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Techniques & Technology

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Cataract surgery with Femtosecond lasers is approaching its practical application in modern ophthalmology. The purpose of this chapter is to update the reader in what is the state of the art of this technology in its application to the practice of cataract surgery.

Femtosecond lasers and their application to cataract surgery constitute a major innovation in modern ophthalmic surgery. These lasers, which act on the near infrared wavelength (1030 nanometers) are capable of penetrating the transparent and even opaque cornea, with the only limitation of an eventual corneal vascularization and the densely calcified plates. They are guided in their intraocular application by 3 dimensional image systems of the anatomy of the anterior segment of the eye. In this way they act in a very precise way, delivering energy to perform corneal incisions, capsulorhexis, softening or breaking the nucleus, thus enabling elimination of the cataract. The surgical procedure performed in this way, facilitates optimization of the surgical time, minimizing the surgeon's work (the least controllable variable of all those involved in cataract surgery) to the elimination of the cortical remains and the implantation of the intraocular lens.¹

From the technological perspective, for femtosecond lasers to be applied in cataract surgery, their numeric opening should be greatly reduced with the aim of penetrating the structures of the anterior chamber. Conversely, the diameter of focus of the laser should be larger than that of corneal surgery. This combination of physical elements leads to an increase in the energy limit needed to produce the adequate tissue photodisruption. This high energetic level needed to produce the crystalline lens lysis or fragmentation, results in a limitation of the repetition index of the laser to be maintained within the safety limits, due to the heat effect that the laser causes in this tissue.

The intraocular photodisruption is guided by image systems that use optical coherence tomography systems or optical technology in real time, such as the Scheimpflug, which is able to define with precision, the structures of the anterior segment up to the posterior capsule. Given that these elements are based on optical technology, they cannot penetrate the iris or the structures located behind the iris.

What is the importance of these lasers in cataract surgery during this initial stage of their application? It should be considered that the cataract surgery that is performed today begins with a small corneal incision which enables a manual capsulorhexis of the anterior capsule to be carried out followed by the phacoemulsification and the elimination of the lens fragments. At present, these procedures, although safe and efficient, are considered to depend greatly on the skill and experience of the surgeon.

Precise performance of the incisions is one of the immediate advantages of these lasers and for reason, the concept of Microincisional cataract surgery (MICS) plays an important and relevant role. MICS, a term coined by Professor Jorge Alió and registered in 2003, embraces the principles of
modern cataract surgery, which aims to perform the surgery through a minimal incision, with no refractive impact on the cornea.

Given that the femtosecond lasers can today guarantee the stability, precision, length, shape and width of the corneal incisions, this step has considerably improved. The capsulorhexis, essential step for the so-called "Premium" intraocular lenses, requires an optimum size, shape and centration for its performance to have a positive effect on the lens stability and in this way contribute to the success of the accommodative, multifocal and toric lenses and also to a reduction in the risk of early development of posterior capsular opacity. The capsulorhexis is one of the steps which depends most on the ability and experience of the surgeon, and is the step in which the fewest technological advances have been incorporated into in recent years, depending totally on the skill of the surgeon.

Finally, the energy delivered by the phacoemulsification tip (cavitation, shock waves and free radicals), damages the corneal endothelium. For all these reasons, a technology that can perfectly control the performance of the incisions and the capsulorhexis and minimize the use of the phacoemulsifier inside the eye, should result in a better surgical outcome and greater control of cataract surgery.

There are current studies by the different companies involved in the development of the femtosecond lasers, applied to cataract surgery, with respect to the improvement in the safety and the precision of the surgery. All these aim to avoid the collateral damage that the energy for the photodisruption may cause by controlling the length of the pulses and the levels of flow-limit of the energy delivered. In addition, the femtosecond lasers may enhance the outcome of the surgery by controlling and correcting preoperative corneal astigmatism using relaxing corneal incisions which have far greater precision and control than those that are performed with diamond knives available until now. In summary, the integrated systems of anterior segment image diagnosis, together with femtosecond lasers, modified for use in the structures of the anterior segment of the eye can provide multiple benefits for cataract surgery.

Different femtosecond technologies are currently being developed. All are technologically similar but differ basically in the way in which they capture the image of the anatomic structures of the anterior segment, in their versatility for surgical use and speed of action.

There are currently four International companies producing femtosecond lasers that are being applied to cataract surgery: LenSx (ALCON), LenSar, Catalys (OPTIMEDICA) and Victus (FEMTEC Technolase Perfect Vision, Bausch & Lomb).

**LenSx Technology (ALCON, Aliso Viejo—California, USA)**

This platform uses a femtosecond laser with a optical coherence tomography diagnostic unit with capacity for real time analysis of the intraocular structures (Fig. 12.1).

The surgical procedure with this technology begins with the fitting of a suction ring in the eye which in turn is attached to the optical system of the laser. At this moment, the OCT image captures the anterior segment in a single image, projected onto the screen with capacity for 3 dimensional manipulation of the image (Figs 12.2A and B). Using the software of the device, the incisions are located regarding their width, depth, profile and length (Fig. 12.3). In addition, the location of the capsulorhexis and the volume of the laser action inside the crystalline lens is determined by the use of the image software. With this data, determined by the software, the procedure is initiated by pressing the pedal.

The procedure is visible in real time while it is being carried out and lasts less than a minute (Figs 12.4A and B). The group that has acquired the most experience in the use of this laser is the group from the University of Budapest, directed by Dr. Zoltan Nagy. The application of this laser using MICS has already been performed by this team and Professor Jorge Alió in June 2010.

In Figure 12.5 the results obtained can be observed, regarding the precision of the incisions observing the comparison between femtosecond laser surgery incisions that are sub 2 mm and 2.75 mm, in which the full impact on the cornea with respect to the induction of corneal aberrations or astigmatic changes can be seen.

This group has also studied the precision of the capsulorhexis performed with this instrument and its clear superiority with respect to the manual capsulorhexis.

![Fig. 12.1 LenSx Laser](image-url)
The LenSx instrument can soften grade 1 and even grade 2 cataracts. Grade 2 + and 3 can be partially segmented, allowing in this way a more efficient division prior to phacoemulsification. Advanced grade 3 cataracts and over cannot be tackled at the moment by this technology.4

The LenSx technology will probably be available mid 2011 in Europe, once the CE mark is obtained.

**LenSar Technology (Winter Park – Florida, USA)**

This technology (Fig. 12.5) uses, an integrated confocal 3 dimensional platform which uses Scheimplug technology (CSI Technology) to create the image of the anterior segment. In contrast to the optical coherence tomography (OCT) the object plane, the lenticular plane and the planar image, are not parallel to each other but intersect in a joint straight line. The theoretical advantage is a greater depth of field which allows greater precision in the laser focalization. The laser is fitted to the cornea using a suction ring below. As with the previous platform, the image obtained of the anterior segment structures, which is observed in a monitor allow adjustment of the corneal incisions, the capsulorhexis and the fragmentation of the crystalline lens. This platform allows the lenticular fibers to be cut with multiple possible forms, including quadrangles, making it different from the others. This technology claims to be able to fragment even grade 4 and grade 5 cataracts, using the nuclear fragmentation in small cubes to facilitate the elimination of hard nuclei.

The CSI technology (3D Confocal Structure Illumination) using modified Scheimplug image, according to the data provided by the company, allows much more precise nuclear fragmentation than with the other technologies. The first experiences with this instrument were carried out in May 2010, and an experimental platform is aimed to be established in Europe during 2010.

**Optimedica Technology (Catalys System) (Optimedica Corporation – Santa Clara, California, USA)**

This technology has developed a femtosecond laser platform for cataract surgery. It incorporates an optical coherence tomography (OCT) image to draw the image of the anterior segment anatomic structures. This is known as the Catalyst system for lens surgery. The experiences with this laser, similar to the previous ones regarding capacity to create precise corneal incisions, controlled capsulorhexis with respect to diameter, location and shape, and nucleus fragmentation, have been satisfactory in the preliminary clinical trials (Fig. 12.6).
As with the previous laser, this laser can perform multiple options for fragmentation of the nucleus, with diverse possible forms.

**Victus Technolas (520F, Customlens) FEMTEC Technology (Munich – Germany) (Fig. 12.7)**

This company has adapted its femtosecond corneal laser for cataract surgery (CUSTOMLENS Technology). They have initiated clinical studies in Europe, in Heidelberg University, and these are expected to be extended to other countries during this year. This is the only technology that offers a combined instrument capable to perform both corneal and intraocular surgery.

**DIFFERENCES AMONG THE TECHNOLOGIES**

The femtosecond lasers for use in cataract surgery, require different parameters to those used for corneal surgery. These lasers need to penetrate more deeply into the eye (approximately 7500 microns compared to 1200 microns required for cornea surgery), and the four companies LenSx, LenSar, Optimedica and FEMTEC have developed very similar with respect to the creation of an efficient photodisruption for the creation of the capsulorhexis and the softening and fragmentation of the nucleus.

The four technologies use anterior segment diagnostic technology capable of drawing the anterior segment of the eye with precision. The LenSar technology uses an optic system which requires the extraction of data for the complete reconstruction of the posterior capsule, apparently similar to OCT technologies, which in theory can imply an limitation to its clinical application, although the initial clinical results confirm its precision.

At the moment, there are no comparative studies that can determine which of these technologies is better than the oth-
ers, although all three are different in terms of ergonomics, size and probably cost. 2011 will open a new era for the application of this technology in cataract surgery given that these three platforms will provide clinical results which will lead to their introduction, to cataract surgery, in the near or long term as a new reality. In any case, femtosecond technology will not eliminate the need for a modern phacoemulificator, as this is necessary to emulsify hard nuclei and the cataract fragments created from grade 2 and 2+ of hardness.

An important question raised by most of the surgeons and administration interested in these technologies is cost. An increase in about 600 US$ per operated eye is expected when introducing femtosecond laser technology in cataract surgery (approx cost of the unit will be about 500,000 US$ plus 150-300 US$ for disposables, plus taxes, loans and hidden costs). How this extra cost, very significant in today’s worldwide financial environment, will be absorbed by the practice is going to be the unresolved question for the cataract surgeon.

Our First Experiences with the ALCON-LENSX Technology

For those surgeons who are used to performing corneal surgery and especially LASIK with femtosecond laser, the learning curve will be easy and short. As occurs with LASIK, the key to the success of performing cataract surgery with femtosecond laser is the docking procedure. The docking is the first step of the surgery and it determines the safety and the accuracy of the whole procedure. It is essential to achieve a perfectly centered docking in order to continue with the surgery. Once the docking is done (Fig. 12.8) and the position of the eye is checked on the screen, suction is applied by simply pressing a button. Regarding the suction, the pressure level is lower than that of the corneal surgery platforms. This is an important point because patients who undergo cataract surgery are usually elderly and a large increase in the intraocular pressure would not be appropriate.

The next step is to center the treatment plan on the screen. First of all, the incisions have to be placed. We have used both, the standard microaxial technique and the microincisional technique (MICS). Our preference is to perform MICS and for this purpose we use two 1 mm microincisions to complete the surgery comfortably and a third incision placed on the steep meridian of 1.8, 2.2 or 2.5 mm (depending on the IOL to implant) which is opened at the end of the surgery prior to the IOL implantation.

Once the corneal incisions are designed in location, length and width, the next step is to perform the capsulorhexis. The capsulorhexis size can be chosen according to the IOL optic diameter that we are going to implant in order to achieve an excellent anterior capsule overlapping. A limitation for the rhexis size is the iris border. Thus, those patients with a mydriasis smaller than 6 mm are not good candidates for this procedure. After determining the size, the capsulorhexis can also be perfectly centered (Fig. 12.9).

The next step is to choose the pattern of nucleus softening/photodisruption. We can choose three different patterns. The first one is the softening pattern (Fig. 12.10) for those not very hard cataracts. The laser creates several cylinders of photodisruption (“like coins”) in the core of the nucleus allowing an easy removal of these soft cataracts. For the hardest cataracts we use the segmentation (Fig. 12.11) or the hybrid pattern (Fig. 12.12). The former creates 4 or more horizontal cuts in the nucleus (like a chopping) while the latter is a combination of the softening pattern creating cylinders in the core of the nucleus and the segmentation pattern producing more peripheral horizontal cuts. Using the segmentation pattern or
the hybrid pattern we have been able to remove hard cataracts with a lower ultrasound energy use.

Once the pattern has been chosen, we have to set two important parameters, first the photodisruption diameter and second the laser depth of action. We determine the depth of action using the posterior capsule OCT image. We keep a safe area between the highest point of the posterior capsule and the laser action. At this moment we have not had any posterior capsule rupture due to a laser damage.

The last step prior to starting the femtosecond treatment is to determine the incision shape. The architecture of the incisions previously located has to be determined. Our preference is the "dimple up" design; there is a short first plane which is orthogonal to the epithelium followed by an inclined plane of about 1600 microns towards the endothelium and finally a third orthogonal plane that penetrates into the anterior chamber (Fig. 12.13). The angles and length of every plane can also be customized.

Finally the treatment parameters on the OCT are confirmed and the foot pedal is pressed to start the treatment. The whole procedure is completed in only 90 seconds. It starts doing the anterior capsulotomy, then continues with the photodisruption and finishes with the incision creation.
We perform this procedure under ordinary corneal refractive surgery aseptic conditions. It is very important to consider that there is no risk of endophthalmitis because the eye is not opened during the femtosecond laser treatment.

**Phacoemulsification after the Femtosecond Laser Treatment**

Once the LENSX treatment is completed we prepare the eye under sterile conditions to perform the phacoemulsification. Alcon recommends that the time elapsed from the femtosecond treatment to the phacoemulsification should not be longer than 30 minutes. In our experience we have performed uneventful procedures with slightly longer time intervals.

The incisions may be opened using either a Sinskey hook or the Alió femtocataract spatula (Epsilon, EEUU). At this point it is very important that the incisions that we have created with the laser have a similar design to our normal manual incisions, this way the incisions will be easily opened and there will not be any problems to find the incisions planes (Fig. 12.14).

The next stage is the viscoelastic injection. We strongly recommend performing this maneuver introducing the tip of the cannula inside the eye placing it over the anterior capsulotomy flap. The viscoelastic injection placing the tip of the cannula in the corneal wound must be avoided because the viscoelastic device may go under the capsulotomy flap producing a capsulotomy tear.

Then, using a cystitome or a MICS capsulorhexis forceps (MICS Forceps Alió, Katena, USA) the anterior capsulotomy flap is carefully removed paying a lot of attention to break any potential capsular bridges (Fig. 12.15). These capsulotomy bridges are usually due to small inclinations of the eye that determine that the laser capsulotomy is done with a higher efficacy in some sectors than in others.

After the anterior capsule flap removal, the next step is the hydrodissection. There is an interesting debate about if the hydrodissection is necessary or not. In many cases, the bubbles from the photodisruption dissect the nucleus from the capsular bag making the hydrodissection maneuvers not strictly necessary. However, hydrodissection can be performed to make sure that the cataract nucleus is free. The capsular bag has an increased volume because there are usually bubbles from the photodisruption. This fact explains why it is so important.
to remove the viscoelastic device completely from the anterior chamber before starting the hydrodissection. If we do not take this precaution we may have a capsular block and a posterior capsule rupture.

The cataract fragments removal is easier because the nucleus already has break lines as a result of the femtosecond laser action. For this purpose we use an ultrasound energy of 2 to 4% in Burst mode and a vacuum from 300 to 350 mm Hg.

After the nucleus removal, the cortex usually looks very clear and transparent. This fact can even create confusion because the surgeon may think that there is no cortex to remove. However, if aspiration is performed using the capsulorhexis border as a guide the cortex will be removed from 360° of the capsular bag. Therefore, it is advisable that the capsulorhexis border is seen easily. We do not recommend capsulorhexis size greater than 5.7 mm. Our most frequently chosen size is about 5.4 mm.

After the regular IOL implantation, the ocular viscoelastic is removed and the incisions are sealed. We have noticed that the femtosecond incisions are very prone to seal spontaneously even with no hydration. We think that this is explained because of the perfect incisional architecture and because with the femtosecond assistance we save intraocular maneuvers that sometimes distort the incisions.

Our first outcomes in Vitum Alicante are still preliminary but confirm that the nucleus removal is facilitated by the femtosecond laser. The incisions and anterior capsulotomy performance with the LenSx technology are excellent. The effective phaco time (EPT) and the total phacoemulsification power are diminished when using this technology.

We have not had any complications related with the femtosecond laser procedure. Our opinion is that the surgical technique will undergo important modifications in the future and only the experience will show us how to transform our current surgery into a new more efficient surgery with better results.

Early Clinical Evidence

Femtosecond laser cataract surgery may indeed provide significant advantages to operate cataracts. Part of the surgery is much more systematic as the corneal incision profiles and dimensions can be set up with much more control of the variability. Capsulorhexis should be performed on a more controlled basis also for size and dimensions. Nuclear softening should reduce the phaco power and effective phaco time used to remove the cataract, as occurs in traditional prechopping. This manoeuvre has indeed been proposed by many authors but so far it is seldomly used because it is considered by many surgeons as difficult and risky. With the use of femtosecond lasers this clear advantage for cataract surgery will no longer be a real barrier for the practical surgeon. There are still very few papers dealing with the real outcomes that happen when using femtosecond cataract surgery. The few reports that have been published are to be considered preliminary and the clinical evidence, although it really suggests a trend to confirm the abovementioned advantages. An adequately designed clinical comparative study, comparing the standard phacoemulsification technique and femtosecond cataract surgery is still lacking at present.

Preliminarily, there is evidence that the control of the corneal incisions in terms of size and dimensions is indeed achieved. Capsulorhexis size and shape is indeed improved with a consequent improvement in the effective lens position of the implanted IOL. The consequence of this is a more precise refractive outcome that standard conventional cataract surgery. The optimized control of the corneal incisions has demonstrated to lead to a better astigmatic control and less induction of higher order aberrations. The total aberration pattern of the eye is indeed also improved, consequently, and based on the better preservation of the corneal dioptric capabilities and the better IOL position. All this preliminary evidence indicates that femtosecond cataract surgery is indeed a step forward in the quality of cataract surgery.

One more aspect to consider for femtosecond cataract surgery is that it is probably the first step towards a real robotization process in cataract procedures. In other areas of medicine, this is happening (neurosurgery, urology, tumor of the digestive tract surgery, etc.), and the trend is approaching in ophthalmology. Such process is starting and most probably with the femtosecond laser devices that we have at this moment constitute the first step of such process.

The only drawback of femtosecond cataract surgery is indeed financial, the added high cost of introducing this as a routine procedure in cataract surgery. In today's environment of cataract surgery, a reduction in the costs to increase the cost effectivity of the procedure is a global trend. How, in this environment, will a clear increase in the cost due to the benefit of an apparently small improvement, even though significant justify such cost? This question remains unsolved. At this moment, in some environments, the cost of using femtosecond cataract surgery can duplicate the total cost of phacoemulsification and IOL implantation. In the developed countries, this is indeed also a problem even with the higher level of financial resources available. Most probably, a new business model for cataract surgery has to be developed to absorb such a cost in a comprehensive and practical way prior to the generalization of the technique.
REFERENCES


