Femtosecond Laser-assisted Cataract Surgery—Challenging Cases, Successes, and Complications

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Abstract

While femtosecond laser-assisted cataract surgery (FLACS) is evolving as an alternative to phacoemulsification, there are a lack of data on its use in challenging cases. This article discusses cases in which FLACS is particularly advantageous including subluxated cataracts, prior eye surgery, combined vitrectomy and FLACS, pediatric cataract surgery, small pupils, and nanophthalmos. However, FLACS does not produce superior outcomes in all cases and caution is needed in cases of posterior polar cataracts, glaucoma, and prior use of silicone oil.

Keywords

FLACS, challenging cases, complications

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The last few years have seen a deluge of publications discussing the potential advantages of femtosecond laser-assisted cataract surgery (FLACS) compared with traditional phacoemulsification, but its introduction has been controversial. While many consider that the technique will transform cataract surgery, others claim it is not cost-effective and offers no significant advantages over traditional techniques. In routine cases, FLACS has been shown to be comparable or superior to manual phacoemulsification.[1,2] On the other hand, in difficult and challenging cases, FLACS may offer new opportunities for success. The quality of the capsulotomies associated with FLACS,[3] together with the reduction in the time and energy required for ultrasound fragmentation of the cataract,[4] suggest that the technique may be of value in high-risk, complex clinical cases. However, the major clinical trials investigating the efficacy and safety of FLACS have had strict exclusion criteria, and details of its use in challenging cases have only recently begun to emerge. This review discusses areas of promise as well as cases requiring caution.

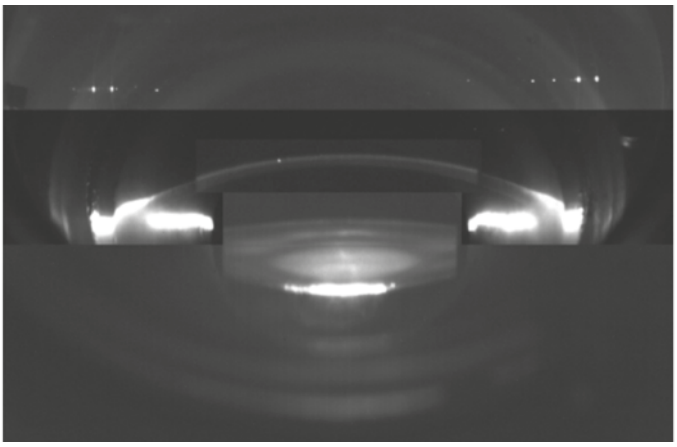
FLACS has been associated with decreased endothelial cell loss,[5] an important consideration in cataract surgery after corneal transplant because postoperative transplant cell counts are lower than those of normal corneas. FLACS has been successfully applied to an eye that had a previous penetrating corneal transplant,[6] and may be beneficial in other conditions causing low preoperative endothelial cell values or at higher risk for endothelial cell loss (e.g. endothelial dystrophy, diabetes, the elderly).

Questions have been raised about the safety of FLACS in patients that have had prior surgery. Cataract surgery in an eye that has had a prior vitrectomy can be challenging because the absence of the vitreous can lead to anatomic abnormalities, such as a deep anterior chamber and less support of the crystalline lens. Vitrectomy and concurrent FLACS is a safe and effective procedure that offers advantages compared with conventional procedures.[7,8] Prior refractive surgery, including laser-assisted *in situ* keratomileusis (LASIK) and radial keratotomy (RK), has not been associated with any flap complications or wound leak in FLACS.[9,10]

Pediatric cataract surgery has a relatively high rate of complications, partly due to the elasticity of the capsule in young eyes. However, the femtosecond laser has potential to perform a circular, well-centered capsulotomy in these cases, and researchers in Germany have successfully performed FLACS anterior and posterior capsulotomies on infants.[11] In another instance of likely capsular complications, FLACS anterior capsulotomy with adjunctive use of a modified capsular tension ring has succeeded in a child with Marfan syndrome.[12]

Cataracts resulting from trauma present significant challenges to the ophthalmic surgeon. Cataract surgery in white or hypermature cataracts has been associated with increased risk for incomplete capsulorhexis, posterior capsule rupture, endothelial cell loss, and incision complications, such as wound burn.[7] FLACS has been successfully employed in cases

Figure 1: Femtosecond Laser-assisted Cataract Surgery in Posterior Polar Cataracts



In a case of posterior polar cataract reported by a different surgeon using another laser platform, precise imaging of the posterior polar plaque allowed timely modification of the fragmentation parameters. In this case, low flow phacoemulsification with an inside-out technique permitted successful lens extraction and intraocular lens implantation without complication. Courtesy of Harvey Uy, MD.

of dense, white cataracts and cataracts following trauma.[13] Subluxated cataracts are also challenging, and traditional phacoemulsification requires the use of various types of endocapsular and fixated capsular tension devices. A case of successful application of FLACS to a subluxated traumatic cataract has recently been described.[14]

Cases of small pupils initially presented a challenge for surgeons performing FLACS because the pupil must be able to dilate sufficiently to make an adequately sized capsulotomy. The application of laser energy may decrease pupil size by around 30 %,[15] potentially risking damage to the pupillary border by laser application during the treatment. However, mechanical dilation devices such as the Malyugin Ring® (Redmond, WA, US) have successfully been used been used for small pupil in different settings.[16] A case has been reported of successful use of FLACS following mechanical dilation of the pupil with a Malyugin Ring in a patient with an irregular, small stuck-down pupil.[17] In addition, the presence of a small pupil can also be managed by applying intracameral mydriatics, and FLACS has achieved good outcomes in these patients.[18,19]

Nanophthalmic eyes have worse refractive predictability and postoperative outcomes compared with relative anterior microphthalmos eyes and normal eyes.[20] FLACS has been successfully performed in a nanopthalmic eye.[21]

Despite all these successes, FLACS does not provide superior outcomes in all cases. In a recent study, two patients with bilateral, visually significant posterior polar cataracts underwent traditional phacoemulsification in one eye and FLACS in the fellow eye. In both cases, the eye treated with FLACS developed a posterior capsule rupture during lens removal; one eye also retained nuclear fragments (see *Figure 1*). Visual outcome was excellent in both eyes of both patients, but this study suggests that traditional phacoemulsification with extensive hydrodelineation and viscodissection of cortex should remain the preferred treatment option for posterior polar cataracts.[22]

Caution may also be needed in the use of FLACS in glaucoma. A recent study found that femtosecond pretreatment of cataract caused a greater transient rise in intraocular pressure (IOP) after treatment and a higher residual IOP after vacuum undocking in glaucomatous eyes than in nonglaucomatous eyes. The long-term implications of these findings are not known and further studies are needed.[23] However, FLACS can also successfully be used in certain cases of phacomorphic glaucoma, though mechanical pupil dilation may be needed.[24]

Silicone oil has been used for decades in retinal surgery, and two cases of FLACS were recently reported following previous retinal-detachment repair using silicone oil that was subsequently removed. The presence of silicone oil in the anterior chamber prevented delivery of the femtosecond laser treatment through the affected area, resulting in incomplete capsulotomy and lens fragmentation in both cases. Because silicone oil has a lower density than aqueous and migrates superiorly, it will be necessary to carefully evaluate for the presence of silicone oil in eyes having FLACS after a vitrectomy with silicone-oil endotamponade.[25]

The use of femtosecond lasers in cataract surgery is continuing to evolve, together with its potential applications. In conclusion, as techniques and technology progress, we look forward to finding new opportunities for success with FLACS, while avoiding pitfalls by heeding cautionary signs. ■

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