

ORIGINAL RESEARCH

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Traumatic cataract study: Surgical outcomes of blunt versus penetrating ocular injuries**Cetin Akpolat, Ferhat Evliyaoglu, Muhammed Mustafa Kurt, Aylin Karadas, Mehmet Necdet Cinhuseyinoglu, Mustafa Nuri Elcioglu***Okmeydani Training and Research Hospital, Clinic of Ophthalmology, Istanbul, Turkey*

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Abstract

The aim of the present study is to evaluate the results of traumatic cataract surgery with regard to the type of trauma, mainly in the assessment of visual acuity. Forty-four patients who had been diagnosed with traumatic cataracts were included in this retrospectively designed study. The patients were divided into blunt and penetrating groups according to the type of trauma. Pre- and postoperative ocular findings of the cases were evaluated. Visual acuity, intraocular pressure, intra- and postoperative complications, associated injuries, and surgical approaches were analyzed. Thirty-three of the cases were male (75%) and 11 (25%) were female. There were 23 patients (52.27%) in the blunt group and 21 (47.72%) in the penetrating group. The pre-operative mean vision of the subjects included in the blunt and penetrating groups was 0.82 and 0.96 logMAR, respectively. Ten (22.72%) eyes were hypotonic (<8mmHg), most of which were found in the penetrating group. The mean postoperative vision was 0.22 and 0.39 logMAR in the blunt and penetrating groups, respectively. Posterior capsule perforation was observed in five cases (11.36%) as an outcome of trauma and in two cases (4.54%) as a surgical complication. Anterior vitrectomy was performed in 15 cases and a capsular tension ring was implanted in five cases. In 34 cases (77.27%), an intraocular lens was implanted, and 10 cases (22.72%) were left as aphakic. The follow-up period of the cases was 12 months. The most important factors affecting the final vision of patients undergoing traumatic cataract surgery are preoperative visual acuity and the severity of the trauma. The time of surgery should be individualized according to the severity of the case. Surgical success is related to the type of trauma and the experience of the surgeon.

Keywords: Traumatic cataract, blunt injury, penetrating injury, phacoemulsification**Introduction**

Ocular trauma is a leading cause of visual loss and blindness [1]. The type of ocular trauma may be penetrating or non-penetrating. The formation of traumatic cataracts is associated with an open globe injury or contusion to the eye [2]. Infrared energy, electric shock, and ionizing radiation may also cause traumatic cataracts [2,3]. Traumatic cataracts are a common complication of ocular trauma [4].

Traumatic cataracts generally give rise to several accompanying findings depending on the type and severity of the trauma [5,6]. Associated injuries to other ocular structures create a significant medical and surgical challenge to ophthalmologists [7]. Consequently, a detailed history, careful ophthalmic examination, and defined case management should be utilized, which facilitate the process and provide the best possible visual outcome.

Management of traumatic cataracts remains a challenge. Obtaining accurate keratometry and axial-length measurements, timing the surgery, and implanting the intraocular lens (IOL) are prominent challenges in the management of traumatic cataracts [8]. The preferred approach to a patient with a penetrating eye injury is first to fix the corneal or scleral laceration (if one exists) and then perform the removal of the cataract [9,10]. The secondary extraction of the cataract may be performed with better visibility during surgery and with less chance of postoperative complications [11].

In this retrospective study, we will report the results of traumatic cataract surgery, including the surgical approach, type of trauma, and postoperative complications.

Material and Methods**Study Design and Patients**

The study was designed in retrospective fashion and the data were obtained via chart review of medical records. The study adhered to the principles of the Declaration of Helsinki, and the Institutional

*Corresponding Author: Cetin Akpolat, Okmeydani Training and Research Hospital, Clinic of Ophthalmology, Istanbul, Turkey
E-mail: akpolatcetin@yahoo.com

Review Board (IRB) approved the study protocol. Informed written consent was obtained from all of the patients prior to surgery. The study included 44 eyes of 44 adult patients who were diagnosed with traumatic cataract at the Department of Ophthalmology.

Adult patients diagnosed with traumatic cataract due to blunt or penetrating injury were included in the study. The patients were divided into two groups based on the type of trauma: closed-globe injuries served as Group 1 (Blunt Group), and open-globe injuries as Group 2 (Penetrating Group). Patients with a history of previous uncontrolled glaucoma or active ocular inflammation were excluded from the study.

The primary data analyzed for the purpose of the study included best-corrected visual acuity (BCVA) as measured by a logarithm of the minimum angle of resolution (logMAR) units, intraocular pressure (IOP) as measured by Goldmann applanation tonometry (IOP<8mmHg was assigned as ocular hypotonia), and intra- and postoperative complications and associated injuries. In addition to BCVA and IOP, detailed ophthalmic examinations including anterior-segment evaluation by slit-lamp biomicroscopy, funduscopy with +90D lens, and B-scan (in cases of hazy media) were performed prior to surgery and following the surgery at days one and seven and at months one, three, six, and 12. The outcome of surgery was assessed primarily by comparing the final (12th month) and baseline BCVA.

Surgical Technique

All surgeries were performed by the same surgeon. The anatomical integrity of the globe was first restored in patients with penetrating injury. The phacoemulsification technique with the Alcon Infiniti Vision System was performed for cataract extraction in cases without lenticular subluxation or zonulolysis and cases with mild lenticular subluxation or partial zonulolysis. In cases with marked lenticular subluxation and/or with zonular dialysis of more than half, intra-capsule cataract extraction (ICCE) was performed. Anterior vitrectomy was performed in patients who had ICCE and preoperative or intraoperative posterior capsule rupture. In addition to primary posterior chamber intraocular lens (PCIOL) implantation, secondary PCIOL was performed in some patients. The acrylic foldable three-piece PCIOL (Alcon AcrySof MA60BM, USA) was implanted in all patients with or without capsular support according to the formula of Sanders-Retzlaff-Kraff (SRK-T). In those cases in which IOL power calculation was not possible using the biometry of the affected eye, it was performed using the biometry of the fellow eye. A capsular PCIOL was implanted in cases with adequate capsular-bag support. The PCIOL was implanted into the sulcus in patients with inadequate capsular-bag support. Scleral-fixated IOL (SFIOL) was performed in patients with inadequate capsular support. All patients were treated with the appropriate topical regimen, and postoperative complications were managed accordingly as soon as they were diagnosed.

Statistics

Continuous data were presented as mean $\pm$ standard deviation, and categorical measurements were noted as numbers (%). Normal distribution (checked by the Kolmogorov-Smirnov test) and random sample selection were the given assumptions during data analysis. All statistical analyses were performed via Statistical

Package for the Social Sciences (SPSS) version 19.0 (IBM Co., Armonk, NY, USA) using the (two-tailed and dependent) Student's t-test and the independent samples t-test to determine the significance of intra- and intergroup study parameters. A p value of less than 0.05 was considered to indicate statistical significance.

Results

Demography and Surgical Intervention

A total of 44 patients were included in the study. The mean age of the patients was 34.26 ± 4.27 (21–62) years. The blunt and penetrating groups were composed of 23 (52.27%) and 21 (47.72%) patients, respectively. With regard to mode of injury, both blunt and penetrating trauma were observed more frequently among males, with a higher proportion in the penetrating group. The patients were followed up for 12 months. All patients visited our hospital within 24 hours following injury and received the proper emergent surgical or medical treatment according to the severity of the case. (Table 1)

The most common causative agents were stones and thorns for the blunt and penetrating groups, respectively. Total cataract was the most common type (86.11%) among the type of cataracts (rosette, absorbed lens matter, calcified, and posterior subcapsular). The time lapses between visiting our hospital and surgery ranged from zero to one month. Cataract extraction combined with primary PCIOL implantation was more prevalent in Group 1 (Blunt Group). Cataract extraction followed by secondary PCIOL implantation was considerably more common in Group 2. More than 75% of the patients underwent implantation of the PCIOL into the capsular bag or sulcus, and the remaining patients underwent surgery for implantation of SFIOL. The time duration between cataract surgery and secondary PCIOL was two to four months. Primary wound repair (four patients with corneal laceration in the penetrating group), foreign-body removal (one patient in the penetrating group), pupilloplasty (one patient in the penetrating group), and vitreoretinal surgery (one patient in the blunt and one patient in the penetrating group) were also performed in addition to cataract extraction. (Table 1)

Table 1. Age and intraocular lens placement in blunt and penetrating groups

	Blunt	Penetrating
Total (N)	23	21
Age (mean, y)	35.42 $\pm$ 6.88	32.26 $\pm$ 4.14
PCIOL-bag	14	9
PCIOL-sulcus	6	5
SFIOL	3	7

PCIOL: Posterior chamber intraocular lens, SFIOL: Scleral-fixated intraocular lens

Associated Injuries and Complications

Several associated ocular injuries were observed among the patients with traumatic cataracts. The involvement of the anterior segment was more prevalent than that of the posterior segment. Traumatic mydriasis, secondary glaucoma, lens dislocation, and anterior-chamber hyphema (ACH) were commonly seen in eyes with closed-globe injuries. Corneal laceration, lens dislocation, anterior capsule violation, uveal prolapses, and iris synechia were

the most common associated anterior-segment ocular injuries in eyes with open-globe injuries. Vitreous hemorrhage and retinal detachment (RD) were the associated posterior-segment findings with blunt-type trauma.

Posterior capsular rupture caused by trauma was detected during the surgery in five cases, and two cases had posterior capsular rupture intra-operatively as a surgical complication. Anterior vitrectomy was performed and a PCIOL was implanted into the sulcus in five cases, and two cases received SFIOLs two to four months after the first surgery. Besides these, eight patients with lens dislocation underwent an anterior vitrectomy, and an SFIOL was implanted in those patients two to four months after the cataract extraction. Five patients were fitted with an implanted capsular-tension ring combined with PCIOL implantation into the capsular bag due to partial zonulysis. The complications noted during the study period included a transient increase in IOP, cystic macular edema (CME) corneal decompensation, posterior capsule opacification (PCO), retinal detachment, and endophthalmitis.

Visual Acuity and IOP

Table 2. Alteration of BCVA and IOP in blunt and penetrating groups

Parameters	Blunt	Penetrating	P
BCVA(logMAR)			
Admission	0.82±0.34	0.96±0.48	0.384
12 th month	0.22±0.16	0.39±0.20	0.026*
P	0.001*	0.002*	
IOP(mmHg)			
Admission	15.82±2.46	11.22±2.86	0.088
12 th month	14.10±3.08	14.55±2.50	0.468
P	0.368	0.038*	

*: Statistically significant, BCVA: Best corrected visual acuity, IOP: Intraocular pressure

Discussion

This retrospective study was designed to report the outcomes of traumatic cataract surgeries in adult patients based on the type of trauma. Best corrected visual acuity, IOP, demographic properties, associated ocular injuries, emergent intervention, implanted IOL, intra- and postoperative complications, and other surgical procedures were the main data assessed in the study.

Traumatic cataract remains an important cause of visual impairment in spite of new diagnostic and therapeutic developments [12,13]. In addition to surgical complications, associated ocular injuries such as corneal laceration and retinal detachment may cause poor prognoses [14–16].

It is much more difficult to treat traumatic cataract as compared to atraumatic cataract, as there is a higher risk of intra- and postoperative complications due to lens subluxation, zonulysis, and other associated ocular injuries [17,18]. More attention must be paid to postoperative inflammation due to accompanying injuries and because the cataract surgery is a second intraocular intervention following the primary repair in cases with a penetrating eye injury [18]. The success of visual rehabilitation in traumatic

In Group 1, one eye had perception of light, eight eyes had visual acuity <0.1, 12 had visual acuity 0.1 - 0.5, and two had visual acuity >0.5 upon admission. In Group 2, two cases had perception of light, 11 eyes had visual acuity <0.1, seven had visual acuity 0.1 - 0.5, and one had visual acuity >0.5 upon admission. In both groups, a significant ($p < 0.05$) improvement was observed in the mean of the final BCVA at the 12th month compared to the baseline. In Group 1, 17 cases saw visual improvement, and four cases had no visual changes, whereas two cases experienced a decrease in visual acuity. Among Group 2, 14 cases had visual improvement, four cases had no visual changes, and three cases experienced a decrease in visual acuity. (Table 2) There was no statistical change ($p=0.368$) between the means of the baseline and final IOP values in the blunt group, while a significant increase ($p < 0.05$) was observed in Group 2. Three (13.04%) and seven (33.33%) eyes were evaluated as hypotonic (<8mm) preoperatively in Groups 1 and 2, respectively. Three (13.63%) patients developed secondary glaucoma (controlled via medical therapy) in Group 1, while no patients had glaucoma in Group 2 during the study period. (Table 2)

cataract cases without adequate capsular support depends upon the choice of the surgical procedure, the experience of the surgeon, and the preferred type of IOL [19].

Capsular bag or sulcus-implanted PCIOL, iris-fixated IOL (IFIOL), anterior-chamber IOL (ACIOL), and SFIOL are the surgical treatment options for traumatic cataract cases [8]. The use of IOL provides minimal aniseikonia and a predictable refractive outcome. Posterior chamber IOL placement into the capsular bag and sulcus has several advantages, as its physiological placement of the IOL is nearest to the original lens position. Anterior chamber IOL implantation is often limited due to complications such as irreversible corneal endothelial loss, corneal decompensation, iris atrophy, iris sphincter erosion, pupil ectopia, and glaucoma [20]. Although SFIOL implantation requires experience and may be a challenging and time-consuming technique, it has many advantages in comparison with ACIOL, such as providing a good physiological placement of the IOL, having a mechanical barrier between the vitreous cavity and the anterior chamber, and having no contact with the corneal endothelium or trabecular meshwork. On the other hand, IOL subluxation, dislocation, endophthalmitis, and RD are important complications of SFIOL and should be considered before implantation [21,22]. In this study, we observed

RD in one case with SFIOL, but there was no other complication related to SFIOL. Iris-fixated IOLs provide an improved design and a greater distance from the endothelium, are easy to implant, and represent a promising technique, but they may result in iris chafing, uveitis, and pupillary constriction [23,24]. Furthermore, iris fixation is not applicable in cases of significant iris trauma, so SFIOL is the treatment of choice in that situation.

Several studies have reported that nearly half of traumatic cataract cases experienced penetrating injuries, and a male majority has been observed among the victims, possibly because of the involvement of males in sports and outdoor activities; this was supported in our findings [25–27]. Sharma et al. [28] studied traumatic-cataract patients with respect to age and found that 50% of patients with traumatic cataracts were less than fifteen years old. However, we did not study subjects in the pediatric age range. Sharma et al. [28] reported that traumatic-cataract patients might have good visual outcomes with proper management, which supports our outcomes. Like Sharma et al. [28], we found that the most common causative agents were stones and thorns for Groups 1 and 2, respectively. However, it is probable that the diverse causative agents reported in the literature depend on region or country, as the most common causes of traumatic cataract may vary according to the region of the study. We noted that corneal laceration was the most common accompanying ocular damage in Group 2, which was strongly supported by other studies [29,30]. Studies show that most patients have cataract surgery within one month in blunt-type traumas, whereas this duration may exceed two months in open-eye injuries, which was also supported in our study [31,32].

Because the final visual assessment is the most important prognostic factor for the success of surgery, most studies focus on the evaluation of visual acuity. We observed a significant visual improvement postoperatively in both groups, supporting many studies [33–35] on this topic. It was statistically comparable to evaluate the intergroup mean of BCVA values at baseline and final visit, as the difference between the numbers of patients was statistically insignificant ($n=23$ and 21 , $p=0.542$). Baseline BCVA values of the groups were similar ($p=0.384$). Both groups had a significant visual improvement, with Group 1 showing a statistically better visual improvement than Group 2 ($p=0.026$). We speculate that this may be related to the fact that, of the associated ocular injuries, corneal laceration was the more common in Group 2. Despite the intergroup similarity of mean IOP measurements at baseline and final visit, we infer that the significant increase of IOP in Group 2 was due to a high proportion of preoperative hypotonic patients compared to Group 1 (2.83:1).

We timed the surgery according to the case, so we did not study this statistically. Tabatabaei et al [36], conducted a study to determine the proper time for traumatic cataract surgery after open-globe injuries. They observed no difference between an early and a late procedure with regard to post-surgical BCVA and prominent intraoperative and postoperative complications. Better visibility due to amelioration of corneal damage and edema, more accurate IOL calculation, and less postoperative inflammation are the benefits of late or secondary intervention [37]. However, it is reasonable to perform the surgical procedure sooner in some special situations, such as the rupture of the anterior capsule and the presence of lens material in the anterior chamber, which may

cause an increase in IOP, prolonged inflammation and anterior/posterior synechiae, and a need for visual rehabilitation and amblyopic therapy in the pediatric/young population [38].

Posterior capsule opacification and CME were the late complications seen in both groups. We observed that a transient IOP increase and PCO did not affect visual acuity after treatments by anti-glaucomatous regimen and Nd: YAG laser, respectively, six months after surgery. Although we experienced some intraoperative difficulties, such as corneal edema and capsular tear, as well as postoperative complications, such as RD and endophthalmitis, we did not find a significant difference in the rates of complications between the two groups.

To our best knowledge, a few studies have reported the outcomes of traumatic cataract surgery performed by the phacoemulsification technique. Kalyanpad and Shinde [39] found in their study that phacoemulsification with PCIOL is also an important modality of treatment in traumatic cataract..

Conclusion

In conclusion, the present study revealed that phacoemulsification and ICCE are successful techniques for treating traumatic cataracts, improving the final visual acuity in blunt- and penetrating-type traumas. Success is also associated with the type and severity of trauma and the experience of the surgeon. Moreover, BCVA improvement may be greater in Group 1 than in Group 2. Its retrospective nature, sample size, study period, and absence of age analysis are the limitations of the study. New studies could be conducted in consideration of these limitations.

Competing interests

The authors declare that they have no competing interest.

Financial Disclosure

The financial support for this study was provided by the investigators themselves.

Ethical approval

Before the study, permissions were obtained from local ethical committee.

Cetin Akpolat ORCID: 0000-0002-7443-6902

Ferhat Evliyaoglu ORCID: 0000-0003-3260-686X

Muhammed Mustafa Kurt ORCID: 0000-0002-4667-3046

Aylin Karadas ORCID: 0000-0001-9343-1421

Mehmet Necdet Cinhuseyinoglu ORCID: 0000-0002-6074-9107

Mustafa Nuri Elcioglu ORCID: 0000-0002-8238-9106

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