Femtosecond Lasers in Cataract Surgery:
What You Need To Know

Femtosecond lasers, developed for refractive surgery in the 1990s, now have an application in cataract surgery. Known for their precision in LASIK¹, the latest generation of the laser moves the technology inside the eye to automate many of the steps of cataract surgery.

Femtosecond lasers use ultrashort pulses (10-15s) of near infra-red light to disrupt tissue with micron precision.² The surgical effect is produced by scanning thousands of pulses to produce a continuous incision or tissue separation. Guided by OCT imaging, a surgeon uses the laser to plan and automate the capsulorhexis (anterior capsulotomy), the corneal incisions and to divide the lens nucleus.

Four companies make a femtosecond laser with a cataract application – Alcon LenSx (Fort Worth, TX), LensAR (Winter Park, FL), Opti-medica (Santa Clara, CA) and Bausch + Lomb’s joint venture company Technolas Perfect Vision (Munich, Germany). Alcon’s LenSx Laser received the first FDA approval in 2009 and is the most progressed, with over 500 surgeons trained and over 10,000 procedures performed worldwide.³ LenSx is the only unit commercialised in Australia and

WRITER Jenny Saunders
Australian procedures account for 20 per cent of global. Two units are in Sydney, one in Melbourne and another in Hobart.

HOW IT WORKS
The LenSx procedure is day surgery, under topical anaesthesia, with the laser part completed outside the operating theatre. A suction contact lens docks the eye to the laser. High-resolution video and OCT imaging help the surgeon plan the treatment. The surgeon can see the entire anterior chamber from the corneal epithelium, to beyond the posterior capsule. Before activating the laser, the surgeon checks the docking, the capsulotomy location and plans the architecture of the corneal incisions and lens fragmentation. The laser operation is less than a minute. Phacoemulsification surgery further into the realm of refractive surgery. It will add safety, but the key is accuracy and predictability. You can use the laser with any style of implant, but even a standard lens has sophisticated aspherics and filters, and we want to utilise the lens to its best ability.

RESULTS SO FAR
Capsulotomy Precision and Reproducibility
Studies by Nagy show laser cut capsulotomies are more likely to have the correct diameter, shape, IOL coverage and IOL centration compared with manual techniques (100 per cent diameter accuracy +/- 0.25 mm versus 10 per cent). Capsulotomy architecture is important in maintaining the integrity of the capsular bag for IOL implantation and also impacts the effective power of the capsular bag for IOL implantation important in maintaining the integrity of the capsular bag for IOL implantation.

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Reduced Phacoemulsification Time
An underestimated benefit is the efficiency the laser brings to the cataract procedure. As the laser softens or divides the cataract, less phacoemulsification is needed during surgery. Associate Professor Snibson is using 40-50 per cent less phaco energy, with less fluid going through the eye, and he says this should translate to fewer complications, particularly in patients with corneal disease.

Better Wound Architecture
Cadaver eye studies have shown the femtosecond laser can produce more

A small case series presented at the 2011 European Society of Cataract and Refractive Surgery meeting showed, at 1-month, 83 per cent of patients were within 0.25 D of the target refraction compared with 64 per cent with traditional surgery. Fifty-eight per cent of laser patients were 6/6 uncorrected, compared with 27 per cent with traditional surgery.

Dr. Paul McCartney from Hobart Eye Surgeons said the study is small but important because it confirms clinically what we expected from the developmental studies.

“We are effectively bringing cataract surgery further into the realm of refractive surgery. It will add safety, but the key is accuracy and predictability. You can use the laser with any style of implant, but even a standard lens has sophisticated aspherics and filters, and we want to utilise the lens to its best ability.”

He also thinks the laser reduces the risk of complications such as posterior capsule tear, which is the major cause of complication in manual surgery. 10 “After the laser assisted lens fragmentation, the nuclear pieces are equal sized and phacoemulsification is more straightforward. You are working in the iris plane, not deep in the capsular bag, and because you are not as close to the posterior capsule, I believe it leads to a safer procedure.”

Better Wound Architecture
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said the predictability of the capsulotomy is one of the delights of using the femtosecond laser. “To draw a perfect exact size circle every time by hand is difficult. With the laser, I specify a 4.8mm capsulorhexis and that’s what I get. You can see the laser creating the circle perfectly.

Dr. Paul Hughes, Senior Managing Partner, Vision Eye Institute Southline,
intricate and more repeatable incisions than with manual surgery.11

Associate Professor Painter says the laser allows you to create a reproducible multiplanar wound that is difficult to construct by hand. “We believe it produces a more robust, more watertight wound and that’s what we’re seeing. It should resist deformation, such as if multiple wound that is difficult to create.”

Three plane incisions are known to be more resistant to wound leakage.12

Precisely controlled incisions may also improve refractive outcomes as the IOL calculation relies on, among other parameters, an estimate of the induced astigmatism. “With manual surgery we calculate the surgically induced astigmatism and then strive to do a perfect wound every time to produce exactly that same amount of induced astigmatism, to minimise the standard deviation of the wound creation. The laser produces the same wound every time, so there is no standard deviation. We know what we’ll get before we start,” said Dr. Hughes.17

WHICH PATIENTS?
Surgeons are using the laser on a high percentage of patients and especially with premium IOLs.13

Dr. Hughes says, “Premium lens patients want premium outcomes. We are now able to correct astigmatism intraocularly, plus the laser gives you the precision to locate the lens properly, again improving outcomes.”17

Toric lenses account for 18.5 per cent of implants used in Australia.14

Associate Professor Painter uses the laser for all grades of cataracts, but thinks another major benefit is for the complicated cases – pseudoxeulamnation, shallow chambers, high hypermetropes and endothelial compromise, like Fuch’s dystrophy.

LIMITATIONS
As with any new technology there is a learning curve as the surgeon learns how to dock the eye and interpret the imaging.15 An incomplete capsulorhexis is possible and is completed with a larger diameter treatment or torn manually.16

Surgeons have also learned to release the cavitary bubbles from behind the nucleus to avoid posterior capsule rupture.17 Patients tolerate the suction well, which is only a third of that used in LASIK, but it can cause the cosmetic concern of subconjunctival haemorrhage.18 There have been no reports of adverse events related to intraocular pressure rise.

The pupil dilation, by drops alone, needs to be beyond the intended capsulotomy size (5.5 mm). Filtering blebs, pterygium, corneal scarring may interfere with suction or visualisation of the anterior chamber. Patients need to be compliant (lie motionless and look at the fixation light) as they are conscious during the procedure.

There is an extra AUD$800 – $1,000 cost per eye, which at this time, is not covered by Medicare or insurance.17 As with premium IOLs, many patients will pay, whether motivated by potential vision, safety or simply because ‘a laser in the eye sounds much better than a needle’. If the technology proves to reduce complications, this also helps offset the extra cost.

PATIENT EDUCATION
New technology always interests patients and they will want to know if the laser cataract procedure suits them. Patients perceive the benefits very easily. They know a computer-controlled laser is more accurate than surgery by hand.

Ray Fortescue, EyeQ Optometrists, Ramsgate, has referred patients for laser cataract surgery and says in many cases the initial counselling comes from the optometrist. “I am already talking to cataract patients about different technologies to reduce their dependence on glasses and femtosecond laser will become part of that conversation. I think being familiar with the technology is essential for proper patient education.”17

“Manual surgery is very good, but I am seeing very neat incisions and I think there is the potential for reduced complications. The idea of the laser gives the patient a sense of comfort and if it’s the best for them, they want it.”17

THE FUTURE
Femtosecond lasers are getting considerable attention at conferences and are likely to change the way cataract surgery is done. Although we need more data to compare long-term visual outcomes, complication and infection rates, the early experience is promising. Access is improving with over 50 surgeons in Australia using the LenSx Laser, making it more available and more likely to be used. If you are interested to see a case live, most surgeons will accommodate your request. Once you are in surgery, seeing the surgeon’s approach to the workflow, seeing the incisions and the results, you’ll be in a better position to guide your patients about their surgical choices.17

References:
3. Data on File, Alcon Laboratories, Australia.
14. LENSx® LASER SYSTEM OPERATOR’S MANUAL, 80-0001 Rev. D
15. Personal communication with ophthalmologists interviewed for this article.

Jenny Saunders is an optometrist and medical writer who consults for the ophthalmic and medical device industries.

Laser Cataract Procedure

1. Topical anaesthesia and pupil dilation
2. Eye docked to laser with suction contact lens
3. Treatment planning (capsulotomy size and location, nucleus fragmentation, corneal and arcuate incisions)
4. Computer guided laser treatment (~ 1-minute) –
5. capsulotomy, lens division (from back to front) and incisions
6. Patient wheeled into theatre to complete phacoemulsiﬁcation and lens implantation

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