Original Article

Active-fluidics-based torsional phacoemulsification in diabetic eyes: A prospective interventional study

Sudarshan Khokhar, Sagnik Sen, Chirakshi Dhull

Purpose: To compare the outcomes of active-fluidics based torsional phacoemulsification in diabetics and nondiabetics using a balanced tip. **Methods:** Two hundred and forty-eight patients undergoing senile cataract surgery using torsional phacoemulsification on an active-fluidics-based platform from December 2016 to August 2017 were included in this prospective, nonrandomized, interventional cohort study; of the 248 patients, 54 were controlled diabetics and 194 were nondiabetics. Intraoperative parameters such as cumulative dissipated energy (CDE), total ultrasound time, torsion usage time, torsion amplitude, aspiration time, and fluid usage were documented and compared. Endothelial cell loss (ECL) and central corneal thickness (CCT) were evaluated at 1 month postoperatively. **Results:** Diabetics and nondiabetics did not differ in CDE, total ultrasound time, torsion amplitude, aspiration time, fluid usage, endothelial cell count, and CCT. ECL on Day 1 (10.2 ± 8.0%) and Day 30 (11.05 ± 8.3%) were significantly higher in diabetics ($P = 0.025$ and $P = 0.045$, respectively). There was an increase in CCT on Day 1 ($P = 0.018$), which settled by Day 30. Grade 4 cataracts in diabetics had significantly higher CCT at Day 1 ($P = 0.032$) and Day 30 ($P = 0.007$). In the diabetic subgroup, Grades 3 and 4 cataracts required lower CDE ($P < 0.001$) and Grade 4 cataracts showed higher ECL than others till 1 month of follow-up ($P < 0.05$). **Conclusion:** Intraoperative and postoperative parameters after torsional phacoemulsification are comparable in diabetics and nondiabetics. Endothelial changes and pachymetry may be related to the grade of cataract in diabetics.

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Diabetes mellitus is a morbidity causing multifarious affections inside the eye. Diabetics face a number of systemic complications, namely, diabetic nephropathy, retinopathy, and neuropathy. Although diabetic retinopathy is the most important medically treatable condition in the eye, other parts of the eye are also involved, e.g., the cornea which despite appearing clinically uninvolved may be abnormal structurally and biochemically.[1] According to Duke Elder, diabetic eyes seem to be affected by cataract earlier with a rapid progression than the normal population.[2] Phacoemulsification is the most preferred technique of cataract extraction today. Compared to older methods, phacoemulsification is largely devoid of gross postoperative complications.[3] Visual gain post phacoemulsification surgery not only depends on the surgical expertise but also on the preoperative status of the patient's eye. In this regard, diabetic corneas seem to be affected more than normal patients in terms of surgical injury.[4] Vision gain in diabetics may be equivalent to healthy individuals, but may be associated with subclinical changes in the cornea. Previous studies have documented a reduced endothelial cell count (ECC) in diabetics preoperatively, with postoperative endothelial cell loss (ECL) and rise in central corneal thickness (CCT). There are varying opinions regarding the changes seen in diabetics after phacoemulsification surgery, and the studies vary in terms of grade of cataract selected for inclusion. We hereby intend to compare the intraoperative and postoperative outcomes of phacoemulsification in diabetics and nondiabetics using an active-fluidics-based torsional phacoemulsification platform.

Methods

This prospective, nonrandomized, interventional cohort study included patients undergoing cataract surgery at a tertiary eye center between December 2016 and August 2017 by a single surgeon (S.K.). Institutional review board approval was obtained and the study adhered to the tenets of the Declaration of Helsinki. The study included all patients with age-related cataract. Patients with congenital/presenile cataract, traumatic cataract, subluxated cataracts, or cataracts secondary to any other pathology were excluded. Patients having any history of other ocular diseases such as uveitis, angle closure glaucoma, pseudoexfoliation, Fuch's endothelial dystrophy, corneal opacities, and having poorly dilating pupils (<4 mm), poorly captured endothelial images, and unwilling for follow-up were excluded. All patients underwent comprehensive ophthalmic

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examination including preoperative uncorrected distance visual acuity (UDVA), corrected distance visual acuity (CDVA), and slit lamp examination to determine the clarity of cornea and the grade of cataract, and a noncontact tonometry to determine the intraocular pressure (IOP). Noncontact specular microscopy (SP 3000P, Topcon, Oakland, US) was performed to measure ECC. CCT was measured using anterior segment optical coherence tomography (ASOCT, Visante, Carl Zeiss Meditec, Inc., Dublin, CA). Cataract density in all eyes was preoperatively graded using the Lens Opacities Classification System III (LOCS III).

Procedures were performed under topical anesthesia with strict aseptic precautions. A clear corneal incision was made with a 2.2-mm single-bevel keratome (Alcon Laboratories, Inc. Fort Worth, TX) and two side port incisions were created with microvitreoretinal blade (Alcon Laboratories, Inc. Fort Worth, TX). Sodium hyaluronate 1.0% (Healon) was injected to form the anterior chamber, and chondroitin sulfate 4.0%–sodium hyaluronate 3.0% (Viscoat) was used to coat the endothelium before performing phacoemulsification. A 5–5.5-mm continuous curvilinear capsulorrhexis (CCC) was made with the help of Utrata forceps (Katena, USA). All eyes underwent torsional phacoemulsification (with Ozil Intelligent Phaco technology) using Centurion Vision system (Alcon Laboratories, Inc. Fort Worth, TX) with a 45° ABS Intrepid Balanced tip (Alcon Laboratories, Inc. Fort Worth, TX). During phacoemulsification, the machine parameters were set at an IOP of 40 mmHg, vacuum of 450 mmHg, and aspiration flow rate of 45 cc/min. The surgeon preferred a quick chop technique to divide the nucleus, whereas stop and chop method was used in hard cataracts not amenable to quick chop. Cortical matter aspiration was performed using irrigation–aspiration (I–A) probe, and a foldable hydrophobic acrylic single-piece intraocular lens (IOL) (Tecnis ZCB00 IOL; Abbott Laboratories, Argentina, S.A.) was injected and placed within the capsular bag. IOL was injected with the help of Intrepid AutoSert IOL Injector (Alcon Laboratories Inc., Fort Worth, TX) using the Monarch III D cartridge (Alcon Laboratories Inc., Fort Worth, TX). Viscoelastic device was aspirated at the end of surgery with an I–A probe and intracameral vancomycin (1 mg/0.1 ml) was injected within the capsular bag. Corneal entries were sealed with stromal hydration using balanced salt solution (BSS). The intraoperative phaco parameters displayed on the machine screen at the end of the surgery were noted, including cumulative dissipated energy (CDE), total ultrasound time (s), torsional amplitude, torsion usage time (s), aspiration time (s), and fluid volume usage (ml).

All patients received a postoperative regimen of topical steroids (prednisolone phosphate, 1% four times a day), antibiotics (moxifloxacin hydrochloride, 0.5% three times a day), and cycloplegics (tropicamide, 1% thrice a day). On each follow-up, a slit lamp examination was performed to assess the corneal clarity and the status of the IOL. IOP was measured with the help of noncontact applanation tonometer. Specular microscopy and CCT measurements were repeated on Day 1 and at 1 month postoperatively.

Statistical analysis

Data were analyzed using SPSS for Windows Software (version 20.0, International Business Machines Corp.). Data normality was checked using histograms. Mean, median, and standard deviations (SD) of each variable were recorded, and the differences among groups were tested using the independent sample *t*-test for parametric data and Mann–Whitney U-test for nonparametric data. Difference was considered significant at a two-tailed *P* value of 0.05. One-way analysis of variance with bonferroni post-hoc adjustment was performed to compare variables with more than two groups.

Results

Out of the 248 patients evaluated, 54 had type 2 diabetes. All diabetics were controlled with fasting blood sugar of <140 mg/dL and HbA1c <7% and were on oral hypoglycemic agents and/or insulin. Dilated fundus examination was performed for all the included patients and diabetic retinopathy was found to be absent or mild in all the diabetic patients evaluated with no evidence of macular edema. Mean age of nondiabetic patients (n = 194) was 58.14 ± 11.96 years and 58.74 ± 11.17 years in diabetic patients (n = 54). The baseline parameters of all the patients are presented in Table 1.

Preoperatively, diabetics and nondiabetics did not differ in terms of UDVA, CDVA, IOP, ECC, and CCT [Table 1]. Successful phacoemulsification was performed in all eyes of the two groups with no conversion to large incision cataract surgery. Diabetic cataracts, and especially those having higher grades, showed a leathery and sticky nature. A lot of these cataracts needed to undergo stop and chop method as a clean

Table 1: Demographic characteristics and visual outcomes by group

	Mean ± SD		*P*
	Nondiabetics (*n*=194)	Diabetics (*n*=54)	
Age (years)	58.14±11.96	58.74±11.17	0.741
Preoperative UDVA (logMAR)	0.824±0.447	0.957±0.576	0.072
Preoperative CDVA (logMAR)	0.42±0.425	0.581±0.522	0.02
IOP (mm Hg)	15.68±3.82	16.53±4.21	0.159
Preoperative ECC (cells/mm2)	2207.51±253.23	2173.63±290.67	0.439
Preoperative CCT (microns)	524.13±18.86	522.85±18.32	0.655
Postoperative CDVA (logMAR) on Postop Day 1	0.228±0.296	0.370±0.447	0.006
Postoperative CDVA (logMAR) on Postop Day 30	0.086±0.085	0.085±0.086	0.939

UDVA: Uncorrected Distance Visual Acuity, CDVA: Corrected Distance visual acuity, IOP: Intraocular pressure, ECC: Endothelial cell count, CCT: Central corneal thickness

split of the nucleus was not possible with a quick chop. The cortical matter and epinucleus removal also appeared to be challenging in such cases, with higher chances of sudden suction of the capsular bag while aspirating the cortical matter. Two incidences of posterior capsular rent with vitreous loss were noted in the diabetic group in which phacoemulsification was combined with a low-aspiration anterior vitrectomy and patients received posterior chamber IOL in sulcus.

The mean CDVA (logMAR) on postoperative Day 1 was 0.228 ± 0.296 in nondiabetics and 0.370 ± 0.447 in diabetics (P = 0.006). Intraocular pressures were normal in all eyes. The corneal edema grading was done according to the Oxford Cataract Treatment and Evaluation Team (OCTET).[5] Postoperatively on Day 1, 2 nondiabetics and 3 diabetics developed severe corneal edema (+++) whereas 4 nondiabetics and 6 diabetics presented with transient corneal edema (+). These patients were prescribed topical sodium chloride 6% ointment twice daily as adjunctive therapy to the usual regimen. All corneas cleared by 1 month of follow-up. The mean CDVA on postoperative Day 30 was 0.086 ± 0.085 in nondiabetics and 0.085 ± 0.086 in diabetics (P = 0.939).

Operative parameters were noted from the phacoemulsification system's monitor displayed at the end of each surgery. There was no significant difference between the mean total CDE, total ultrasound time, torsion amplitude, aspiration time, and fluid use between the two groups [Table 2]. Postoperative comparison of ECC and CCT revealed that the ECC on Days 1 and 30 were not significantly different in the two groups [Table 3]. However, the net reduction of ECC at Day 1 (P = 0.025) and 1 month (P = 0.045) were significantly higher in the diabetic group. Moreover, CCT in diabetics was higher on postoperative Day 1 (P = 0.018); however, the percentage rise from the preoperative value was not significant, and by 1 month postoperatively there was no difference in CCT between the two groups [Table 3]. Subgroup analysis was performed to compare the outcomes in the operated eyes according to different preoperative grades of cataracts [Tables 4 and 5]. CDE usage was not significantly different for grades 1 and 2 cataracts, however, in grades 3 and 4 cataracts, more CDE was required in nondiabetics (P < 0.05) for successful phacoemulsification [Table 4]. There was no significant difference between the groups among the parameters of phacoemulsification in grades 1 and 2 cataracts. The ECC reduction did not reach significant levels individually in any cataract grade, although the overall reduction was significant. Absolute CCT values were significantly higher in diabetics than nondiabetics in grade 4 [Table 5]. Aspiration time and fluid usage were found to be lesser in the diabetic group in grade 4 cataracts whereas there was no significant difference in the other grades. Parameters in only the diabetics separately were analyzed and revealed that grade 4 as compared to grade 3 cataracts required significantly higher CDE and had lower ECC on Day 1 and Day 30 and higher CCT on Day 1 and Day 30 (P < 0.05). Moreover, the percentage loss in ECC and increase in CCT was also significantly more for higher grades of diabetic cataracts at both time points.

Table 2: Comparison (overall analysis) of intraoperative parameters of phacoemulsification in the groups

	Mean±SD		*P*
	Nondiabetic (*n*=194)	Diabetic (*n*=54)	
CDE*	11.10±9.56	10.76±8.42	0.93
Ultrasound total time (sec)*	37.71±31.89	40.11±28.82	0.432
Torsional amplitude*	39.83±16.10	41.59±11.04	0.584
Torsion usage time (s)*	27.08±21.76	32.15±25.21	0.259
Aspiration time (s)	189.74±66.57	181.11±42.70	0.254
Fluid usage (mL)	82.42±35.73	80.41±24.05	0.629

*Mann-Whitney U-test; CDE=Cumulative dissipated energy

Discussion

Phacoemulsification has become the standard of care for cataract surgery over the past few decades. With time, phacoemulsification has seen a sea change in technology involving phacodynamics and fluidics with advancement toward reduction of phaco energy to reach the goal of minimal corneal damage after surgery. Several methods have been applied toward reduction of endothelial damage including viscosurgery, torsional phacoemulsification against linear mode, modification in tip design to enhance efficiency of phacoemulsification, etc.[6-8]

Phacoemulsification subjects the corneal endothelium to trauma induced by ultrasound energy, ricochet of nuclear fragments, irrigating fluid turbulence, and contact by instruments. Our study found a net reduction of ECC at our last follow-up period of 1 month in diabetics, which was not associated with any significant increase in CCT.

Table 3: Comparison (overall analysis) of postoperative parameters of phacoemulsification in the groups

	Mean±SD		*P*
	Nondiabetic (*n*=194)	Diabetic (*n*=54)	
Postop Day 1 ECC	2044.42±294.57	1952.52±327.92	0.067
Postop Day 30 ECC	2026.68±298.20	1935.00±329.22	0.069
Percentage change in ECC on Postop Day 1*	7.50±6.34	10.20±8.01	0.025
Percentage change in ECC on Postop Day 30*	8.34±6.66	11.05±8.26	0.045
Postop Day 1 CCT	558.48±11.67	566.28±22.70	0.018
Postop Day 30 CCT	531.49±12.47	533.28±12.72	0.362
Percentage change in CCT on Postop Day 1*	6.71±4.85	8.48±6.61	0.068
Percentage change in CCT on Postop Day 30*	1.46±1.67	2.05±2.25	0.073

*Mann-Whitney U-test; SD=Standard deviation; CDE=Cumulative dissipated energy; ECC=Endothelial cell count; CCT=Central corneal thickness

Table 4: Comparison of intraoperative parameters of phacoemulsification in the groups stratified according to the grade of cataract operated

	Grade 1			Grade 2			Grade 3			Grade 4		
	Mean±SD		*P*	Mean±SD		*P*	Mean±SD		*P*	Mean±SD		*P*
	Nondiabetic (*n*=45)	Diabetic (*n*=11)		Nondiabetic (*n*=80)	Diabetic (*n*=17)		Nondiabetic (*n*=52)	Diabetic (*n*=13)		Non-diabetic (*n*=17)	Diabetic (*n*=13)	
CDE*	3.22±3.24	3.732.24	0.321	8.55±4.97	7.18±3.97	0.469	15.50±7.37	11.15±5.94	0.031	30.59±10.27	21.0±8.69	0.009
Ultrasound total time (s)*	11.07±11.02	18.09±20.08	0.329	30.91±20.96	27.18±19.97	0.468	53.15±26.84	49.38±24.36	0.60	93.00±34.90	66.38±26.16	0.050
Torsional amplitude*	24.47±19.05	32.45±13.36	0.351	40.34±11.20	40.41±8.80	0.672	48.46±10.70	43.15±6.35	0.092	51.71±9.49	49.31±10.03	0.408
Torsion usage time (s)*	9.80±10.03	9.09±5.20	0.777	24.55±16.67	20.53±13.42	0.345	37.40±18.34	45.23±25.95	0.257	53.24±32.41	53.77±22.39	0.711
Aspiration time (s)	163.51±41.84	161.82±56.97	0.928	186.76±61.26	187.12±44.35	0.978	198.60±66.48	183.38±31.15	0.235	246.06±102.12	187.31±36.30	0.039
Fluid usage (mL)	66.58±25.58	70.09±22.47	0.657	76.94±32.75	83.59±31.77	0.443	93.77±34.72	82.38±14.81	0.078	115.47±45.04	83.0±21.12	0.015

*Mann-Whitney U-test; SD=Standard deviation; CDE=Cumulative dissipated energy; ECC=Endothelial cell count; CCT=Central corneal thickness

Table 5: Comparison of postoperative parameters of phacoemulsification in the groups stratified according to the grade of cataract operated

	Grade 1			Grade 2			Grade 3			Grade 4		
	Mean±SD		*P*	Mean±SD		*P*	Mean±SD		*P*	Mean±SD		*P*
	Nondiabetic (*n*=45)	Diabetic (*n*=11)		Nondiabetic (*n*=80)	Diabetic (*n*=17)		Nondiabetic (*n*=52)	Diabetic (*n*=13)		Nondiabetic (*n*=17)	Diabetic (*n*=13)	
Postop Day 1 ECC	2230.96±327.58	2145.36±445.48	0.560	2054.0±226.0	1989.0±246.00	0.334	1969.0±245.0	2055.0±153.0	0.123	1739.0±302.0	1638.0±226.0	0.306
Percentage change in ECC Postop Day 1	2.91±3.12	3.73±2.45	0.190	6.0±4.0	7.0±4.0	0.204	10.0±5.0	9.0±4.0	0.414	19.0±8.0	21.0±8.0	0.509
Postop Day 30 ECC*	2223.07±330.71	2140.18±448.08	0.570	2034.0±226.0	1971.0±236.0	0.324	1948.0±246.0	2035.0±160.0	0.132	1711.0±304.0	1614.0±220.0	0.319
Percentage change in ECC Postop Day 30*	3.31±3.41	4.07±2.49	0.150	6.74±4.0	7.73±3.92	0.367	11.15±4.86	10.27±4.58	0.358	20.64±8.86	22.08±7.86	0.457
Postop Day 1 CCT	555.51±8.04	555.64±5.70	0.950	556.0±8.0	551.0±6.0	0.017	562.0±8.0	569.0±16.0	0.127	569.0±27.0	592.0±28.0	0.032
Postop Day 30 CCT	535.11±8.38	533.18±10.62	0.580	533.0±10.0	530.0±12.0	0.338	528.0±14.0	530.0±15.0	0.752	524.0±21.0	541.0±10.0	0.007
Percentage change in CCT on Postop Day 1*	4.61±2.53	5.29±3.37	0.520	5.32±3.76	4.94±3.32	0.507	8.78±5.18	10.38±4.28	0.168	12.42±6.32	13.90±9.38	0.462
Percentage change in CCT on Postop Day 30*	0.75±0.88	0.98±1.19	0.520	0.98±1.31	0.85±1.13	0.494	2.16±1.78	2.69±1.46	0.173	3.41±2.18	3.89±3.19	0.902

*Mann-Whitney U-test; SD=Standard deviation; ECC=Endothelial cell count; CCT=Central corneal thickness

Reports have found that ECL may be greater in diabetic patients with Langwinska *et al*. reporting a 14% loss in diabetics against 9% loss in nondiabetics. This finding has been supported by several other reports.[4,9] However, others could not find such an association.[10] This observed difference may have been because of a lower baseline ECC preoperatively in diabetics, along with an increased coefficient of variation (CV) rendering them vulnerable during cataract surgery. Moreover, diabetics of disease duration more than 10 years had higher CV than nondiabetics.[11,12]

Research has shown that high levels of intracellular glucose may impair the activity of Na+/K+-ATPase of the corneal endothelium, leading to morphological and functional changes manifested as increased CV and reduced hexagonality of endothelial cells. These changes may lead to increase in permeability of the corneal endothelium. Moreover, the diabetic endothelium may have an increased surface tension on the monolayer of cells because of shift from the regular hexagonal pattern.[13] Enhanced functioning of polyol pathway converts excess sugars to alcohols intracellularly with a resulting rise in osmotic pressure and increased fragility of the endothelial cells.[14] Hyperglycemia may also lead to enhanced expression of matrix metalloproteinases (MMPs) and advanced glycosylated end products (AGE), which lead to poor wound healing and abnormal cell-to-cell adhesion, respectively.[15] Fluctuating high blood glucose levels may also be related to functional changes in endothelial cells even without frank morphological changes.[16] However, Keoleian *et al*. reported that diabetic patients did not show difference in terms of function of fluorescence permeability of the corneas despite having structurally abnormal endothelium, rendering the theory of structural abnormality more plausible.[17]

CCT is an indirect measure of the amount of surgical damage to the endothelium. Using same fluids and viscoelastics and fixing the operating surgeon (S.K.) for all patients, the surgical variability of our study was nullified and the evaluating effect of the comparison increased. Although there was an initial increased CCT at Day 1 in our diabetic group, on 1-month follow-up no CCT rise was observed in diabetics. However, subgroup analysis revealed that diabetic patients with grade 4 cataracts had increased CCT till 1 month postoperatively, although the percentage change was not different from nondiabetics. All patients irrespective of diabetic status achieved perfect vision at 1 month postoperatively.

Corneal thickness has been seen to be higher in diabetics preoperatively, with no correlation between disease duration and CCT, although it has also been shown that diabetics of more than 10-year disease duration have thicker CCT.[18] It has been described that post-phacoemulsification CCT further increases within 1 week postoperatively in both diabetics and nondiabetics, which does not correlate with diabetes control.[19] Others have found that diabetics have a comparatively raised CCT than nondiabetics after phacoemulsification.[20,21]

Postoperatively, a stabilized cornea recovers over time from the surgical stress with a shift of CV and hexagonality toward the preoperative status.[22,23] However, this process of healing/repair may be delayed in diabetics.[4] Morikubo *et al*. found a delay in the recovery of corneal edema after following up cataract surgery patients till 1 month postoperatively, with maximum CCT at the end of first week post-phacoemulsification.[22] Diabetics may have a persistence of ECL till 3 months postoperatively and stabilization may take more than 3 months.[12] Fukuda *et al*., however, demonstrated a significant CCT increase only in the early postoperative period, which subsided by 2 weeks postoperatively.[23] Similarly, Wong *et al*. did not find any significant difference in the corneal parameters after 1 month postoperatively.[24]

We found that the phacoemulsification parameters were equivalent in the nondiabetics and diabetics and grade of cataract did not affect the parameters between the two groups overall. In a previous study, we found that diabetic cataracts exhibited cortico-capsular and cortico-nuclear adhesions during hydro procedures, which may cause them to become sticky.[25] However, subgroup analysis of our current results found grade 4 diabetic cataracts to be requiring lesser CDE and lesser fluid for successful emulsification as compared to nondiabetic cataracts of similar grade. Diabetic cataracts have been shown to have significantly higher content of glucose, sorbitol, and fructose compared to nondiabetic cataracts.[26] Interestingly, our diabetic cataracts did not apparently have increased hardness, unlike the senile nondiabetic cataracts, as was evidenced by our finding of lesser CDE usage. This may be attributed to difference in molecular composition and osmolality of nucleus constituents. Another probable reason would have been the active-fluidics of the machine for phacoemulsification, which enabled better efficacious utilization of torsional mode despite lesser fluid usage in diabetics.

With the advent of the active-fluidics technology and increased efficiency of phacoemulsification, maintenance of stable anterior chambers intraoperatively is possible with minimum fluctuation in intraocular pressure.[27] Higher vacuums can be set without an associated rise in post-occlusion surge, which effectively reduces the phacoemulsification time and optimizes the fluid volume usage.[3,28] The newly designed intrepid balanced tip also improves the efficiency of torsional ultrasound by enhancing lateral movement of the tip, which helps reduce shaft movement at the incision site.[6,29] A recent study by Oh *et al*. comparing active-fluidics phacoemulsification system with gravity-based system found that there was a statistically significant difference between them, with active-fluidics offering better surgical and visual outcomes.[30] Moreover, in higher nuclear grades of cataracts (3 and more), visual outcomes were superior with the active-fluidics system.[30] Studies have also reported comparable surgical complications in higher nuclear densities.[6,31,32] An animal study had showed that the amount of "chatter" was lesser with the active-fluidics technology, and it was recommended that lesser torsional power may be required than gravity-based systems.[33] However, previous studies evaluating outcomes of phacoemulsification in diabetics have either taken grade 4 cataracts only or have not specified the grade studied.

Conclusion

Till date, few studies exist which have evaluated the effect of torsional phacoemulsification in diabetic eyes and compared with healthy eyes according to the different grades of nuclear hardness of cataract. Future research may be conducted for comparative evaluation of the new fluidics technology over the previous gravity-based systems in diabetic and nondiabetic eyes.

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Conflicts of interest

There are no conflicts of interest.

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