

ARTICLE

Femtosecond laser–assisted cataract surgery in Fuchs' endothelial corneal dystrophy: Long-term outcomes

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Purpose: To compare the corneal endothelial cell loss and central corneal thickness (CCT) after conventional phacoemulsification surgery or femtosecond laser–assisted cataract surgery in patients with Fuchs endothelial corneal dystrophy and senile cataract.

Setting: Xiamen Ophthalmic Center, Affiliate Xiamen University, Xiamen, China.

Design: Prospective case series.

Methods: Eyes with mild or moderate Fuchs endothelial corneal dystrophy and cataracts had femtosecond laser–assisted cataract surgery or phacoemulsification. The endothelial cell density (ECD), rate of ECD loss, cumulative dissipated energy (CDE), and CCT were measured preoperatively and 3 days and 1, 3, 6, and 12 months postoperatively.

Results: The study evaluated 31 eyes. The CDE was lower in the femtosecond group than in the phacoemulsification group

($P < .05$). The preoperative and postoperative ECDs were similar in the 2 groups ($P > .05$). The rate of ECD loss was higher in the phacoemulsification group from 1 to 12 months postoperatively ($P > .05$). The CCT was thicker in the phacoemulsification group 1, 3, and 6 months postoperatively (all $P > .05$). In both groups, the postoperative CCT at all follow-up visits were greater than the preoperative CCT (all $P < .01$). No bullous keratopathy or other intraoperative complications occurred in either group during the follow-up.

Conclusions: For eyes with Fuchs endothelial corneal dystrophy and cataract, the CCT 12 months after surgery remained thicker than the preoperative thickness. The femtosecond group, with a lower CDE, tended to have a thinner CCT and less endothelial cell loss than the phacoemulsification group.

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Fuchs endothelial corneal dystrophy is a slowly progressing, bilateral corneal dystrophy characterized by the development of focal excrescences of Descemet membrane called guttae, thickening of Descemet membrane, and increasing endothelial cell loss.¹ Fuchs endothelial corneal dystrophy initially develops in an asymptomatic condition that does not always evolve into symptomatic disease.² Hence, many patients with Fuchs endothelial corneal dystrophy might go undiagnosed until more symptomatic epithelial edema and obvious guttae are present.

Providing care for patients with Fuchs endothelial corneal dystrophy and cataract can be challenging. Although cataract surgical techniques have improved in recent years and the risk for damage to the

endothelium has been reduced for all patients, endothelial injury and cell loss remain unavoidable. Patients with Fuchs endothelial corneal dystrophy patients and cataract are inherently at high risk for corneal decompensation and thus are predisposed to require the more complicated triple procedure comprising cataract extraction, intraocular lens (IOL) implantation, and corneal transplantation.³

To our knowledge, no large-scale studies have evaluated the outcomes of femtosecond laser–assisted cataract surgery in patients with Fuchs endothelial corneal dystrophy. The aim of this study was to compare the postoperative corneal endothelial cell loss and central corneal thickness (CCT) of cataract patients with mild or moderate Fuchs endothelial corneal dystrophy who had conventional

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phacoemulsification or femtosecond laser–assisted cataract surgery.

PATIENTS AND METHODS

In this prospective clinical study patients diagnosed with Fuchs endothelial corneal dystrophy (grade 2 to 4) and senile cataract were selected from all cases that presented for cataract surgery at the Department of Cataract, Xiamen Ophthalmic Center, Affiliate Xiamen University, China, between June 2014 and June 2016. Patients were informed of the risk for endothelial decompensation after cataract surgery, including the possible need for corneal transplantation. All protocols adhered to the tenets of the Declaration of Helsinki, and all patients provided informed consent. Approval was obtained from the ethics committee at the institution.

The eyes diagnosed with Fuchs endothelial corneal dystrophy and cataract were divided randomly into 2 groups, 1 of which had femtosecond laser–assisted cataract surgery (femtosecond group) and 2 of which had conventional phacoemulsification surgery (phacoemulsification group). For patients with bilateral cataract, the same surgical procedure was used in both eyes.

Inclusion criteria were mild or moderate Fuchs endothelial corneal dystrophy with cornea guttae of grade 2 to 4 according to earlier studies,^{4,5} visually significant cataract interfering with activities of daily living according to the Lens Opacities Classification System III (LOCS III),^{6,7} age of 18 years or older, transparent central cornea, and pupil dilation of at least 6.0 mm before surgery. Excluded from the study were patients with a history of ocular surgery, coexisting non-Fuchs dystrophy corneal abnormalities, active ocular inflammation, uncontrolled glaucoma, pseudoexfoliation syndrome, dislocation of lens, optic nerve or retinal disease, age-related macular degeneration, or preoperative corneal pachymetry measurements of more than 640 μm .⁸

Preoperative and Postoperative Evaluation

Preoperative ophthalmic examinations including corrected distance visual acuity (CDVA), endothelial cell density (ECD), CCT, and cataract severity grading based on LOCS III at the slitlamp. The cumulative dissipated energy (CDE) was measured on the phacoemulsification platform. The postoperative main outcomes were the rate of endothelial cell loss, ECD, CCT, and CDVA at the 3-day and 1-, 3-, 6-, and 12-month follow-ups.

Transparent corneas with signs of guttae and darkening of the central cornea were observed by slitlamp examination. Visual acuity was expressed as the logarithm of the minimum angle of resolution (logMAR). The ECD was measured using a noncontact specular microscope (Type SP-01, Costruzione Strumenti Oftalmici) at each follow-up visit. The CCT was measured by ultrasonic pachymetry (Sonogage, Inc.). To reduce variability, 3 measurements were averaged and an experienced ophthalmic technician performed the preoperative and postoperative examinations were in an identical manner in all cases. All measurements were taken between 8 AM and 11 AM.³ Patients who had preoperative slitlamp evidence of epithelial decompensation were excluded because they were immediately scheduled to have a triple procedure that included corneal transplantation, cataract extraction, and IOL implantation.

Surgical Technique

All procedures were performed by the same experienced ophthalmologist (G.Z.). Topical or sub-Tenon anesthesia was administered, and adequate dilation was obtained with preoperative mydriatic drops.

Phacoemulsification A 2.2 mm clear corneal incision was placed temporally. The soft-shell technique comprising a cohesive ophthalmic viscosurgical device (OVD) (sodium hyaluronate 1.0% [Provisc]) and a dispersive OVD (sodium hyaluronate

3.0%–chondroitin sulfate 4.0% [Viscoat]) was used to protect the corneal endothelial cells. Under a Verion Image Guided System (Alcon Laboratories, Inc.), a continuous curvilinear capsulorhexis was created with a forceps. After hydrodissection, phacoemulsification was performed using a Centurion Active Fluidics torsional phaco machine and an Intrepid balanced ultrasonic tip with a small sleeve (both Alcon Laboratories, Inc.). The residual cortex was aspirated after phaco-chop phacoemulsification was performed. The capsular bag was then inflated with a cohesive OVD, and a foldable acrylic IOL was inserted through the main incision. Finally, the OVD was thoroughly evacuated.

Femtosecond Laser–Assisted Cataract Surgery Femtosecond laser–assisted cataract surgery was performed with the Lenx femtosecond laser platform (Alcon Laboratories, Inc.) and included corneal incisions, anterior capsulotomy, and lens fragmentation. In the femtosecond laser–assisted cataract surgery group, conventional femtosecond laser settings were used. A 5.5 mm diameter capsulotomy with pupil centration was used, and a concentric cylinder and chop (sextants cut) pattern was adjusted for lens fragmentation. Next, a 2.3 mm 3-plane tunnel primary laser incision and a 1.2 mm secondary laser incision were created. Parameters included laser pulse energy at 7 μJ for corneal incisions and 5 μJ for capsulotomy and lens fragmentation. After all laser procedures, each patient was transported to a day-surgery operating room for conventional phacoemulsification cataract surgery performed as in the phacoemulsification group.

Both Groups In all cases, an IOL was placed in the capsular bag. After surgery, patients received the same treatment consisting of a combination of levofloxacin (Cravit) and dexamethasone (Tobradex) eyedrops 4 times a day during the first week; the drops were slowly tapered over the next 3 weeks.

Statistical Analysis

Descriptive values are given as means \pm SD. All data were tested for normal distribution using the Kolmogorov-Smirnoff test. An independent *t* test was used to compare the percentage of endothelial cell loss, ECD, and CCT in the 2 groups at all follow-up visits. Paired *t* tests were used to compare the CCT before and after surgery in both groups. The correlation between the preoperative CCT and postoperative 12-month CCT was determined using Pearson correlation analysis. A *P* value less than 0.05 was considered statistically significant. All statistical analyses were performed using SPSS statistical software (version 19.0, IBM Corp.).

RESULTS

Demographics and Preoperative Data

Of the 12 042 patients (18 133 eyes) who presented for cataract surgery, 18 (0.15%) had simultaneous Fuchs endothelial corneal dystrophy and senile cataract who required extraction and IOL implantation but did not require corneal transplantation. The mean age of the 5 men and 13 women was 65.1 ± 0.9 years (range 44 to 85 years). Preoperatively, the mean CCT was 547.3 ± 30.4 μm (range 499 to 606 μm) and the mean ECD, 2075 ± 552 cells/ mm^2 (range 893 to 2890 cells/ mm^2). Table 1 shows the demographics and preoperative data by group (femtosecond and phacoemulsification). There were no significant differences in the mean age, cataract grade (LOCS III), preoperative CDVA, CCT, or ECD between the femtosecond surgery group and phacoemulsification group.

Postoperative Data

The mean CDE was significantly less in the femtosecond group than in the phacoemulsification group (*P* = .008)

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