Intraocular Femtosecond Laser Use in Traumatic Cataracts Following Penetrating and Blunt Trauma

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ABSTRACT

PURPOSE: To investigate the use of femtosecond laser cataract surgery in traumatic cataracts of different origin.

METHODS: The first case developed acute traumatic cataract due to penetrating injury of the cornea and the anterior lens capsule; the second developed traumatic cataract 11 years after a penetrating corneal injury; and the third developed a "white" cataract 12 months after blunt ocular trauma. In all cases, 4.5-mm capsulorrhexis and corneal incisions were performed using a femtosecond laser system (Alcon LenSx Inc), and nucleus liquefaction with the laser was performed additionally in the second case.

RESULTS: In all patients, a capsulorrhexis could be created with the femtosecond laser. Preexisting radial tears were present in the first case, but the remaining anterior capsule could be cut with the laser. The second and third cases showed an intact 4.5-mm capsulorrhexis. Corneal incisions were stable in all cases, and nucleus liquefaction was possible in the second case (grade 1-2 nuclear density).

CONCLUSIONS: Results indicate that a femtosecond laser can be used successfully in certain instances of traumatic cataract after penetrating eye injury, even if an anterior capsule laceration is present, and also after blunt trauma resulting in "white" cataracts. [*J Refract Surg.* 2012;xx(xx):xxx-xxx.] doi:10.3928/1081597X

Traumatic cataract is a frequent complication of eye injuries. Anterior lens capsule laceration occurs not only in penetrating injuries but also after blunt trauma rendering traumatic cataract surgery more difficult. Capsular complications (anterior and posterior capsular tear, vitreous loss, etc) during cataract extraction decrease the probability of achieving good long- and short-term postoperative results. Subjective complains are more common in patients with capsular rupture and more myopic spherical equivalent and higher cylindrical refraction.[1-4] Until now, capsulorrhexis has been a manual multi-step procedure. With the aid of femtosecond lasers in ophthalmic surgery, a more precise and centred anterior capsulotomy became possible for routine cases.[5-8] This report presents the use of an intraocular femtosecond laser to perform capsulorrhexis, lens fragmentation, and corneal incisions in eyes with traumatic cataract either after penetrating globe injury, with or without anterior capsule laceration, or after blunt trauma.

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Drs Nagy and Knorz are consultants to Alcon LenSx Inc. The remaining authors have no financial interest in the materials presented herein.

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Received: July 19, 2011; Accepted: December 19, 2011

Posted online:

CASE REPORTS

CASE 1

A 28-year-old race car driver suffered a penetrating eye injury from a thread of wire that hit his left eye while working with a wire brush. He immediately removed the piece of wire from his eye and presented for treatment.

On admission, uncorrected distance visual acuity (UDVA) was 20/50. A 2-mm corneal laceration was visible mid-peripherally between 9 and 10 o'clock, and the iris had prolapsed. The corneal laceration was sutured (10-0 nylon interrupted sutures) and the iris was repositioned (Fig 1).

After dilating the pupil, an oblique anterior capsule laceration from the center to the periphery between 8 and 2 o'clock became visible, but the lens was not removed at this stage. Two days later, cataract surgery was performed using an intraocular femtosecond laser (Alcon LenSx Inc, Aliso Viejo, California). As both eyes had no refractive error previously, data of the fellow eye were used to calculate intraocular lens (IOL) power. After pupillary dilation (cyclopentolate 0.5%) and instillation of topical anesthetics (proparacaine 0.5%), the curved applanation lens was attached to the laser, docked to the eye, and suction was started. We did not anticipate a problem with wound leakage due to an increase in intraocular pressure caused by the suction because the wound was small and remained sealed as expected (see Fig 1). The laser has built-in optical coherence tomography and a scan was performed after suction was started. The start and endpoint of the circular cut the 4.5-mm capsulorrhexis were placed 300 µm behind and 300 µm in front of the anterior capsule, respectively. The laser was also used to perform the main 3.2-mm corneal incision and a 0.9-mm side-port incision. No laser treatment of the nucleus was performed as it was assumed to be soft. Suction was released and the patient was transferred

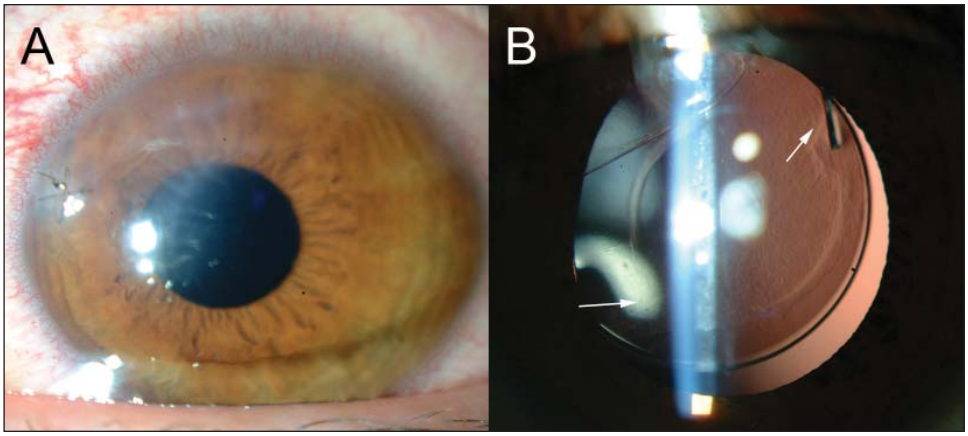

Figure 1. *Case 1.* Penetrating injury of the cornea and anterior lens capsule after cataract removal. **A)** Corneal sutures in place 1 day after cataract removal. **B)** Implanted IOL 1 week after surgery. Anterior capsule tears are visible at 2 and 8 o'clock.

to the main operating room. After draping the eye, the incisions were opened with a blunt spatula and the anterior capsule was removed with capsulorrhexis forceps. Two radial tears of the anterior capsule at 8 and 2 o'clock respectively were noted. Between those tears, which we believe occurred during the initial trauma, the laser had cut a round capsulorrhexis. The soft nucleus and cortex were aspirated and a 3-piece acrylic IOL (+24.00 diopters [D], Acrysof MN60AC; Alcon Laboratories Inc, Ft Worth, Texas) was implanted into the capsular bag. The IOL haptics were oriented to 11 and 5 o'clock to minimize the likelihood of tear extension. The anterior tears did not extend into the posterior capsule.

Two weeks after surgery UDVA was 20/25 while the corrected distance visual acuity (CDVA) was 20/20 (+0.50 +0.50 D × 40°). Intraocular lens tilt and decentration were measured using a Scheimpflug imaging system (Oculus Pentacam HR 70900; Oculus Optikgeräte GmbH, Wetzlar, Germany). The IOL was decentered 0.38 mm in the horizontal and 0.52 mm in the vertical direction, with a total decentration of 0.64 mm. Inraocular lens tilt was −8.09° around the vertical (y axis) and −1.74° around the horizontal axis (x axis). Slit-lamp examination showed a partial overlap of the anterior capsule over the IOL optic (overlap nasally and temporally), while the anterior capsule was peripheral to the IOL optic superiorly and inferiorly. One year later the result remained stable, UDVA was 20/20, and the patient continued as a successful race car driver.

Case 2

A 33-year-old woman, who presented in 2010, experienced a penetrating trauma in her left eye in 1999 caused by a pair of scissors. Slit-lamp examination showed a corneal scar starting paracentrally and extending to the periphery at 2 o'clock. Anterior synechiae were noted peripherally, causing slight pupil irregularity. The lens showed a cortical cataract anteriorly. Corrected distance visual acuity was 20/40. Cataract surgery was performed with the femtosecond laser. Pupil size was 8 mm after dilatation. Nucleus liquefaction was performed using a pattern of stacked cylinders (largest diameter 4.5 mm, smallest 1 mm; starting 1.2 mm in front of the posterior capsule and ending 0.5 mm behind the anterior capsule). A 4.5-mm capsulorrhexis was created, and a 3.2-mm corneal incision and 0.9-mm side-port incision were performed with the laser. After transferring the patient to the main operating room, the surgery was uneventful; the capsulorrhexis was intact, the nucleus could be removed using aspiration only, and a 3-piece acrylic IOL (+22.00 D, Acrysof MN60AC) was implanted in the bag.

One month after surgery CDVA was 20/35 (+0.75 D cyl) (irregular astigmatism was due to a corneal scar between the paracentral and peripheral area from a childhood corneal injury). Intraocular lens decentration was 0.34 mm in the horizontal and 0.35 mm in the vertical direction, with a total decentration of 0.49 mm. The IOL tilt was −1.07° around the vertical (y axis) and 13.12° around the horizontal axis (x axis).

Case 3

A 48-year-old man suffered blunt trauma to his right eye from a piece of brick in December 2009 and presented in March 2010. Visual acuity was hand movements only. The cornea was clear, the anterior chamber was normal, pupil shape and response were normal, and the lens showed a complete "white" cataract. Cataract surgery was performed using the femtosecond laser to create a 4.5-mm capsulorrhexis, a 3.2-mm corneal incision, and a 0.9-mm side-port incision. No laser treatment of the nucleus was performed because of the lack of transparency. Intraoperativly, an intact 4.5-mm capsulorrhexis was found. Manual chopping of the nucleus and removal using standard phacomulsification were performed and a

3-piece acrylic IOL (+19.50 D, Acrysof MN60AC) was implanted into the capsular bag.

Corrected distance visual acuity was 20/20 1 week after surgery. Intraocular lens decentration was 0.07 mm in the horizontal and 0.48 mm in the vertical direction, with a total decentration of 0.49 mm. The IOL tilt was −9.84° around the vertical (y axis) and −2.64° around the horizontal axis (x axis) (Fig 2).

DISCUSSION

Penetrating trauma often makes capsulorrhexis technically more difficult due to anterior capsule rupture. According to Marques et al,[9] in eyes with traumatic cataract the most common intraoperative complication is irregularity of the capsulorrhexis. A tear of the anterior capsule may extend to the posterior capsule, and into a radial anterior and posterior capsular tear that can complicate surgery at any stage. Capsule injuries have been reported to be not only the most frequent complications of traumatic cataract eyes but also prognostic factors for worse visual rehabilitation.[1-4] Anterior capsule tears as observed in case 1 may also affect IOL position. To minimize this, it is important to place the IOL haptics away from the anterior capsule tear, ideally 90° away.

We previously published that reproducibility of the capsulorrhexis is significantly better with a femtosecond laser in non-traumatic cataract eyes.[5-8] A limitation of the femtosecond approach is the need for adequate pupil dilation. Pupil size must be 1 to 1.5 mm larger than the area treated with the laser (which means 0.5 to 0.75 mm on each side). We typically use a 4.5- to 5-mm capsulorrhexis and a 4.5-mm laser treatment diameter inside the nucleus; this means the minimum pupil size must be 5.5 to 6 mm. Our three cases reported indicate that a femtosecond laser–created capsulorrhexis is possible even if anterior capsule tears are present or in "white" cataracts. The laser-created capsulorrhexis may provide added safety in traumatic cataract cases.

AUTHOR CONTRIBUTIONS

Study concept and design (Z.Z.N, R.G.); data collection (K.K., A.T., R.G.); analysis and interpretation of data (K.K., T.F., M.C.K.); drafting of the manuscript (Z.Z.N., R.G., M.C.K.); critical revision of the manuscript (K.K., A.T., T.F.); administrative, technical, or material support (Z.Z.N.); supervision (K.K., A.T.)

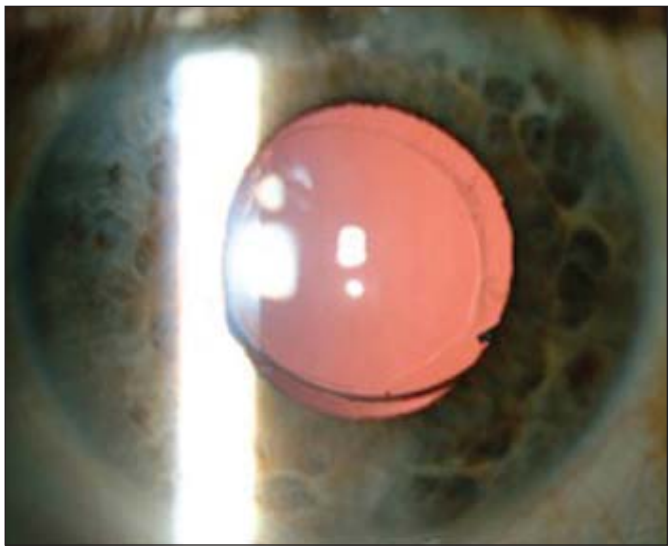

Figure 2. *Case 3.* Slit-lamp photograph 1 month after cataract surgery in an eye with "white" cataract following blunt trauma. The IOL optic is not symmetrically covered. Decentration was 0.07 mm in the horizontal direction and 0.48 mm in the vertical direction.

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