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Comparing the intraoperative complication rate of femtosecond laser-assisted cataract surgery to traditional phacoemulsification

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Abstract

• AIM: To compare the complication rate of femtosecond laser-assisted cataract surgery (FLACS) and traditional phacoemulsification for the first 18mo of FLACS use at a private surgical center in Hawaii.

• METHODS: A retrospective chart review was conducted from January 2012 to June 2013. The first 273 consecutive eyes receiving FLACS and 553 eyes receiving traditional phacoemulsification were examined. All surgeries were performed at a single surgical center in Hawaii. The presence of intraoperative complications was used as the main outcome measure. Approval was obtained from the institutional review board of the University of Hawaii.

• RESULTS: The overall complication rate for FLACS was 1.8%, while that of the traditional procedure was 5.8% (P <0.05). A majority of the surgeons (80%) had a lower complication rate while using FLACS.

• CONCLUSION: FLACS is comparable in safety, if not safer, than traditional cataract surgery when performed by qualified cataract surgeons on carefully selected patients.

• KEYWORDS: femtosecond laser; cataract surgery; cataract surgery complications; phacoemulsification
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INTRODUCTION

Since the conception of laser-assisted cataract surgery in the early 1970s, the laser has become an invaluable tool for many cataract surgeons [1]. One of the most recent advances in laser technology has been the femtosecond laser system, which can be used to perform lens fragmentation, anterior capsulotomy, and self-sealing corneal incisions [2]. Femtosecond laser-assisted cataract surgery (FLACS) has numerous benefits. Recent studies have found the femtosecond laser to be more accurate than manual capsulotomy[3-6]. This improved accuracy translates into more stable intraocular lens (IOL) position and more predictability in the IOL power calculation [7]. Use of the femtosecond laser has also been shown to provide more efficient lens fragmentation[4].

Other studies have examined the complication rates of FLACS and found the procedure to be safe when performed by experienced surgeons [8,9]. The studies in question acknowledged that there is a learning curve for the procedure during which complication rates are notably higher [10]. Our study examines the intraoperative complication rate of FLACS at a small private practice surgical center with five experienced cataract surgeons in Honolulu, Hawaii. The center adopted the laser technology in January 2012. This study seeks to determine if early FLACS procedures were as safe as traditional phacoemulsification for our cataract center.

MATERIALS AND METHODS

Charts of patients receiving FLACS and traditional phacoemulsification from January 2012 to June 2013 were obtained and retrospectively reviewed. Patients were given information on both procedures and allowed to choose which one they preferred. The following is a basic overview of how the procedures were performed by all of the 5 surgeons. FLACS was performed using the LenSx Laser (Alcon, Texas, USA) for the initial incision, capsulorhexis, cataract fragmentation, and limbal relaxation. The Infiniti phacoemulsifier (Alcon) was then used for phacoemulsification. The LenSx Laser system is an all-solid-state laser source that acts by producing a kHz pulse train of femtosecond pulses[11]. It acts by focusing a beam of low energy infrared light pulses into the eye. These pulses create photodisruption of a microvolume of tissue at the focal point of the beam. Upon scanning, the beam puts the individual photodisruption sites in a consecutive pattern to create continuous incisions [11]. An optical coherence tomography (OCT) imaging device and a video camera microscope are utilized to view the patient's eye and locate specific target locations. The intended uses of the LenSx system for cataract surgery include anterior capsulotomy, phacofragmentation and creation of single plane and multi-plane arc cuts/incisions in the cornea [11]. All of these have the potential to be performed either individually or consecutively during the same procedure. The Infiniti

Table 1 Complications of laser-assisted cataract surgery

Complications	Surgeon 1	Surgeon 2	Surgeon 3	Surgeon 4	Surgeon 5	Total
None	25	130	60	38	20	273
Descemet's membrane detachment	0	1	0	0	0	1
Lens material in vitreous	0	0	0	0	0	0
Posterior capsule open	0	0	0	2	0	2
Significant anterior chamber hemorrhage	0	0	0	0	0	0
Significant iris damage	0	0	0	0	0	0
Vitreous loss	0	0	0	0	0	0
Zonular dehiscence	0	0	0	0	0	0
Corneal abrasion	0	2	0	0	0	2
Total complications	0	3	0	2	0	5
Complication rate (%)	0	2.4	0	5.3	0	1.8

Table 2 Complications of traditional phacoemulsification

Complications	Surgeon 1	Surgeon 2	Surgeon 3	Surgeon 4	Surgeon 5	Total
None	101	197	163	2	90	553
Descemet's membrane detachment	0	0	1	0	0	1
Lens material in vitreous	0	0	0	0	2	2
Posterior capsule open	0	1	1	0	8	10
Significant anterior chamber hemorrhage	0	2	0	0	0	2
Significant iris damage	0	0	0	0	0	0
Vitreous loss	0	2	0	0	9	11
Zonular dehiscence	0	2	1	0	2	5
Corneal abrasion	0	1	0	0	0	1
Total complications	0	8	3	0	21	32
Complication rate (%)	0	4.1	1.9	0	23.4	5.8

phacoemulsifier (Alcon) was also used for traditional phacoemulsification. However, unlike the FLACS procedure, blades were used for the initial incision and limbal relaxation incision for this group of patients. Capsulorhexis was carried out with a cystotome. All surgeries were performed by a group of five surgeons at a single surgical center. The presence of intraoperative complications was used as the main outcome measure. Statistical significance was evaluated using Fischer's exact test of independence. Approval was obtained from the institutional review board of the University of Hawaii.

RESULTS

FLACS was performed on 273 eyes. Intraoperative complications were noted in five (1.8%) cases. Complication rates for individual surgeons ranged from 0% to 5.3%. Observed complications include detachment of Descemet's membrane, open posterior capsule, and corneal abrasions. Specific results for individual surgeons are listed in Table 1.

Traditional phacoemulsification was performed on 553 eyes. Intraoperative complications were noted in 32 (5.8%) cases. Complication rates for individual surgeons ranged from 0% to 23.4%. Observed complications include detachment of Descemet's membrane, an open posterior capsule, anterior chamber hemorrhage, vitreous loss, zonular dehiscence, lens material in the vitreous, and corneal abrasions. Specific results for individual surgeons are listed in Table 2. There was a statistically significant difference in total intraoperative complications for the two procedures (P<0.05).

DISCUSSION

Many consider FLACS to produce outcomes that meet and, in many cases, exceed those obtained through traditional phacoemulsification [3-6]. While the efficacy of this new technology has been discussed in depth, fewer studies have compared the safety of FLACS to traditional cataract removal during the initial phase of use for a single group of experienced surgeons.

Our study found that FLACS resulted in a statistically significant decrease in complications when compared to traditional phacoemulsification. The overall intraoperative complication rate of the laser-assisted procedure was 1.8%, compared to 5.8% for traditional phacoemulsification. These results suggest that FLACS is considerably safer overall. This is supported by other studies on FLACS, which have found it to have many advantages over traditional phacoemulsification (Table 3) [11].

Four of the five surgeons in the study had a lower complication rate when conducting the laser-assisted procedure (Figure 1). Thus, while FLACS is safer on the whole, some surgeons may still experience a higher complication rate. This is clear for surgeon 5, who had a substantially higher complication rate. Although we do not know whether this was due to poor operative technique or

Table 3 Benefits of FLACS suggested in other studies

Benefit	Reasons
Less corneal edema and less damage to eye	Less phaco time, less damage to endothelium
Better wound healing	More precise wound
Better capsulorhexis	Precise, round, and strong capsulorhexis
Better LRI for astigmatism without perforation	Precise depth and width
Better IOL power prediction and centration with better visual outcome	Near perfect capsulorhexis
Better prevention of endophthalmitis	Better wound healing

LRI: Limbal relaxation incision.

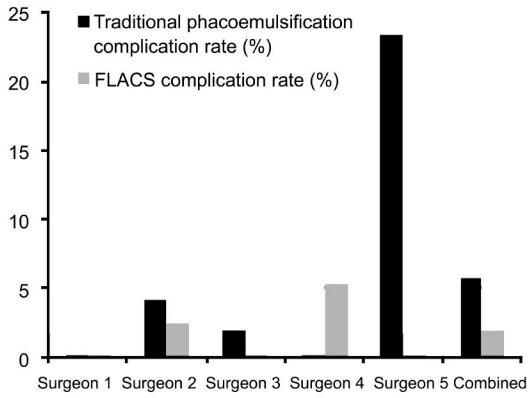

Figure 1 Comparing intraoperative complication rates for the two procedures.

more difficult cases, we hypothesize that this surgeon may have been working on more complicated cataracts. This emphasizes the importance of proper FLACS training to ensure that the best possible outcomes are achieved. It should also be noted that one surgeon had a considerably higher complication rate than the other surgeons for the traditional phacoemulsification procedure. However, even if this surgeon's data is excluded, traditional phacoemulsification still had a higher overall complication rate than laser-assisted cataract removal. Thus, while this surgeon was an outlier, his results did not skew the overall conclusion of the study.

Another study examining the FLACS procedure suggested that the intraoperative complication rate undergoes a statistically significant decrease for an individual surgeon after the first 100 cases [10]. This suggested that the initial trial of FLACS use entails a higher complication rate. However, our study contradicted this suggestion. We showed that an experienced surgeon can obtain a relatively low complication rate during the initial period of performing FLACS. This may reassure surgeons that are considering adopting the FLACS technology that it can be safely incorporated with proper training.

In regard to our outcomes, there are several possible reasons, beyond the suggestion that FLACS is safer, that these cases had fewer complications than traditional phacoemulsification, leading to a potential bias. In order to account for the possible learning curve and the extra costs, patients given the option of FLACS were carefully selected. Ideally, these patients had simple uncomplicated cataracts. Thus, patients receiving traditional phacoemulsifaction were more likely to have small pupils, hard cataracts, and hazy corneas. We acknowledge that the two patient groups may have had different cataract types and densities, which could impact the results. These patients could have had other risk factors, such as pseudoexfoliation, that were not reported. It should also be noted that patients receiving FLACS were typically paying more for the procedure. This likely increased adherence, which may have ultimately improved outcomes. Thus, there is a possible socioeconomic bias as well. Going forward, we plan to conduct additional studies to explore these possible discrepancies. Regardless, we believe that our results support the assertion that FLACS is comparable in safety to traditional phacoemulsification.

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