New technology for improved outcomes
Originally, vibration used to remove cataracts was not based on ultrasound energy. Charles Kelman at one time removed lenses via small incisions, a collapsible "butterfly net" made of thin latex, and manual head vibration, according to the book *Phacoemulsification Surgery* by Rasik B. Vajpayee, M.D.

Using that technique, the pupil was dilated, a special enzyme loosened the zonules, and the patient was turned over on his face. His head was vibrated manually until the lens fell into the anterior chamber. Eventually the latex net was introduced to trap the cataract, which was mashed with a needle. The net and crumbled cataract were then pulled through the small incision, Dr. Vajpayee noted.

In other efforts at breaking up the nucleus before his phacoemulsification invention succeeded, Dr. Kelman employed the use of a drilling mechanism, an electric toothbrush, and a butcher shop device based on meat-grinding principles.

When he finally succeeded in using ultrasonic energy to emulsify the nucleus, the original handpiece was so heavy that it was suspended from a three-dimensional parallelogram during the three-hour procedure. Even with all that mass, Dr. Vajpayee noted, hard cataract removal with that device was out of the question at the time.

It clearly took a lot of effort to bring phacoemulsification into the modern age. Now, nucleus removal through microincisions is safe, effective, quick, and relatively painless.

It's easy to look back retrospectively and say that was a surgical revolution. But what about today? Are there revolutions still happening?

Indeed there are big advances, but cataract surgery has become so refined that we have to look more closely at what is emerging in the field. We're not going to see an electric toothbrush doubling as a phacoemulsification device, nor should we. We're long past that. So what should surgeons be looking at for mile markers of the ongoing cataract surgery revolution?

Consider torsional phacoemulsification as compared to traditional ultrasound. According to many in the surgical community, traditional ultrasound only works half the time it is in motion. The backward stroke doesn't touch the lens material, and so the logic goes, it only works 50% of the time.

Given that Dr. Kelman first employed ultrasonic strokes in phacoemulsification in 1967, it would seem that a lot of cataracts have missed out on a lot of emulsifying action time.

Enter OZil torsional phaco (Alcon, Fort Worth, Texas). Instead of longitudinal forward and backward ultrasound motion, the OZil torsional handpiece employs a side-to-side movement, leading to continuous efficient cutting. Ultrasound is no longer working only half the time, OZil torsional supporters note. It is no longer repulsing fragments with its forward stroke. Even emulsifying the nucleus becomes a cooler process because with more efficient cutting, less heat is generated.

It didn't take long for surgeons to get the idea. Not long after the OZil handpiece was launched in 2006, Teruyuki Miyoshi, M.D., Fukuyama, Japan, demonstrated the benefits of torsional phacoemulsification in his grand prize-winning 2007 ASCRS Film Festival video.

With any successful revolution, leaders must transition from winning over the status quo to putting revolutionary ideals into best practice. OZil has changed the way many surgeons use ultrasound technology. Like many advances, the technology continues to improve. Today, OZil has made a step forward with the release of OZil Intelligent Phaco. OZil IP is an intelligent energy management system that keeps material in the ideal shearing plane to increase cutting efficiency while increasing followability by keeping material flowing to the tip. The results yield even more improved efficiency for both the surgeon and the patient.

Richard Mackool, M.D., said, “The best advances in medicine are ones that have no learning curve; they’re just elegantly simple.”

Dr. Mackool, along with other OZil IP users Stephen Lane, M.D., Donald Serafano, M.D., and Lawrence Woodard, M.D., report no difficulty in introducing the IP element into their technique. They report great benefits, which they are eager to share and continue the kind of momentum toward phacoemulsification advancement that even Dr. Kelman couldn’t have imagined.
Combining the advantages of traditional and torsional phaco

Imagine torsional technology provided not only quicker, cooler, more efficient phacoemulsification, but it also had the ability to “think.” Now, it virtually does. The OZil torsional handpiece (Alcon, Fort Worth, Texas) can now be combined with an intelligent phaco (IP) application, which improves movement of nuclear fragments through the aspiration tip when it senses occlusion is imminent.

In traditional ultrasound, the phaco tip moves back and forth in a longitudinal manner. That is not ideal, according to Richard Mackool, M.D., director, The Mackool Eye Institute & Laser Center, Astoria, N.Y., because during backward motion, the tip does not emulsify anything. It’s not coming into contact with the nuclear fragments so it’s not working.

Forward motion of the oscillating tip isn’t ideal either because even though it’s cutting, it’s also repelling the nucleus away from the aspiration, making followability and other key cataract surgery ingredients less efficient.

Alternatively, the side-to-side cutting movement of the OZil torsional handpiece means that the tip is always in contact with nuclear fragments. Cutting simply doesn’t take a break, and nuclear fragments aren’t repelled either.

But sometimes, torsional can use some very brief help from its traditional ultrasound cousin. “The back-and-forth motion of traditional ultrasound is like a snake swallowing a mouse—it tends to move particles through the phaco tip easily,” Dr. Mackool said.

Since torsional doesn’t have that back-and-forth movement, OZil handpiece manufacturers have added the IP element, which allows the handpiece to give a few short pulses of traditional ultrasound whenever the tip comes close to full occlusion with nuclear material.

“You don’t usually need much traditional ultrasound—certainly less than 1% of the time,” Dr. Mackool said. “But when you need it, you need it. Otherwise the tip can become fully occluded in the process and reduce efficiency.”

Past users of the OZil handpiece had to recognize that occlusion had occurred and manually activate some linear pulses of ultrasound to remove the obstruction.

“The IP system now recognizes when an obstruction has occurred and at that point in time, throws in a preselected number of very short pulses of traditional ultrasound,” Dr. Mackool said.

These pulses can be customized. How long they last, how strong they are, and how many of them occur at a given time is up to the operator.

Take Dr. Mackool’s settings as a case in point. “When my system achieves 100% vacuum level, then the system knows it is fully occluded and throws in the appropriate...”

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tephen S. Lane, M.D., adjunct professor of ophthalmology, University of Min-
nesota, Minneapolis, has been using OZil IP (Alcon, Fort Worth, Texas) for a month, and already he is impressed with the new advances toward safety and efficiency. “It performs as advertised,” said Dr. Lane, who has performed 50 to 60 cataract cases using OZil IP.

For one, OZil IP secures nuclear material where it needs to be. “It keeps material at the plane of the tip and at the tip,” Dr. Lane said. “One of the things I noticed with the OZil torsional phaco is often the pieces of nucleus would come off and get stuck in the upper right quadrant. That’s because the material wasn’t necessarily being held at the tip. Now with OZil IP, there is very little to no material in the upper right quadrant because the IP holds the material on the tip much better.”

Another feature of OZil IP is improved followability. “OZil has excellent followability and attractability to the tip,” Dr. Lane said. “It oscillates in a torsional fashion as opposed to a longitudinal fashion, so torsional over standard phaco is a great benefit. The IP is even a step beyond that in terms of nuclear attractability and improved followability.”

OZil IP especially improves flow with more dense nuclei. “If you’re only using torsional phaco with the OZil handpiece there are occasions when the handpiece gets fully occluded and flow is interrupted,” Dr. Lane said. “With IP, there is an extra pulse of traditional longitudinal phaco, so the occlusion has been a non-issue so far in my experience.”

The changes IP institutes are no doubt subtle, which speaks to the quality of the standard torsional handpiece, but they are changes that are important in optimizing surgical outcomes. “IP is a further enhancement on an already very sophisticated system,” Dr. Lane said. “By enhancing the emulsification, improving followability, and decreasing post-occlusion surges, surgeons can keep the IOL environment in a much more steady state. Equilibrium of inflow and outflow is important so you don’t get fluctuations in anterior chamber depth.”

If anterior chamber depth fluctuates too much, a surgeon’s phaco tip could hit one of the vital structures in the eye, resulting in endothelial cell loss, damage to the iris, or a broken posterior capsule, Dr. Lane said. Occlusion also slows the pump function down so that there is less flow, less exchange of fluid, and heat can build up and cause problems such as wound burns, he said. OZil IP prevents these worst-case scenarios from happening.

“It is essentially a safety guard,” Dr. Lane said. “It doesn’t allow full occlusion to occur.

“Now I know high levels of vacuum aren’t being reached because the IP initiates so I can hear it or feel it in the handpiece,” Dr. Lane said. “I can literally hear a tone coming from the handpiece, which is the IP initiating. One thing that surprised me is that the IP kicks in more frequently than you might imagine. It kicks in relatively frequently even on softer lenses.”

After awhile, hearing that tone gives one a sense of security, Dr. Lane said. “It’s almost like a safety belt, giving me a feeling that I am avoiding potentially dangerous situations,” Dr. Lane said.

By enhancing the emulsification, improving followability, and decreasing post-occlusion surges, surgeons can keep the IOL environment in a much more steady state.

Key Points

- OZil IP enhances emulsification
- OZil IP increases followability
- OZil IP keeps the eye in a more natural IOP state
Then again, few—if any—safety belts actually increase automobile efficiency. The IP adds both safety and efficiency to the phacoemulsification procedure. “It’s an enhancement that allows emulsification of the lens material at the shearing plane of the needle without introducing a repulsion type of mechanism,” Dr. Lane said. “It allows vacuum to build to near maximum but not to the maximum, so I don’t get complications that arise at total occlusion. As a result, I can improve overall fluidics of the system and prevent post-occlusion surge.”

When using OZil IP, surgeons get added benefits without any need to change their technique, Dr. Lane said. “If you’re used to listening to the sounds of instruments during surgery, you might be a little startled by the new sounds coming from the phaco handpiece,” Dr. Lane said. “But it doesn’t require a change in technique, and I don’t see any downside in using IP.”

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It is important to keep the tip free from full obstruction. “You can’t bring anything to the tip during occlusion,” Dr. Mackool said. “The IP system says to itself, ‘Nothing is happening; activate the system, open the floodgate.’ As soon as that’s accomplished, it stops traditional ultrasound.”

IP brings a surgical advancement into clinic without surgeons having to do anything differently. “Show up and put the thing in the eye,” Dr. Mackool quipped.

There are some slight differences a surgeon may note when operating with OZil IP. “When IP activates itself, surgeons will hear a bell so they know it activated,” Dr. Mackool said. “If surgeons are working on a denser nucleus, they may hear one or two dings during the procedure.”

Previously, when surgeons noticed an occlusion with torsional phacoemulsification, they tended to overdo their use of traditional ultrasound, Dr. Mackool said. “Twenty percent of the time they were using traditional ultrasound,” he said. “You just don’t need that.”

But is it possible an occlusion could occur that would not be resolved by, for example, 10 preprogrammed pulses of traditional ultrasound?

“I never have persistent obstruction if I use 10 millisecond pulses and 100% vacuum,” Dr. Mackool said. “That relieves every obstruction I have ever had. I only need it less than 1% of the time. My settings are optimal or close to optimal for the great majority of surgeons using OZil.”

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Surgeons choose their preference with OZil IP’s customizable settings

Very once in a while, Donald Serafano, M.D., leaves his clinic for the hospital to perform cataract surgery. He might as well make the trip in a time machine. “The hospital still has a machine with traditional longitudinal phacoemulsification,” he said. “It’s like taking a step back in time.”

Dr. Serafano, associate clinical professor, University of Southern California, Los Angeles, isn’t being glib. He said he’s “startled by what I once thought was a pretty good technique” because longitudinal phacoemulsification turns out to be “a step back in time.”

Dr. Serafano switched to using torsional phacoemulsification four to five years ago and he’s been extremely pleased with the technique. “When I go back to traditional ultrasound, there’s more difficulty managing the case,” Dr. Serafano said. “It seems like the case is more prolonged, and I’m chasing fragments more.”

When Dr. Serafano gets to choose which kind of phacoemulsification to use, it’s a no-brainer. “I use 100% continuous torsional,” he said. “When IP became available, I added that on top.”

For the last six months, Dr. Serafano has been using the OZil IP software upgrade (Alcon, Fort Worth, Texas) in every surgery. He said there are many upsides to doing so, and the major benefit is continuous flow.

It’s easy to use, Dr. Serafano said. Just personalize the settings to begin with. “For me, anytime I reach 90% of my maximum vacuum, IP automatically clicks on and gives me 10 millisecond pulses of longitudinal, and that helps re-arrange the fragments on the tip so I get continuous flow,” he said. “If I had full occlusion at the tip, at that point I wouldn’t be getting flow to the tip. I like to have flow all the time, and OZil IP lets me have it.”

Some physicians may prefer to reach occlusion to some extent, Dr. Serafano said. “I think that surgeons who

OZil Intelligent Phaco Summary

- OZil IP is an intelligent energy management system that:
  - Enhances OZil emulsification by keeping material at the shearing plane
  - Increases followability by not allowing maximum vacuum to be achieved
  - Keeps the eye in a more natural state because IOP fluctuations are reduced
use more of a chop technique
use occlusion to help form the
chop," he said. "They want to
reach occlusion, chop the nu-
cleus with a horizontal or ver-
tical chop, and then proceed
from there."
IP is customizable and al-
lowssurgeonstochoose
when they want to throw in a
few pulses of longitudinal
phaco. While Dr. Serafano
sets the threshold at 90%—
largely because his technique
is more of a "divide and quad-
rant management," one in
which he usually doesn’t need
full occlusion—other sur-
geons may choose to set the
IP threshold at 95 to 100%
vacuum.
"The interesting thing
about IP is that you have the
ability to set the threshold and
also the milliseconds of longi-
tudinal pulse," Dr. Serafano
said. "You can perform a chop or sculpt and divide tech-
nique with it."
Dr. Serafano sees improved flow with IP as a matter of
efficiency. "If I can keep flow going, that should keep frag-
ments coming to the tip, which increases efficiency in terms
of how much time it takes to remove a cataract and also de-
creases the amount of energy required," Dr. Serafano said.
IP simply builds upon the strengths of torsional pha-
coemulsification, he said. "The downside of longitudinal all
the time is that you get repulsion," Dr. Serafano said. "On
the forward stroke, it would tend to chatter and push the nu-
cleus away, and on the back stroke nothing was happening.
You’re really only emulsifying the cataract 50% of the time
with longitudinal ultrasound."
Torsional, meanwhile, shears the nucleus all the time,
Dr. Serafano said, "right, left, right, left." Shearing works
best when the tip is not occluded, he said.
The default IP settings allow surgeons to add 10 mil-
iseconds of longitudinal phacoemulsification, although
some people go up to 20 milliseconds, Dr. Serafano said.

**Utilizing INFINITI**
with OZil Intelligent Phaco**

- Keeps eye in more natural IOP state
  - Without reaching full occlusion, pressure fluctuations in
    the eye are decreased, resulting in less surge

"It’s such a small amount of time," but it’s a sufficient jolt
to eliminate occlusion and then keep shearing efficiently, he
said.

Using OZil IP doesn’t require any technique changes,
Dr. Serafano said. "I think the reason that bimanual microin-
cision phacoemulsification never caught on was because it
required a lot of changes. In general, most ophthalmolo-
gists weren’t willing to do that. They didn’t see enough up-
side to warrant changes in what was already a successful
technique."

Dr. Serafano suggested that patients with especially
dense nuclei will benefit most from IP. "Those are patients
that we struggle with, and it’s in those patients that sur-
geons are trying to increase efficiency and make the case
safer," he said.

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Lawrence Woodard, M.D., is a big believer in anti-lock brake technology. “When people drive in the rain and have to stop suddenly, they used to be under-aggressive in how far they pushed the brake pedal,” said Dr. Woodard, medical director, Omni Eye Services, Atlanta. “Car companies realized that if they automated the braking, people would be more efficient in stopping the car.”

Dr. Woodard invites ophthalmologists to look at new surgical automation in the area of phacoemulsification in a similar light. Prior to using the OZil IP (Alcon, Fort Worth, Texas), Dr. Woodard was ultra cognizant about his Infiniti Vision System (Alcon) foot pedals, which could raise and lower vacuum and phacoemulsification energy levels depending on the mode they were in. The foot pedals still do that, but OZil IP has taken a lot of the guesswork out of ensuring safe and efficient settings.

Dr. Woodard often emulsifies the nucleus in foot pedal position 2 only, which uses vacuum exclusively. “If you have a very soft nucleus, often you can aspirate almost all that nucleus under vacuum,” Dr. Woodard said. “The trick and art to cataract surgery is trying to use as little energy as possible to remove a given density of nucleus.”

Before the advent of IP, that art was a little less sophisticated in foot pedal position 3, which uses a combination of vacuum and phacoemulsification energy.

Dr. Woodard described a scenario that traditionally could have happened and did happen. The tip suddenly becomes occluded in position 2 and the nucleus has not been completely aspirated. The surgeon then goes into position 3 in the hope of emulsifying the nucleus with the addition of phacoemulsification energy. If the nucleus is emulsified, the vacuum levels would drop since the tip would no longer be occluded. But vacuum levels could also rise very high in position 3 if the nucleus wasn’t being emulsified.

“That is what you don’t want,” Dr. Woodard said. “High vacuum isn’t a problem in position 2. But if the vacuum rises high in position 3 and it’s not emulsifying the nucleus, the tip will heat up because of the additional phaco energy being exerted.”

IP automatically prevents this from happening, Dr. Woodard said. “It senses the fact that the tip is occluded and vacuum levels are very high, so it gives a little longitudinal energy and increases followability,” Dr. Woodard said.

In other words, instead of allowing torsional phacoemulsification and high vacuum to continue ineffectively while the tip is occluded, the IP adds milliseconds of traditional longitudinal ultrasound, which helps to clear the tip.

“The OZil IP can identify what is going on faster than a human can,” Dr. Woodard said. “For instance, I may grab a piece of nucleus with the phaco tip, build vacuum and control how much energy I’m applying to emulsify it, but I may not efficiently move the material through the tip. The machine will pick up on that fact faster than me and add longitudinal energy to move the material and emulsify it. So I’m not spinning my wheels to emulsify the nucleus. Ultimately, that means I’m using less energy.”

Dr. Woodard said he has noticed a difference in cumulative dissipated energy (CDE) since using the OZil IP, although torsional technology has always been good. “With OZil, corneal clarity has always been excellent at the first follow-up visit,” Dr. Woodard said. “I was already happy with the corneal clarity and low CDE ratios before IP. I have, however, noticed a difference in the amount of energy I’m using.”

According to Dr. Woodard, most experts contend that a CDE of 10 or less is considered low energy usage. “For me, the average case prior to IP had a CDE of 4 to 5,” Dr. Woodard said. “Now I’m down to a 3 to 4. There’s no denying that the lower the CDE, the better the long-term results. Lower CDE will decrease the rate of endothelial cell loss over time, but this is something you have to follow many years out.”

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Surgeons recommend tools to use with OZil IP

While OZil IP (Alcon, Fort Worth, Texas) is an advancement in the surgical workplace, ophthalmologists must use it in conjunction with other devices at their disposal. Surgeons said that OZil IP allows them to go on with their personalized phacoemulsification technique untouched. That said, users of OZil IP recommend certain modalities, which they suggest other surgeons consider as well.

Lawrence Woodard, M.D., medical director, Omni Eye Services, Atlanta, used the OZil IP about 250 times in one month and said he prefers a 45-degree angled Kelman tip. “This works nicely,” Dr. Woodard said. “In the past I used a straight tip before I moved to torsional phacoemulsification, and I was a big supporter of that. Now I have started using an angled tip, which works well with IP. It is absolutely the tip I recommend.”

Dr. Woodard explained that torsional works by a side-to-side shearing movement, while longitudinal phacoemulsification moves forward and back. A straight tip works fine with the traditional ultrasound and that forward and backward movement, but OZil IP is optimal with an angled tip, Dr. Woodard said. “If you use a straight tip, the tip will move left a certain distance and then right a certain distance, and the overall distance is twice that radius,” Dr. Woodard said. “Everything is linear in that scenario.”

On the contrary, a rotated angled tip actually lengthens the distance the tip will move from left to right, Dr. Woodard said. “You need the angled tip to really take advantage of torsional,” he said. “The whole benefit of torsional is that if you have a certain piece of nucleus, the tip can touch multiple pieces of nucleus at the same time.”

With a straight tip, Dr. Woodard said he would have to manually move the tip—or the nucleus to the tip—a lot more with torsional phacoemulsification. But with the angled tip, torsional oscillation will move the tip to different places on its own, thus making the emulsification of nucleus more efficient, he said.

An OVD to protect the corneal endothelium

Richard Mackool, M.D., director, The Mackool Eye Institute & Laser Center, Astoria, N.Y., said that chondroitin sulfate is a good enhancement to cataract surgery. “I think the [Surgeons] don’t have to change their technique of lens removal, and it doesn’t require any new instruments. IP truly is intelligent phaco.

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unique value of chondroitin sulfate to protect the corneal endothelium is recognized by everyone but still vastly undervalued,” Dr. Mackool said. “It protects the endothelium so much better than anything else.”

In one experimental study, Dr. Mackool said, researchers found that dragging an IOL without OVD across the inside of the cornea completely denuded the cornea of endothelium. “It was like scorched earth,” he said.

The researchers then coated corneas with various viscoelastics. IOLs were again dragged across the inside of the cornea. “The researchers were shocked,” Dr. Mackool said. “There was no sign that the IOL had done anything to the cornea when chondroitin sulfate was used.”

There was a night and day difference between using chondroitin sulfate—specifically VisCoat (sodium chondroitin sulfate/sodium hyaluronate, Alcon)—and not using any, Dr. Mackool said.

Dr. Mackool said that when he coats the endothelium with VisCoat, below which he puts ProVisc (sodium hyaluronate, Alcon), the endothelium cell loss at one year is 1%. “It’s a ridiculously low level,” he said. Dr. Mackool noted that without having surgery, endothelial cell loss is 0.5% a year.

“When someone has a very low endothelial cell count it helps a great deal to use VisCoat,” Dr. Mackool said. “VisCoat has that characteristic of being difficult to be removed.”

Disposable tips to reduce cross contamination

Neither the OZil torsional handpiece nor chondroitin sulfate is the end-all of cataract surgery innovation. Tip technology, for example, continues to evolve.

Stephen S. Lane, M.D., adjunct professor of ophthalmology, University of Minnesota, Minneapolis, likes to use Intrepid Polymer I/A tips (Alcon), which are being newly marketed this year. This is a true single-use tip, Dr. Lane said. It therefore reduces the risk of cross contamination, he said.

I am able to achieve the same level of safety and flexibility with the polymer tip as I could with previous generation silicone I/A tips
"The cortex and other material can get stuck in other tips, which may be a potential nidus for toxic anterior segment syndrome (TASS)," Dr. Lane said. "The polymer material is not as soft as a silicone tip, but has the same attributes in terms of gentleness to the capsule and the ability to come very close and polish the capsule without the concern of breaking it. As a result I am able to achieve the same level of safety and flexibility with the polymer tip as I could with previous generation silicone I/A tips." The design also allows easy entry and exit from the wound, Dr. Lane said.

The tip is available in three configurations: a 20-degree curved tip, a 35-degree bent tip, and a straight tip, and is compatible with all MicroSmooth sleeves (Alcon) and Ultraflow handpieces (Alcon).

Whatever tools surgeons choose for cataract surgery, Donald Serafano, M.D., associate clinical professor, University of Southern California, Los Angeles, points out that they don’t have to change anything about their technique to use the OZiL IP.

"Surgeons can still use their favorite OVD," he said. "No special solutions are required, so they can continue using BSS (Balanced Salt Solution) or BSS PLUS (Alcon). They don’t have to change their technique of lens removal, and it doesn’t require any new instruments. IP truly is intelligent phaco."

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