

Experience in cataract surgery assisted by femtosecond laser at Fundación Hospital Nuestra Señora de la Luz

Experiencia en cirugía de catarata asistida por láser de femtosegundo en la Fundación Hospital Nuestra Señora de la Luz

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Abstract

Objective: The aim of the study was to describe the transoperative results of cataract surgeries assisted by femtosecond laser. **Methods:** This was a observational, descriptive, retrospective, and cross-sectional study of 420 surgical records made with the LenSx platform from April 2015 to August 2017. The review of records was made through the internal electronic system accessing the pre-operative and post-operative note. The information was collected through a database in Excel. The analysis of variables was performed by means of descriptive statistics with measures of the central tendency. **Results:** Eighty-six files met inclusion criteria. The average age was 63 years. There was a general frequency of complications of 27.9% (24 surgeries). The most frequent complications were incomplete or impermeable corneal wound (37.5%), incomplete capsulorhexis (25%), and posterior capsule rupture (16.7%). **Conclusions:** The femtosecond laser technology incorporated in cataract surgery can be considered successful because of a low overall frequency of complications.

Keywords: Cataract surgery. Femtosecond laser. Complications.

Resumen

Objetivo: Describir las complicaciones transoperatorias de las cirugías de catarata asistidas por láser de femtosegundo. **Método:** Estudio observacional, descriptivo, retrospectivo y transversal de 420 expedientes de cirugías realizadas con la plataforma LenSx de abril de 2015 a agosto de 2017. La revisión de expedientes se realizó a través del sistema electrónico interno accediendo a las notas preoperatoria y posoperatoria. La información se recopiló en una base de datos Excel. Se realizó el análisis de variables por medio de estadística descriptiva con medidas de tendencia central. **Resultados:** Cumplieron criterios de inclusión 86 expedientes. La edad promedio de los pacientes fue de 63 años. Se presentó una frecuencia general de complicaciones del 27.9% (24 cirugías). Las complicaciones que ocurrieron con mayor frecuencia fueron herida corneal incompleta o impermeable (37.5%), capsulorhexis incompleta (25%) y rotura de cápsula posterior (16.7%). **Conclusiones:** La tecnología de láser de femtosegundo incorporada en la cirugía de catarata puede considerarse como exitosa al tener una baja frecuencia general de complicaciones.

Palabras clave: Cirugía de catarata. Láser de femtosegundo. Complicaciones.

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Introduction

There are approximately 285 million visually impaired people in the world, out of whom 39 million are blind and 246 million have low vision, with cataracts being the leading cause of blindness in low- and middle-income countries. Non-operated cataracts are estimated to account for 33% of global visual impairment¹.

The conventional phacoemulsification technique for cataract removal has been displaced by the use of high-frequency laser associated with eye imaging technology, which provides a surgical precision that hardly could be obtained with manual technique².

The Food and Drug Administration initially approved the use of the femtosecond laser system for corneal incisions and anterior capsulorhexis, and in April 2010, its use was approved for cataract fragmentation².

Femtosecond laser works on a wavelength in the near-infrared region (1030 nm). The basic mechanism of action lies in the fact that a highly focused energy beam can elevate the energy of matter to a level where plasma is created. This free-electrons and ionized molecules plasma expands rapidly, creating cavitation bubbles. The force of cavitation bubbles creation separates the tissue. This process of converting laser energy into mechanical energy is known as photodisruption. Intraocular photodisruption is guided by imaging systems that use real-time optical coherence tomography (OCT), which allows accurately defining the structures from the anterior segment to the posterior capsule, and thus it can also be used to point at the anterior chamber at several depths without risk of collateral damage. The surgical procedure with this technology begins with the adjustment of a suction ring in the eye, which, in turn, is attached to the laser optical system. At this point, OCT captures the anterior segment in a single image, projected on the screen with the capacity for three-dimensional manipulation using the software of the device. Incisions are located with respect to their width, depth, profile, and length. With this data determined by the software, the procedure is started by pressing the pedal. The intervention is visible in real-time while it is performed. With this technology, making corneal incisions, anterior capsulotomy, and fragmentation of the nucleus are possible^{3,4}.

With femtosecond laser, corneal tunnel incisions with the required length are achieved, with the possibility of being able to choose the square shape, which has been shown to be more resistant to deformation and leakage⁵.

During capsulotomy, femtosecond laser allows obtaining regular incisions, centered on the desired position with a defined and straight border, which increases its resistance and safety when performing core fragmentation and intraocular lens insertion⁶. For fragmentation, femtosecond laser produces the most adequate cutting pattern in the lens according to the type of cataract that is being treated, by modifying the parameters of location, shape, number, and distance to the posterior and anterior capsule, thus achieving a fully customized pre-fragmentation of the nucleus for each patient and a shorter ultrasound application time, which could lead to less post-surgical intraocular inflammation and less loss of endothelial cells^{7,8}.

In Mexico, the Central Military Hospital reported its experience over 2 years, establishing differences in the standard femtophaco technique, such as the limits for lens fracture, epithelial sectioning above the corneal plane to achieve higher percentage of main incision opening, and modification in the fracture and hydrodissection sequence to avoid capsular blockage, with these variables being considered essential for optimizing the results of the technique and shorten the learning curve this can represent⁹.

The integration of femtosecond laser into cataract surgery is a technique that continues under clinical investigation with regard to its efficacy, safety, advantages, and limitations. This study has the purpose to describe the results of the surgical technique of cataract surgery assisted by femtosecond at *Fundación Hospital Nuestra Señora de la Luz*, in Mexico City.

Methods

A descriptive, retrospective, cross-sectional, and observational study was carried out. Medical records of patients undergoing femtosecond laser-assisted phacoemulsification without corneal opacities with palpebral slits and keratometry that would allow adequate coupling were included in the study. The post-operative note had to clearly document the use of femtosecond laser, as well as findings and complications; otherwise, medical records were excluded from the study. Patients with hydrated total cataracts were also excluded from the study. Four hundred and twenty records of cases of femtosecond laser-assisted cataract surgery performed at *Fundación Hospital Nuestra Señora de la Luz*, IAP, Anterior Segment Department using a LenSx of the Alcon commercial house, between April 2014 and August 2017, were reviewed.

The variables that were analyzed during the study were wound permeability, anterior capsule tears, incomplete capsulorhexis, incomplete nucleus fracture, posterior capsule rupture, zonular dialysis, and post-femtomyosis.

The review was carried out through the electronic medical records system, our hospital center has, accessing pre-operative and post-operative notes. The information was collected in an Excel database and each variable was analyzed using descriptive statistics with the central tendency measures.

Results

Of the 420 reviewed medical records, 86 met the inclusion criteria. Twenty-nine surgeries were carried out in 2015, 29 in 2016 and 28 until April 2017. Patient average age was 63 years. There were 53 (61.63%) women and 33 (38.37%) men. Of the included patients, 47 (54.65%) had comorbidities (18 hypertension, 15 diabetes, and 14 both). Overall frequency of complications is shown in figure 1: 72.1% of surgeries reported no complications, while 27.9% had any. The most common complication was incomplete corneal wound, with nine cases, followed by incomplete capsulorhexis, with six cases. Total complications are shown in figure 2.

Discussion

Femtosecond laser incorporated into cataract surgery has been used in various hospital centers. As shown in table 1, the frequency of complications we obtained differs from that reported in the literature. Roberts et al.¹⁰ and Chang et al.¹¹ found a higher frequency of anterior capsule tearing and post-femtomyosis, in contrast to what was reported by Abell et al.^{7,8}, who did not record any case of anterior capsule tear and only 3% of myosis. In our case, tears were equatorial, with capsulotomy being, therefore, manually completed. The most common complication was incomplete corneal wound, which was manually completed with slit knives, thus allowing the ensuing phacoemulsification steps to be carried out with no further problems. The most serious intra-operative complication was posterior capsule rupture, which showed a higher proportion in our hospital center, as shown in table 1, with anterior vitrectomy being required and, in all cases, a three-piece lens was placed in the sulcus. Reported complications are mostly susceptible to be resolved with manual techniques

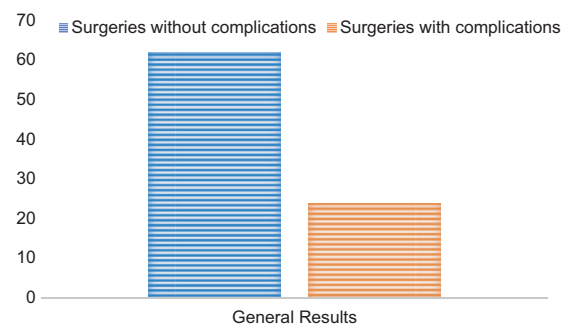


Figure 1. General frequency of complications: 62 surgeries without complications and 24 surgeries with complications.

Table 1. Reported complications in comparison with other series

	FHNSL	Roberts et al. ¹⁰	Chang et al. ¹¹	Abell et al. ^{7,8}
Incomplete corneal wound	9 (37.5%)			
Anterior capsule tear	2 (8.3%)	10.5%	5.3%	0%
Incomplete capsulorhexis	6 (25%)			
Myosis	2 (8.3%)	9.5%	10%	3%
Incomplete nucleus fracture	0	4.2%		
Posterior capsule rupture	4 (16.7%)	3.5%		0.5%
Zonular dialysis	1 (4.2%)			

FHNSL: Fundación Hospital Nuestra Señora de la Luz.

without deterioration of patient visual prognosis, which is why it is necessary for the surgeon who uses femtosecond laser technology to master the manual technique. Since the technique is operator-dependent, it is recommended for the devices to be calibrated, and for the parameters related to the delivery of energy, dimension, and depth of the wounds to be adjusted according to the experience in the surgeon's initial cases. In the comparison of results, it is necessary to consider that the reported complication rate depends on the experience of the surgeon and whether the series involved a single surgeon or several, or whether it is a multicenter study. In our study, surgeries were performed by both experienced surgeons and surgeons in training who were completing their learning curve.

Femtosecond laser remains in practice as a cutting-edge technique that continues to implement modifications to the system, such as interfaces for corneal curvatures out of normal range, which allows to increase the number of treated patients and to decrease the rate of complications.

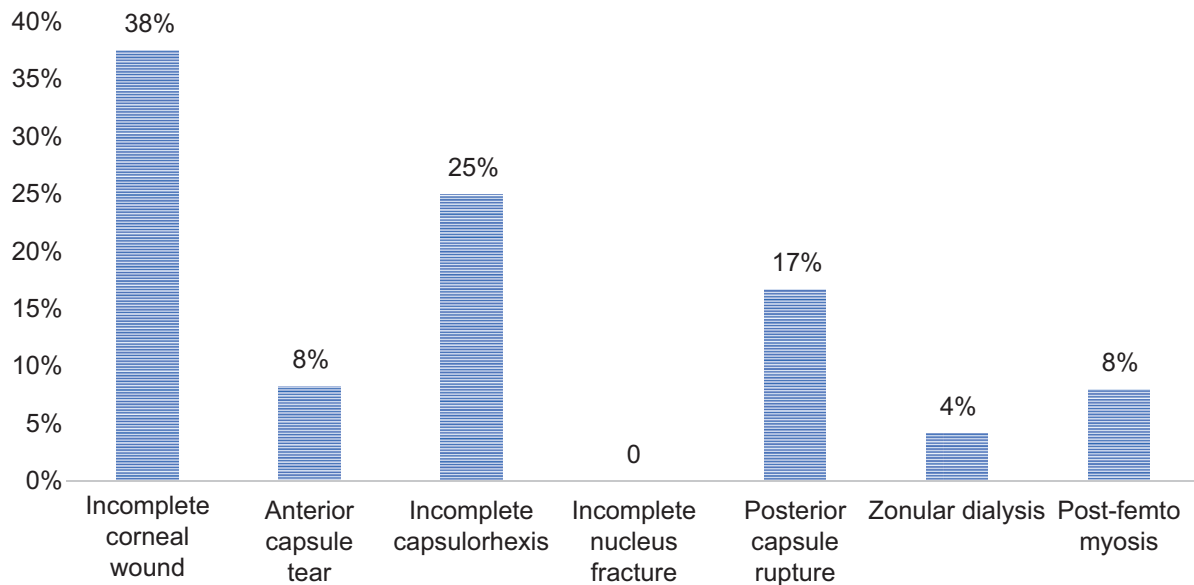


Figure 2. Distribution of complications.

Conclusion

Femtosecond laser-assisted cataract surgery is a successful procedure with a low frequency of complications that require a learning curve. We hope that the results of this study will serve to evaluate the impact of femtosecond laser on cataract surgery.

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Conflict of interests

The authors declare that they have no conflict of interests.

Ethical disclosures

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this investigation.

Confidentiality of data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors have obtained informed consent from the patients and/or subjects referred to in the article. This document is in the possession of the corresponding author.

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