions.

Both cases were performed prior to the described modifications in the tip and console. In both instances, the capsule plaque was partially removed when the capsule was drawn into the port producing an obvious “spider” pattern. Continued ultrasonics produced a small oval hole at the point of capture. In neither case did vitreous protrude, and in both cases posterior chamber lenses were successfully implanted within the capsular bag without enlarging the tear.

The current technique is based on the following rationale. The effect of low evacuation rate is to minimize the tendency for the capsule to suddenly move to the tip. Instead, the desired occlusion is produced by moving the tip to the capsule. This allows the surgeon to glide over the capsule without producing a series of grabs and releases. As occlusion is obtained, the low


table

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Ultrasound Power</th>
<th>Evacuation Pressure</th>
<th>Evacuation Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cortical clean up</td>
<td>0.07</td>
<td>-150 mmHg</td>
<td>4 cc/min</td>
</tr>
<tr>
<td>Cortical clean up at 12:00</td>
<td>0.07</td>
<td>-150 mmHg</td>
<td>6-8 cc/min</td>
</tr>
<tr>
<td>Dense capsular</td>
<td>0.1-0.3</td>
<td>-32 mmHg</td>
<td>1 cc/min</td>
</tr>
</tbody>
</table>

**FIGURE 9**: Summary of suggested control settings.

evacuation rate produces a slow gradual rise in evacuation pressure until the pressure limit of -32 mm Hg is reached. At this point, the capsule should form a “drumhead” (Figure 7) against the evacuation port rather than be drawn into a “peak” within the tip (Figure 8). This “peaking” appears to be the critical requirement for ultrasonics to cut capsule. To avoid this situation it should be remembered that capsule configuration against the evacuation port is determined not only by the “pull” of negative evacuation pressure, but also by the “push” of positive intraocular pressure. This net transportal pressure is directly proportional to the tendency for capsule peaking to occur. Since evacuation pressure has already been minimized with the console controls, and intraocular pressure is determined by infusion bottle height, it might seem ideal to work with the infusion bottle at its lowest position. There is, however, another factor to consider.

Just as a loosely draped curtain is more easily sucked into a vacuum cleaner than is a taut fabric, so capsule “tautness” tends to oppose the “peaking” effect of transportal pressure. Since capsule tautness is directly proportional to intraocular pressure, it becomes apparent that a “happy medium” must be struck for infusion bottle height.

In practice, the proper interplay between transportal pressure and capsule tautness appears to occur at an intraocular pressure of approximately 25 mm Hg. This can be determined intraoperatively by introducing the instrument tip into the eye and engaging position one (infusion). In this mode, the evacuation pressure readout on the console is a relatively accurate measure of intraocular pressure in positive millimeters of mercury. It remains for the surgeon to simply raise or lower the infusion bottle until this reading is obtained. With the evacuation pressure limit set at -32 mm Hg and evacuation rate at 1 cc/min, an operative condition is defined within which ultrasonic vacuuming of the posterior capsule becomes a safe and relaxed procedure. It should be emphasized, however, that raising the bottles to inflate the capsular bag fully not only introduces stretch forces on a relatively inelastic material, but also increases transportal pressure and predisposes to capsule or zonular rupture.

**CONCLUSION**

To our knowledge, this is the first time an ultrasonic instrument has been designed for use against the posterior capsule. Its safe and effective application depends upon an understanding of the surgical effects of fluid and pressure dynamics within the eye. With refined control of these parameters, the Heslin/Mackool Ocusystem has permitted expanded use of ultrasonics to include cortical clean-up and posterior capsule polishing. The principles and techniques discussed, however, apply equally well to non-ultrasonic cortical and vacuuming procedures. We believe that the greatest danger to capsule and zonules is not from ultrasonics, but from limited understanding and use of the fluid dynamics which create the surgical environment within the eye.

**REFERENCE**


---

**Letters to the Editor**

*OPHTHALMIC SURGERY* is pleased to publish Letters to the Editor. Such letters may concern a recent article in *OPHTHALMIC SURGERY* or elsewhere, may describe unusual clinical findings, or may comment on other matters of interest to ophthalmic surgeons.

The title and names of authors whose correspondence is published will appear in the Table of Contents and will be indexed. Correspondence that reports data must not duplicate material published or submitted for publication elsewhere.

Letters to the Editor must be limited to no more than two typewritten pages in length, and must be submitted in the format described elsewhere in *OPHTHALMIC SURGERY*.

If accepted for publication, Letters to the Editor will usually appear within three months from the time of acceptance. Galley proofs will not be sent to the authors.

SEPTEMBER 1985, VOL. 16, NO. 9

555