Original Article

To assess surgical outcomes of combined femtosecond laser-assisted cataract surgery with 25-gauge vitrectomy surgery at a tertiary eye care center

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Background: The aim of this study was to assess the surgical outcomes of combined femtosecond laser-assisted cataract surgery (FLACS) with 25-gauge vitrectomy surgery. **Materials and Methods:** A retrospective analysis of 45 patients who underwent combined FLACS with 25-gauge vitrectomy surgery. **Results:** A total number of 45 eyes of 45 patients were treated with a mean age of 63.27 years (range 45–75). The mean follow-up was 3 months (range 3–12 months). The mean preoperative best-corrected visual acuity was 1.47 ± 0.86. The mean postoperative vision was 0.36 ± 0.36 and 0.275 ± 0.184 at a paired *t*-test revealed a statistically significant improvement in visual acuity at 1 month ($P < 0.001$) and 3 months ($P < 0.001$). The most common indication for surgery was full-thickness macular hole (51.1%), vitreous hemorrhage (24.4%), followed by epiretinal membrane (17.7%) and rhegmatogenous retinal detachment (4.4%). **Conclusion:** Combining FLACS with vitrectomy may be a step toward achieving better outcomes when combined CS and vitrectomy is performed.

Key words: Femto vitrectomy, phacovitrectomy, prognosis, visual outcome

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Vitreoretinal disorders are frequently associated with cataract in elderly patients. Performing phacoemulsification at the time of vitrectomy may be preferable to a second operation owing to the high rate of cataract progression after vitrectomy surgery.[1] Furthermore, performing cataract surgery (CS) enables better visualization intraoperatively during vitrectomy surgery and faster visual recovery.[2,3]

Femtosecond laser-assisted CS (FLACS) has advantages over conventional phacoemulsification in terms of better continuous curvilinear capsulorhexis (CCC) predictability in difficult situations like in eyes with poor fundal glow and hypotony. Better CCC affords better intraocular lens (IOL) placement and stability. Furthermore, it reduces the effective phaco time and the resultant corneal edema leading to better intraoperative visualization of the retina.[3] Combining FLACS with vitrectomy may be a step toward achieving better outcomes when combined CS and vitrectomy is performed. We present our experience of 45 cases treated with combined surgeries using FLACS and 25-gauge pars plana vitrectomy.

Materials and Methods

We reviewed the medical records of all patients treated at our center using a combined technique of FLACS and 25-gauge pars plana vitrectomy between December 2014 and September 2015. The authors adhered to the tenets of the Declaration of Helsinki. The study protocol was approved by the Institutional Ethics Committee.

Patients with coexisting cataract and retinal pathologies were operated by combining FLACS and 25-gauge pars plana vitrectomy after informed written consent. All patients were assessed preoperatively for vision, intraocular pressure (IOP), specular microscopy, and as and when indicated, optical coherence tomography, B-scan, and A-scan were performed.

Femtosecond laser (CATALYS®, Abbott Medical Optics Inc., Santa Ana, CA, USA)-assisted procedure consisting of capsulorhexis and phacofragmentation was performed under topical anesthesia [Fig. 1].

Peribulbar block was given after the laser application. Under all aseptic precautions, 2.2 mm posterior limbal incision was made with keratome. Phacoaspiration of the nucleus and irrigation-aspiration of the remaining cortical matter were performed (Stellaris®, Bausch and Lomb, USA) Using an injector, the hydrophobic aspheric foldable IOL was introduced into the capsular bag. A posterior capsulotomy was performed with the cutter in all patients.

Three transconjunctival sclerotomies were made 3.5 mm from the limbus using 25-gauge trocar cannulas [Fig. 2]. A three-port vitrectomy (Alcon Constellation Vision System, Fort Worth, Texas, USA) including vitreous base shaving whenever necessary was performed. The resight (Carl Zeiss Meditec AG, Germany) wide-angle viewing system was used.

Surgical adjuvants such as intravitreal triamcinolone, trypan blue (0.15%), and brilliant blue (0.05%) were used as

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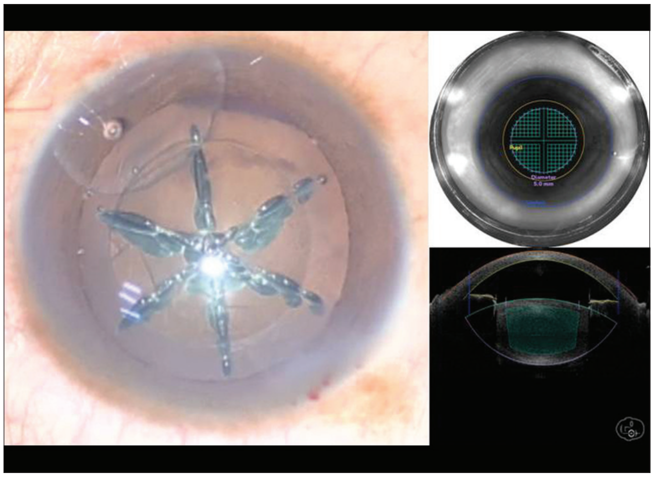

Figure 1: Femtosecond laser-assisted capsulorhexis and lens fragmentation

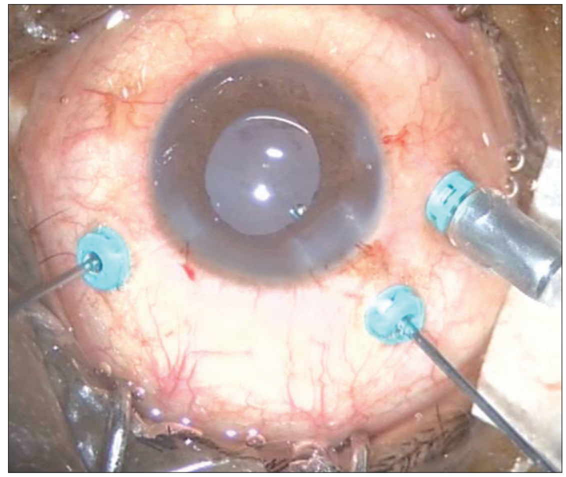

Figure 2: Vitrectomy postfemtosecond laser-assisted cataract surgery

and when needed to assist visualization. Internal tamponade when required was provided using air, saline, 20% sulfur hexafluoride (SF_6), and 1000cs Silicon oil depending on the retinal condition.

Topical antibiotics and steroids were prescribed postoperatively.

Results

The preoperative characteristics of the selected patients are shown in Tables 1 and 2. A total of 45 eyes of 45 patients were included. 33.3% were female (15 patients). The mean age (±standard deviation) at the time of surgery was 63.27 years (range 45–75 years). The mean follow-up was 3 months. The most common retinal pathology was full-thickness macular hole (FTMH) (51.1%) followed by vitreous hemorrhage (VH) (24.4%), epiretinal membrane (ERM) (17.7%), and rhegmatogenous retinal detachment (RD) (4.4%) [Table 3].

Final visual acuity was dependent on the preexisting retinal pathology. Patients with VH, FTMH, and ERM showed better improvement in visual acuity compared to patients with RD [Table 4]. The mean preoperative best-corrected visual acuity was 1.47 ± 0.86. The mean preoperative IOP was 14.23 ± 1.75 mmHg. The mean postoperative vision was 0.36 ± 0.36 and 0.275 ± 0.184 at 1 and 3 months, respectively. A paired t-test revealed a statistically significant improvement in visual acuity at 1 and 3 months and final follow-up ($P < 0.001$). The mean postoperative IOP was 14.6 ± 3.45 and 13.73 ± 2.43 mmHg at 1 and 3 months, respectively [Table 5]. Postoperative 24 h, four patients developed IOP >25 mmHg which was treated with paracentesis and drainage of aqueous humor from the anterior chamber with a 26-gauge needle and antiglaucoma medications.

No major intraoperative complications were noted. Average effective phacoemulsification time was 5.2 s. ±0 to +1 cells were noted in the anterior chamber on the 1st postoperative day. They resolved with the postoperative regimen of eye drops. There was no significant corneal edema. In all cases, intraoperative posterior capsulotomy prevented the formation of posterior capsular opacification during follow-up. All IOLs remained well positioned.

Table 1: Age group of patients

Age group (years)	Number of patients	Percentage
≤50	3	6.67
51-60	11	24.44
61-70	21	46.67
>70	10	22.22
Total	45	100

Table 2: Grade of nuclear sclerosis

NS grade	Number of patients	Percentage
I	12	26.67
II	22	48.89
III	11	24.44
Total	45	100

NS: Nuclear sclerosis

Discussion

The efficacy and safety of 2.8 mm FLACS with 23-gauge vitrectomy have been published, and it has several advantages over a conventional phacoemulsification technique in combined CS with vitrectomy.[4-7]

FLACS reduces phaco energy and also avoids the problems faced while chopping in the absence of the red reflex. Resultant less power used during phacoemulsification reduces the chances of intraoperative corneal edema which can hamper the intraoperative view during vitrectomy.[8]

In our series, we customized the capsulorhexis diameter to suit the pupillary diameter and the optical diameter of the IOL. There was no need to stain the anterior capsule in eyes with VH. At least 1 mm of overlap of the optic of the IOL was achieved in all patients. All cases displayed IOL stability and centration during a fluid-air exchange in vitrectomy. IOL stability was maintained in cases with gas tamponade due to better overlap of the optic of the IOL by the CCC margin. None of the cases showed decentration of the IOL at the subsequent follow-up visits. Jung *et al*. and Gómez-Resa have reported similar observations.[5,9]

Table 3: Visual outcome depending on the retinal pathology

Diagnosis	Number of patients	Mean preoperative VN	VN postoperative 1 month	VN postoperative 3 months
VH	11	2.09	0.22	0.50
FTMH	23	1.19	0.37	0.45
ERM	8	0.47	0.29	0.30
RD	2	2	0.10	0.22
VMT + ERM	1	2	0.30	0.60

VH: Vitreous hemorrhage, FTMH: Full-thickness macular hole, ERM: Epiretinal membrane, RD: Retinal detachment, VMT: Vitreomacular traction, VN: Vision

Table 4: Surgical outcome

Age	NS	diagnosis	Surgical procedure	VN preoperative	VN postoperative 1 month	VN postoperative 3 months	Retinal outcome
73	II	ERM	CS + PCIOL + PPV + ERM P + AIR	0.77	0.77	0.77	Retina attached
65	I	VMT + ERM	CS + PCIOL + PPV + ERM P + AIR	2	0.3	0.6	Retina attached
55	II	VH	CS + PCIOL + PPV + PRP	2.3	0.17	0.17	VH cleared, retina attached
65	III	FTMH (Stage III)	CS + PCIOL + PPV + ILM P + 20% SF_6	2	2	2.00	Type I closure
67	II	FTMH (Stage II)	CS + PCIOL + PPV + ILM P + 20% SF_6	0.6	0.3	0.17	Type II closure
65	I	VH	CS + PCIOL + PPV + PRP	2	0.17	0.17	VH cleared, retina attached
63	I	VH	CS + PCIOL + PPV + PRP	3	0.3	0.3	VH cleared, retina attached
70	II	ERM	CS + PCIOL + PPV + ERM P + AIR	1	0.17	0.17	Retina attached
59	I	VH	CS + PCIOL + PPV + PRP	2	0.17	0.17	VH cleared, retina attached
67	III	FTMH (Stage III)	CS + PCIOL + PPV + ILM P + 20% SF_6	0.6	0.47	0.47	Type II closure
55	II	FTMH (Stage II)	CS + PCIOL + PPV + ILM P + 20% SF_6	0.77	0.17	0.17	Type II closure
62	I	FTMH (Stage III)	CS + PCIOL + PPV + ILM P + 20% SF_6	2	0.77	0.47	Type II closure
54	II	VH	CS + PCIOL + PPV + PRP	3	0.3	0.17	VH cleared, retina attached
66	III	ERM	CS + PCIOL + PPV + ERM P + AIR	0.3	0.17	0.17	Retina attached
44	II	RD	CS + PCIOL + EL + SO	2	0.77	0.77	Retina attached
58	II	VH	CS + PCIOL + PPV + PRP	1	0.17	0.17	VH cleared, retina attached
71	III	ERM	CS + PCIOL + PPV + ERM P + AIR	0.3	0.3	0.3	Retina attached
67	II	FTMH (Stage III)	CS + PCIOL + PPV + ILM P + 20% SF_6	1	0.3	0.17	Type II closure
50	II	VH	CS + PCIOL + PPV + PRP	2	0.17	0.17	VH cleared, retina attached
52	I	VH	CS + PCIOL + PPV + PRP	0.77	0.17	0.17	VH cleared, retina attached
73	I	FTMH (Stage II)	CS + PCIOL + PPV + ILM P + 20% SF_6	1	0.3	0.3	Type I closure
62	III	ERM	CS + PCIOL + PPV + ERM P + AIR	0.3	0.17	0.17	Retina attached
71	II	FTMH (Stage I)	CS + PCIOL + PPV + ILM P + 20% SF_6	2	0.17	0.17	Type II closure
60	I	VH	CS + PCIOL + PPV + PRP	2	0.17	0.17	VH cleared, retina attached
63	II	FTMH (Stage III)	CS + PCIOL + PPV + ILM P + 20% SF_6	1	0.3	0.3	Type II closure
60	II	VH	CS + PCIOL + PPV + PRP	3	0.17	0.17	VH cleared, retina attached
65	III	ERM	CS + PCIOL + PPV + ERM P + AIR	0.17	0.17	0.17	Retina attached
59	II	VH	CS + PCIOL + PPV + PRP	2	0.47	0.3	VH cleared, retina attached
71	II	FTMH (Stage III)	CS + PCIOL + PPV + ILM P + 20% SF_6	1	0.3	0.3	Type II closure
45	I	RD	CS + PCIOL + EL + SO	2	0.47	0.47	Retina attached
65	III	FTMH (Stage III)	CS + PCIOL + PPV + ILM P + 20% SF_6	2	2	2	Type I closure

Contd...

Table 4: Contd...

Age	NS	diagnosis	Surgical procedure	VN preoperative	VN postoperative 1 month	VN postoperative 3 months	Retinal outcome
67	II	FTMH (Stage III)	CS + PCIOL + PPV + ILM P + 20% SF_6	0.6	0.3	0.17	Type II closure
67	III	FTMH (Stage III)	CS + PCIOL + PPV + ILM P + 20% SF_6	0.6	0.47	0.47	Type II closure
55	II	FTMH (Stage III)	CS + PCIOL + PPV + ILM P + 20% SF_6	0.77	0.17	0.17	Type II closure
62	I	FTMH (Stage III)	CS + PCIOL + PPV + ILM P + 20% SF_6	2	0.77	0.47	Type II closure
67	II	FTMH (Stage II)	CS + PCIOL + PPV + ILM P + 20% SF_6	1	0.3	0.17	Type I closure
73	I	FTMH (Stage III)	CS + PCIOL + PPV + ILM P + 20% SF_6	1	0.3	0.3	Type II closure
72	III	ERM	CS + PCIOL + PPV + ERM P + AIR	0.3	0.17	0.17	Retina attached
71	II	FTMH (Stage III)	CS + PCIOL + PPV + ILM P + 20% SF_6	2	0.17	0.17	Type II closure
63	II	FTMH (Stage II)	CS + PCIOL + PPV + ILM P + 20% SF_6	1	0.3	0.3	Type II closure
71	II	FTMH (Stage III)	CS + PCIOL + PPV + ILM P + 20% SF_6	1	0.3	0.3	Type I closure
73	I	FTMH (Stage III)	CS + PCIOL + PPV + ILM P + 20% SF_6	1	0.3	0.3	Type II closure
62	III	ERM	CS + PCIOL + PPV + ERM P + AIR	0.3	0.17	0.17	Retina attached
67	III	FTMH (Stage I)	CS + PCIOL + PPV + ILM P + 20% SF_6	0.6	0.47	0.47	Type II closure
55	II	FTMH (Stage III)	CS + PCIOL + PPV + ILM P + 20% SF_6	0.77	0.17	0.17	Type II closure

NS: Nuclear sclerosis, ERM: Epiretinal membrane, VMT: Vitreomacular traction, VH: Vitreous hemorrhage, FTMH: Full-thickness macular hole, RD: Retinal detachment, CS: Cataract surgery, PCIOL: Posterior chamber intraocular lens, PPV: Pars plana vitrectomy, P: Peeling, PRP: PAN retinal photocoagulation, SO: Silicon oil, SF_6: Sulfur hexafluoride, ILM: Internal limiting membrane, VN: Vision, AIR: Air

Table 5: Comparison of vision and intraocular pressure on preoperative and postoperative 1 month and 3 months follow-up

	n	Mean±SD	*P*	Result	T test (paired/unpaired)
IOP					
Pair 1					
IOP preoperative	45	14.233±1.755	0.497	Not significant	Paired *t*-test used
IOP 1 month	45	14.600±3.450			
Pair 2					
IOP preoperative	45	14.233±1.755	0.275	Not significant	Paired *t*-test used
IOP 3 months	45	13.733±2.243			
VN					
Pair 1					
VN preoperative	45	1.31±0.79	<0.001	Significant	Paired *t*-test used
VN 1 month	45	0.38±0.39			
Pair 2					
VN preoperative	45	1.31±0.79	<0.001	Significant	Paired *t*-test used
VN 3 months	45	0.28±0.16			

IOP: Intraocular pressure, VN: Vision, SD: Standard deviation

We would like to highlight certain changes that we incorporated in our procedure to overcome some frequently encountered intraoperative difficulties with FLACS. The peribulbar anesthesia can cause chemosis and can hinder in cone placement and may cause suction loss during the femtosecond laser application. Similarly, we reported two cases of suction loss; we, therefore, applied femtosecond laser under topical anesthesia and the rest of the procedure was then carried out under peribulbar anesthesia.

We used the 2.2 mm incision for FLACS and 25-gauge for the vitrectomy offers better wound integrity, self-sealing incisions, and lesser astigmatism. Femtosecond laser incisions through three planar[10] are placed clear corneal. We encountered significant stromal hydration intraoperatively in one patient where the incision was placed more centrally (1.5 mm inside the limbus). Although surgery could be completed, significant visualization difficulty was encountered. We, therefore, recommend use of manual 2.2 mm incisions with the keratome.

Intraoperative pupillary miosis can pose potential difficulty for the subsequent vitrectomy surgery. The incidence of intraoperative pupillary miosis is reported to be about 32% in FLACS;[11] however, the incidence of pupillary miosis was only 4% in our series which was overcome by use of intraoperative intracameral adrenaline (0.001%). The low incidence of papillary miosis may be due to following measures.

We prescribed topical nonsteroidal anti-inflammatory drug drops preoperatively (three times) and in addition added topical tropicamide plus phenylephrine eye drop immediately after the femtosecond laser procedure before the patient was shifted to another table for further procedure.

We also did away with the lens-softening procedure during FLACS in cataracts less than Grade IV nuclear sclerosis. Use of femtosecond laser energy for nuclear fragmentation is said to release prostaglandins (PGs) leading to pupillary miosis.[12] We believe that abstaining from nuclear softening causes lesser PG release due to which pupillary miosis was circumvented to a great extent. We also noted that air bubble formation was lesser in these cases leading to easier fragment removal.

However, the limitations of this technique include high cost, the need to shift the patient to another table for the subsequent procedure, the difficulty in the use of femtosecond laser in patients with inadequate palpebral fissure, and poor pharmacological mydriasis for optimally sized capsulorhexis maybe impending factors in this combined approach.

Conclusion

FLACS when combined with vitrectomy offers advantage over conventional phacoemulsification as it offers excellent capsulorhexis without the need of additional dye, nucleus management in the absence of red reflex better lens stability during air-fluid exchange, reduced phacoemulsification time leads to clear cornea which helps in better visualization of retina during vitreoretinal maneuvers and lesser rates of posterior capsular opacification and consequent neodymium-doped yttrium aluminum garnet laser requirements.

Final visual acuity is dependent on the preexisting retinal pathology.

Although safe and effective studies comparing the combined FLACS with vitrectomy versus conventional phacoemulsification with vitrectomy are required.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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