Advances in capsular extraction and lens implant technologies have commanded significant attention in the world of cataract surgery. New implants allow surgeons to provide even higher levels of visual outcome, including spectacle independence and a continuous range of vision covering all distances. One of the enabling technologies that makes this possible is non-contact biometry offered by the IOLMaster. In just five years since introduction, the IOLMaster has become rapidly adopted as the preferred method for obtaining IOL calculations among the majority of surgeons in the U.S. and is used in 7,000 locations worldwide. Manufacturer Carl Zeiss Meditec engaged SM² Consulting to survey ten of its original customers to illustrate the impact this technology has made on cataract surgery. These surgeons also provided feedback on the newly-released Advanced Technology Software (referred to as Version 5).

**Introduction**

In the year 2000, Carl Zeiss Meditec launched a novel technology to perform biometry for IOL calculation that employed partial coherence interferometry (PCI). Unlike the two traditional methods of obtaining anterior chamber depth and axial length, applanation and immersion ultrasound, the proposition afforded by the IOLMaster was that it could gather more accurate results without touching the eye. Since that time, the IOLMaster has gradually become the preferred method among cataract surgeons in the U.S. for obtaining these calculations, as shown in Figure 1. Ten leading cataract surgeons who were among the earliest adopters of the technology were surveyed to better understand how the IOLMaster has impacted their practice as well as surgical outcomes. These surgeons (see Figure 2) also are among the first to use the newest release of the IOLMaster, known as Advanced Technology Software Version 5 of the IOLMaster.

**Axial Length Measurement: The Weak Link**

While cataract surgery has undergone tremendous transformation in terms of extraction and implantation technology, the field is perhaps now at an even greater rate of innovation. New lens technologies are allowing surgeons to provide spectacle independence for patients and achieve levels of accuracy (intended vs. actual correction) typically associated with LASIK. Most cataract surgeons understand, however, that their results are limited to the accuracy of the input variables, including axial length, K readings, and the formula used to determine the IOL dioptic power to be implanted. “While one perfect component won’t yield a perfect result, one poor component can lead to very poor results,” commented Warren Hill, MD. The weakest component in the system, according to these surgeons, had been the accuracy of the biometry. Now, with multiple years of experience, these surgeons are unanimous (10 of 10, 100% agreement).
100%) in their belief that IOLMaster is the standard of care for biometry and strongly agree that they would recommend the IOLMaster to other surgeons. As seen in Figure 1, this feat has been achieved through increasing adoption by surgeons over the past seven years.

Ease of Use

In 2001, applanation biometry was in use by the majority of practices, mainly due to its ease of use relative to immersion biometry (which was considered the “gold standard” at the time). “Now, we have a technology which is both the easiest to use and the best for our patients,” according to Samuel Masket, MD., who viewed this as an unusual combination of events. The relative ease of use of each of the technologies was rated by each of the surgeons, as shown in Figure 3. While the IOLMaster has traditionally been easier to use than either of the ultrasound techniques, surgeons feel the new Version 5 takes ease to a whole new level. “Every office had one tech who was best at applanation; this pressure was relieved with the IOLMaster,” noted Mark Packer, MD. “Earlier versions of the device required our techs to figure out how to shine the light around opacities using the joystick. Now, that’s not even necessary with Version 5. It’s fully automatic.”

Reading Through Dense Cataracts

One of the early concerns of surgeons when they first acquired the IOLMaster was its ability to read through dense cataracts. The surgeons were asked how often they had to use an alternative method to perform biometry. The range of responses is shown in Figure 4 both before and after the introduction of Version 5. Before Version 5, surgeons needed to use an alternative method 12 percent of the time on average. With Version 5, that need has dropped to 3 percent on average.

Automation of Scan Analysis

Given their long tenure with the IOLMaster, these surgeons literally marveled at the technical expertise and intelligence that has been progressively added to the device. Today’s IOLMaster with Version 5, they exclaim, has made the data capture virtually foolproof, as it gives technicians feedback using a green-yellow-red (i.e. traffic light) system to let them know that accurate readings are being taken. By using sophisticated signal-to-noise analysis, the device software is able to automatically exclude bad readings and create a composite best measurement for each eye. “We used to be left with a packet of A-scan images, trying to decide which one is best,” remarked Dr. Packer. “That burden has now been taken away.”
Use in Keratometry Readings

Another early concern was the accuracy of K readings obtained from the device. According to surgeons, IOLMaster’s automated keratometry has continuously improved with each release. Dr. Jack Singer MD believes K readings from the IOLMaster have always tended to be more accurate because of the skill and calibration issues associated with manual keratometers. “Ks are foolproof and faster using IOLMaster.” Dr. Hill, whose practice has a Javal Schiotz Ophthalmometer for performing keratometry, has stopped using it and relies solely on the IOLMaster Version 5. Their sentiment is shared by 60% of these surgeons who rated the IOLMaster as either more accurate than (4 of 10) or equivalent to (2 of 10) manual keratometry. The remaining 4 surgeons felt manual Ks are more accurate.

“Dr. Hill, whose practice has a Javal Schiotz Ophthalmometer for performing keratometry, has stopped using it and relies solely on the IOLMaster Version 5”

Throughput and Quality

Surgeons were adamant about how the device has improved overall quality of the cataract surgery process as well as outcomes. All surgeons either agreed strongly (8 of 10) or somewhat (2 of 10) that the IOLMaster has significantly improved patient flow in their practice due to its accuracy, speed and convenience for surgeons, technicians and patients. Beyond this, however, many of the surgeons interviewed brought forth how IOLMaster has helped solve a deficiency in the overall process: “Doctors often fail to recognize the costs they incur with poor results,” commented Richard Tipperman, MD. “This affects us both in having to spend additional time hand-holding unhappy patients and the negative word-of-mouth it creates. To measure this impact, surgeons were asked to estimate the direct impact on their time of an unhappy patient whose end result is one diopter away from intended. The surgeons in this survey indicated that such a patient would require nearly one additional hour of surgeon management time. (average of responses: 3.7 visits averaging 14.3 minutes per visit).

Return-On-Investment

Calculating return-on-investment (ROI) is an important decision when evaluating capital equipment expenditures. All ten surgeons in this survey were unanimous in their statement that the IOLMaster has provided a meaningful ROI for the practice. Using current reimbursement in the U.S., the payback period for these surgeons ranged from under six months to two and one half years. In addition, the time savings using IOLMaster (5 minutes) versus A-scan and manual K readings (up to 30 minutes) serves as an important component in the ROI equation.

Two additional questions were asked to help assess return on investment: When asked how this device compared in terms of relative value to other diagnostic devices in the practice, such as topography and visual fields, 90% (9 of 10) said IOLMaster was more useful than these other devices and the remaining surgeon viewed it as equally useful. To assist surgeons who already own an IOLMaster, these surgeons were also asked to use their experience with the new Version 5 and comment on its value relative to its cost. All 10 surgeons indicated it was worth the cost, with 4 of these 10 rating its value as higher and “definitely” worth the cost.

Surgeon’s comments in the survey revealed an intangible ROI that can’t be measured using standard accounting or time and motion methods. “Priceless” is how one surgeon described the peace-of-mind the device has given, citing less frustration and greater confidence in determining the right measurements prior to selecting the IOL power.

Patient Expectations

Surgeons in this survey commented that patient expectations for outcomes have changed dramatically in recent years. LASIK outcomes and the availability of advanced IOL technology have clearly impacted the typical patient consultation for cataract surgery, with patients increasingly seeking to be spectacle free for distance vision and, when choosing to have a premium IOL, at near and intermediate as well. “Patients judge the quality of surgery by the refractive outcome, and anything that improves...
this is a win-win,” remarked Dr. Tipperman. This sentiment seems to apply to all types of cataract surgery, as noted by Dr. Masket: “They may not be willing to pay more (for a premium IOL), but they definitely expect more.”

When it comes to the premium IOL category (defined in this survey as accommodating or multifocal technology), surgeons attribute even greater value to the IOLMaster, where the need to reach the target refraction is more critical given the additional fees paid by patients. Dr. Singer, whose practice is focused exclusively on intraocular refractive surgery, believes the IOLMaster has been an integral part of his surgical system: “The IOLMaster has allowed me to optimize the Haigis formula as part of my calculations,” he said. This in turn has allowed him to consistently deliver superior outcomes, which Dr. Singer believes has led to significant growth in his refractive lens exchange procedure volume.

The impact on each surgeon’s premium IOL offering was assessed by asking them to rate their confidence in offering IOLs both using and without using the IOLMaster. As shown in Figure 6, surgeon confidence is significantly higher (mean of 9.0 out of 10) when using the IOLMaster than without it (mean of 5.3).

**Discussion**

The role of technology in improving surgical outcomes cannot be underestimated in the ophthalmic profession. Cataract surgery in particular has benefited from numerous innovations over the past 50 years. What’s remarkable about the IOLMaster is that it has become a standard in such a short period of time, unlike both phaco-emulsification and the intraocular lens, each of which was available for several decades before becoming embraced on a widespread basis.

While not perfect, the IOLMaster Version 5 can be summed up as “pretty darn close” by this group of surgeons. The one caveat with the full automation offered by Version 5 is that surgeons may view it literally as a plug-and-play device. Dr. Hill believes it is important for surgeons to initially supervise measurements so they understand the entire process. And Dr. Packer recommends that surgeons who have invested in an IOLMaster also invest in one of the new state-of-the-art formulas rather than rely on one of the free ones available, which he likens to “driving a brand new car on old tires.”

The IOLMaster is making a significant difference in both the surgical process as well as outcomes for cataract patients. It is a tool that has arrived at the right time, allowing surgeons to extract greater value out of the lenses that are and will be available in the future.

Those who would argue that the IOLMaster is a “nice to have” rather than a “have to have” need to keep in mind that the cataract market of today and tomorrow is vastly different than that of just a few years ago. In addition to innovative technology, patient expectations have similarly risen to the point where cataract surgery is truly another form of refractive surgery.

This report was designed to help cataract surgeons evaluate whether they should acquire the IOLMaster or upgrade to Version 5. Hopefully, the passion and commitment among the surgeons participating in this project are self evident. They want to see cataract surgery become increasingly effective in step with improvements in safety. They view the IOLMaster as a “surgical imperative” that helps increase patient satisfaction and decrease risk of litigation (given that cataract surgery is the top reason for lawsuits filed against ophthalmic surgeons). In a world where consumers have greater choice, it seems reasonable to conclude that any patient who understands the difference between ultrasound and IOLMaster would insist on the latter. It appears that most surgeons agree, and we expect the IOLMaster to continue its penetration in the surgical marketplace.