Since the introduction of torsional ultrasound in 2006, many surgeons around the world have embraced the enhanced efficiency of the side-to-side cutting movement of the phaco tip created by torsional ultrasound technology. I predicted at the introduction of the Ozil torsional ultrasound handpiece (Alcon Laboratories, Inc.) that this new technology would revolutionize cataract surgery.1-6

The torsional ultrasound modality causes the phaco tip to rotate slightly around its axis, inducing a twist that results in a significant sideways displacement of the phaco tip end. Figure 1 is a simplistic geometric approximation of the actual tip motion.

**COMPARISON OF CUTTING EFFECTIVENESS**

The phaco tip end displacement is dependent on the degree of asymmetry of the tip shaft. A straight tip induces very little phaco tip displacement. As the angle of the bend increases, more movement of the phaco tip cutting end occurs.

Current phaco tips are available with 12° or 20° bends. The 12° tip is favored by surgeons who are used to straight tips, but it has approximately 30% less tip end movement than the 20° bend tip.

Reducing the tip diameter and/or tip wall thickness also augments phaco tip cutting edge displacement. The mini-flared phaco tips, which are commonly used for micro-coaxial phaco, show increased cutting efficiency compared with the thicker tapered and micro tips.

**TIP BEVEL**

All tips are available with either 30° or 45° bevels; however, the 45° variety excels with torsional phacoemulsification. Its sharper tip provides enhanced cutting, especially during nucleus sculpting. The larger opening of a 45° tip also removes a softer nucleus more rapidly because greater holding force on the nucleus occurs during tip occlusion.

The greater bevel may also induce more repositioning of dense lens material on the tip. This prevents coring of the nucleus and, therefore, the need to frequently reposition lens material with a second instrument. The increased cutting of lens material may reduce the possibility of tip obstruction.7

**Table 1. The Performance of Various Tip Designs**

<table>
<thead>
<tr>
<th>Stroke</th>
<th>Tapered Kelman</th>
<th>Mini-Flared Ozil 12</th>
<th>Mini-Flared Kelman</th>
<th>0.9 Mini Tip Kelman</th>
</tr>
</thead>
<tbody>
<tr>
<td>At cutting edge</td>
<td>90 µm*</td>
<td>100 µm*</td>
<td>130 µm*</td>
<td>135 µm*</td>
</tr>
</tbody>
</table>
| * Rounded to the nearest 10 µm

Figure 1. A geometric approximation of the torsional phaco tip motion.
Some times necessitate retraction of the phaco handpiece longed occlusion, especially with denser nuclei. This can

**MICROCOAXIAL PHACO**

A NONFLARED TIP DESIGN FOR

The oscillatory movement of the torsional tip is highly effective in shaving lens material. When a flared tip design is used, the mechanism does not cause aspirated material to be jackhammered into and through the tip, as with traditional longitudinal phacoemulsification. Therefore, it is important for the material to be broken up into relatively small pieces that can pass through the lumen of the tip without obstructing it. If torsional vibration is interrupted, or if larger fragments of dense lens material enter the lumen, obstruction may result. Periods of prolonged tip occlusion halt the shaving process and decrease the tip’s efficiency.

The advantage of a bigger port opening is an increased holding surface and therefore holding power of the phaco tip. With flared tips, the larger port opening narrows into a smaller size lumen shaft, which reduces surge upon occlusion break. This type of flared phaco tip is particularly advantageous when using longitudinal ultrasound technology, in which high vacuum and aspiration flow settings are necessary to overcome the repelling effect of the longitudinal movement of the phaco tip. With torsional ultrasound, lower fluidics settings are safer and more effective.⁸,⁹

**FLARED TIP DESIGN AND PROLONGED OCCLUSION**

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**A NONFLARED TIP DESIGN FOR MICROCOAXIAL PHACO**

Flared tips repeatedly undergo brief periods of prolonged occlusion, especially with denser nuclei. This can sometimes necessitate retraction of the phaco handpiece to liberate the tip from nuclear material.

Recently, a small nonflared tip has been introduced. The size of the 0.9 Mini Tip (Alcon Laboratories, Inc.) shaft lumen (570 µm) is identical to that of the mini-flared tip. The outside diameter of the 0.9 Mini Tip is slightly smaller than the mini-flared tip at 800 µm versus 830 µm (Figure 2). The slightly thinner wall is probably responsible for the slightly increased cutting edge tip displacement. During clinical evaluation, I found that the 0.9 Mini Tip performed very well and did not show any significant prolonged occlusion, therefore enhancing overall cutting efficiency, especially in denser nuclei. For a video demonstration, visit eyetube.net/?v=wogof. The smaller port size theoretically leads to reduced holding force, but in clinical use this has not been a factor for me.

A comparison of the performance of several tip designs is shown in Table 1.

**CONCLUSION**

The 0.9 Mini Tip is the first phaco tip designed specifically for torsional ultrasound. The nonflared design prevents inadvertent prolonged occlusion, which in turn prevents unwanted temperature increase, as the phaco tip is sufficiently cooled by the aspiration flow. This new phaco tip shows a noticeably enhanced cutting efficiency on dense nuclei, but it is suitable for all densities. I highly recommend this new phaco tip for routine use with torsional ultrasound.

**TAKE-HOME MESSAGE**

- The nonflared tip design prevents inadvertent prolonged occlusion, and, thus, unwanted temperature increase.
- The 0.9 Mini Tip shows enhanced cutting efficiency on dense nuclei but is suitable for all densities.

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Figure 2. A comparison of tip dimensions.
OD = outer diameter; ID = internal diameter