

# Visual recovery and predictors of visual prognosis after managing traumatic cataracts in 555 patients

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**Aim:** The aim was to evaluate the visual recovery after managing traumatic cataracts and determine the predictors of a better visual prognosis. **Materials and Methods:** This was a prospective study. We enrolled patients with specific inclusion criteria, examined their eyes to review the comorbidities due to trauma, performed surgery for traumatic cataracts, and implanted lenses. The patients were reexamined 6 weeks postoperatively. We divided the cases of traumatic cataract into two groups, the "open globe" (Group 1) and "closed globe" (Group 2) groups, according to the ocular trauma based on the Birmingham Eye Trauma Terminology System (BETTS) and compared the determinants of visual acuity. **Result:** Our cohort of 555 eyes with traumatic cataracts included 394 eyes in Group 1 and 161 in Group 2. Six weeks postoperatively, the visual acuity in the operated eye was >20/60 in 193 (48%) and 49 (29%) eyes in Groups 1 and 2, respectively ( $P = 0.002$ , ANOVA). At follow-up, >20/60 vision was significantly higher in Group 1 than in Group 2 (OR = 1.61; 95% CI, 0.85–3.02). Overall 242 (43.5%) eyes gained a final visual acuity of >20/60. **Conclusions:** Open globe injury has a favorable prognosis for satisfactory (>20/60) visual recovery after the management of traumatic cataracts.

**Key words:** Traumatic cataract, Birmingham Eye Trauma Terminology System, India, cataract surgery

Trauma is an important cause of monocular blindness in the developing world, although few studies have addressed the problem of trauma in rural areas.<sup>[1]</sup> The etiology of ocular injury is likely to differ from that in urban areas and is worthy of investigation.<sup>[2-4]</sup> Any strategy for prevention requires knowledge of the cause of injury, which may enable more appropriate targeting of resources toward preventing such injuries. Both eye trauma victims and society bear a large, potentially preventable burden.<sup>[3]</sup>

Ocular trauma can cause cataracts.<sup>[1]</sup> The methods used to evaluate the visual outcome in eyes managed for traumatic cataracts and senile cataracts are similar,<sup>[5]</sup> but the damage to other ocular tissues due to trauma may compromise the visual gain in eyes operated on for traumatic cataracts. Hence, the success rates may differ between eyes with these two types of cataracts.

With the introduction of the Birmingham Eye Trauma Terminology System (BETTS), the documentation of ocular trauma has been standardized.<sup>[5]</sup> Consequently, it would be interesting to study the visual outcomes following traumatic cataract surgery and the determinants predicting the outcome, especially in relation to the BETTS. Visual outcomes of traumatic cataracts have been reported in some cases.<sup>[6,7]</sup> However, most studies involved small samples or were case studies. Weinand *et al.* and Bayakara *et al.* reported series focusing on the primary management of traumatic cataracts and perforating injuries.<sup>[6,7]</sup>

In the present study, we examined the visual outcomes following cataract surgery in eyes sustaining injuries, and

the predictors of satisfactory visual outcomes following the management of traumatic cataracts. Our study was conducted in a city located at the borders of three states in India: Gujarat, Madhya Pradesh, and Rajasthan. Qualified ophthalmologists at our institute provide low-cost eye services mainly to the poor belonging to the tribal population of 4.2 million in this area.

## Materials and Methods

We obtained approval from the hospital administrators and research committee to conduct this study and received the participants' written consent. This was a prospective study designed in 2002. All traumatic cataracts in either eye diagnosed and managed between January 2003 and December 2008 were enrolled in our study, and those consenting to participate and not having other serious body injuries were included. In our preoperative assessment, eyes with closed globe comorbidities such as retinal detachment and secondary glaucoma were excluded.

For each patient enrolled in our study, we obtained a detailed history, including details of the injury and information on eye treatment and surgery performed to manage past ocular trauma. Data for both the initial and follow-up reports were collected using the online BETTS format of the International Society of Ocular Trauma. Details of the surgery were also collected using a specified pretested online form.

The cases of traumatic cataract were grouped as those with open or closed globe injuries. The open globe injuries were further categorized into those with lacerations versus rupture. Lacerations of the eyeball were subcategorized into eyes with perforating injuries, penetrating injuries, or injuries involving an intraocular foreign body. The closed globe group was subdivided into lamellar laceration and contusion.

Based on the monthly family income, each patient was classified as rich (>US \$300/15,000 Indian rupees [INR]), poor (US \$50–300/2500–15,000 INR), or very poor (<US \$50/2500

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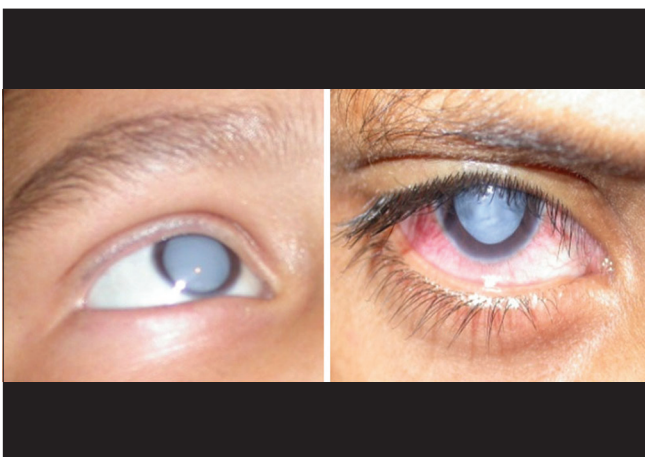
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INR). Other demographic details collected included entry of the patient, residence, activity at the time of injury, object of injury, and previous examinations and treatments. After enrollment, all patients were examined using a standard method. Visual acuity was checked using Snellen's chart, and the anterior segment was examined using a slit lamp.

Based on lenticular opacity, the cataracts were classified into total [Fig. 1], membranous, white soft, and rosette types. When an ophthalmologist did not observe clear lens matter between the capsule and nucleus, the cataract was defined as total. When the capsule and organized matter were fused and formed a membrane of varying density, it was defined as a membranous cataract. When loose cortical material was found in the anterior chamber together with a ruptured lens capsule, the cataract was defined as white soft. A lens with a rosette pattern of opacity was classified as a rosette-type cataract. For a lens that was partially opaque, the posterior segment examination was carried out with an indirect ophthalmoscope and a +20 diopter (D) lens. When the optical medium was not clear, B-scan ultrasonography was performed to evaluate the posterior segment.

The surgical technique was selected according to the morphology and the condition of tissues other than the lens. Phacoemulsification was used to operate on cataracts with hard, large nuclei. With a lens that had either a white soft or rosette type of cataract, unimanual or bimanual aspiration was used. Membranectomy and anterior vitrectomy, either via an anterior or a pars plana route, were performed when the cataract was membranous.

In all patients undergoing corneal wound repair, the traumatic cataract was managed in a second procedure. Recurrent inflammation was more prominent in patients who had undergone previous surgery for trauma.<sup>[8-10]</sup> In such cases, the ocular medium turns hazy due to condensation of the anterior vitreous, unless a vitrectomy is performed. Hence, we performed a capsulectomy and vitrectomy via an anterior or a pars plana route in adults. In children younger than 2 years of age, both lensectomy and vitrectomy via a pars plana route were performed, and the same surgical procedures were used to manage the traumatic cataract. Lens implantation as part of the primary procedure was avoided in all children younger than 2 years of age.<sup>[11]</sup>



**Figure 1:** Total cataract – no clear zone between the capsule and cortex

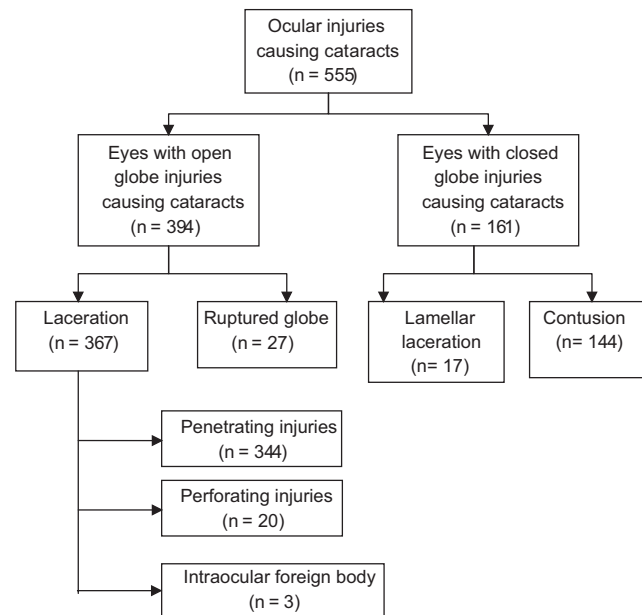
All patients with injuries and without an infection were treated with topical and systemic corticosteroids and cycloplegics. The duration of medical treatment depended on the degree of inflammation in the anterior and posterior segments of the operated eye. The operated patients were re-examined after 24 hours, 3 days, and 1, 2, and 6 weeks to enable refractive correction. Follow-up was scheduled for the third day, weekly for 6 weeks, monthly for 3 months, and every 3 months for 1 year.

At every follow-up examination, visual acuity was tested with Snellen's chart. The anterior segment was examined with a slit lamp, and the posterior segment, with an indirect ophthalmoscope. Eyes with vision better than 20/60 at the glasses (6 weeks) were defined as having a satisfactory grade of vision.

During the examination, data were entered online using a specified pretested format designed by the International Society of Ocular Trauma (initial and follow-up forms) that was exported to a Microsoft Excel spreadsheet. The data were audited periodically to ensure completion. We used the Statistical Package for Social Studies (SPSS 15) to analyze the data. The univariate parametric method was used to calculate frequency, percentage, proportion, and 95% confidence interval (95% CI). We used binominal regression analysis to determine the predictors of postoperative satisfactory vision (>20/60). The dependent variable was vision >20/60 noted at the follow-up, 6 weeks after cataract surgery. The independent variables were age, gender, residence, time interval between injury and cataract surgery, primary posterior capsulectomy and vitrectomy procedure, and type of ocular injury.

## Results

Our cohort consisted of 555 patients with traumatic cataracts [Fig. 2]. There were 394 eyes with open globe ocular injuries



**Figure 2:** Distribution of trauma according to Birmingham Eye Trauma Terminology System

(Group 1) and 161 eyes with closed globe injuries (Group 2; Fig. 2). The patients included 388 (69.9%) males and 167 (30.1%) females. The mean patient age was 27.9 ± 18.64 years (range, 1–80).

We analyzed several demographic factors, including patient entry ( $P = 0.4$ ); socioeconomic status, 83% were from poor class; and residence, 94% lived in rural area and none had a significant relationship with the final visual acuity, according to cross-tabulation and statistical tests. The object causing the injury [Table 1;  $P = 0.3$ ] and the activity at the time of the injury [Table 2;  $P = 0.3$ ] were also not significantly associated with satisfactory final visual acuity. A wooden stick was the most common agent of injury (56.3%). A comparison of the pre- and postoperative visual acuity showed that treatment significantly improved visual acuity [Table 3; Pearson's  $\chi^2$  test,  $P < 0.001$ ; ANOVA,  $P = 0.001$ ] [Fig. 3] An intraocular lens was implanted in 453 (81.6%) cases. Aspiration was significantly associated with improved visual acuity ( $P < 0.001$ ) and was performed using one or two ports in 48.6% of the patients in Group 1. Injury to a structure of the eye in addition to the lens was identified in 514 of the 555 patients [Table 4]. The probable reason for no improvement in vision was comorbidity [Table 5]. Postoperative vision was compared according to the type of injury. Primary posterior capsulectomy and anterior vitrectomy, commonly performed for eyes with significant inflammation,

resulted in a significant improvement in the final visual acuity [Table 6;  $P < 0.001$ ].

One eye with an intra ocular foreign body (IOFB) had <3/60 vision after surgery. Six weeks postoperatively, the visual acuity in the operated eye was >20/60 in 193 (48%) eyes in Group 1 and 49 (29%) eyes in Group 2 ( $P = 0.002$ , ANOVA), and the difference between the groups was significant (OR = 1.61, 95% CI 0.85–3.02). Overall, 242 (43.5%) eyes gained a final visual acuity of >20/60 [Table 7]. We compared the postoperative visual gain between eyes for which the interval between injury and cataract surgery was less than 1 week and those operated on, more than 1 week after injury. The difference was not significant ( $P = 0.8$ ). Patient age had a significant effect on the final visual acuity ( $P < 0.001$ , Pearson's  $\chi^2$  test), and the effect was greatest for patients between 6 and 20 years of age.

We used binominal regression analysis to identify the predictors of satisfactory postoperative vision among eyes operated on for traumatic cataracts in our cohort. Satisfactory postoperative visual gain was predicted in traumatic cataracts when the ocular trauma was open globe and the surgical procedure was primary posterior capsulectomy and vitrectomy.

### Discussion

Visual gain following surgery for traumatic cataracts is a complex problem. Electrophysiological<sup>[10]</sup> and radio-imaging<sup>[12-14]</sup> investigations are important tools available in industrialized countries for assessing comorbidities associated

**Table 1: Cause of injury**

Object	Frequency	Percentage
Ball	4	0.7
Cattle horn or tail	13	2.0
Chemical or electrical burn	13	2.0
Finger	7	1.3
Glass	3	0.5
Insect	1	0.2
Iron wire	35	6.3
Metal door	1	0.2
Needle	1	0.2
Other	43	7.6
Rope	1	0.2
Stone	72	13.0
Unknown	48	8.7
Wooden stick	313	56.4
Total	555	100.0

**Table 2: Activity during injury**

Activity	Frequency	Percentage
Fall	10	1.8
Fighting	4	0.7
Fireworks	1	0.2
House work	144	25.9
Job work	105	18.9
Other	102	18.4
Walking	10	1.8
Playing	149	26.8
Travel on top	26	4.7
Unknown	1	0.2
Vehicular injury	3	0.5
Total	555	100.0

**Table 3: Relationship between pre- and posttreatment visual acuity**

Preoperative	Postoperative						Total
	<1/60	1/60 to 3/60	20/200 to 20/80	20/60 to 20/40	20/32 to 20/20	Uncooperative	
<1/60	151	32	100	102	98	4	487
1/60 to 3/60	3	2	7	10	6	0	28
20/200 to 20/80	1	0	6	8	14	0	29
20/60 to 20/40	0	0	0	1	0	0	1
Uncooperative	0	0	1	1	1	7	10
Total	155	34	114	122	119	12	555

Pearson's  $\chi^2$  test,  $P = 0.013$

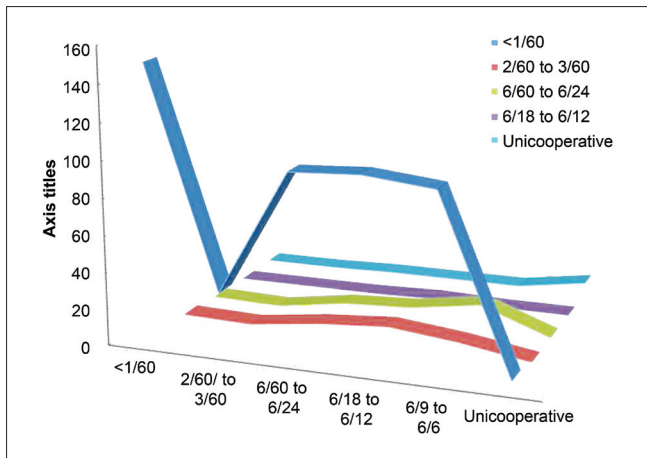


Figure 3: Relationship between pre- and post-treatment visual acuity

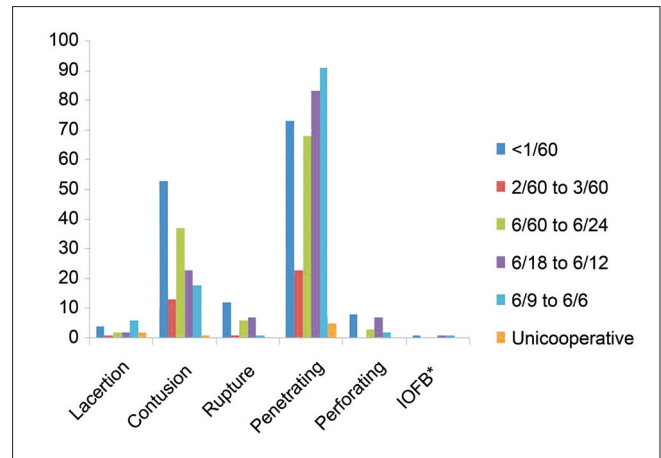


Figure 4: Visual recovery in different type of injuries

Table 4: Injured structures of the eye, in addition to the lens

Involved structure	Frequency	Percentage
Lid	17	3.1
Conjunctiva	68	12.2
Cornea	370	71.3
Sclera	8	1.4
Choroid	1	0.2
Retina	2	0.4
Vitreous	10	1.8
Anterior chamber	5	0.9
Iris	16	2.9
Pupil	17	3.1
Total	514	72.5
Missing	41	2.7
Total	555	100.0

Table 5: Probable reasons for failure of improvement in vision

Reason for failure	Number	Percentage
No reason	202	36.4
Corneal scar	27	5.0
Extensive postdamage	14	2.5
Glaucoma	2	0.4
Infection	3	0.5
Inflammation	28	5.0
Lens position	2	0.4
Lost to follow-up	30	6.2
Other	7	1.3
Total	315	

Table 6: Primary posterior capsulectomy and vitrectomy and final best corrected visual acuity

Procedure	Final BCVA										Total	
	<1/60		1/60 to 3/60		20/200 to 20/80		20/60 to 20/40		20/32 to 20/20		<1/60	
	No	%	No	%	No	%	No	%	No	%	No	%
Not performed	76	13.7	26	4.8	71	12.8	101	18.2	88	15.8	362	65.2
Performed	34	6.1	14	2.5	32	5.8	11	1.9	11	1.9	102	18.4
Total	110	19.8	40	7.2	103	18.5	112	20.2	99	17.8	464	83.6

BCVA = best corrected visual acuity; Pearson's  $\chi^2$  test,  $P < 0.001$

with an opaque lens. Predictors of visual gain after traumatic cataract surgery would be useful for ophthalmologists in such cases. In our study, patients with open globe and closed globe injuries had essentially similar characteristics. However, a satisfactory grade of vision following the management of traumatic cataracts was significantly better in the eyes with open globe injuries.

We could implant lens in 81.6% cases in comparison with Synder *et al* reported 78.6%.<sup>[15]</sup>

Brar *et al.* found that postoperative complications following ocular injuries were the main factor responsible for 20/40 or better vision in 38.8% of eyes with closed globe injuries and in 86.4% in eyes with open globe injuries.<sup>[16]</sup> This difference in success rates could be attributed to differences in the type of ocular trauma, presence of other ocular tissue damage, and variation in surgical procedures. In a study conducted in Yemen involving a small sample of traumatic cataracts and IOFBs, Aldakaf *et al.* found that the initial visual acuity and mechanism

**Table 7: Comparison between open and closed globe injuries**

Parameter	Open globe		Closed globe		Total	
	No.	%	No.	%	No.	%
<b>Socioeconomic status</b>						
Poor	326	58.7	132	23.8	458	82.5
Rich	66	11.9	28	5.0	94	16.9
Very poor	2	0.4	1	0.2	3	0.5
Total	394	70.9	161	29.0	555	100
<b>Entry</b>						
Camp	90	16.2	50	9.0	140	25.2
Door-to-door	0	0	1	0.2	1	0.2
Other	6	1.1	1	0.2	7	1.3
Referral	12	2.2	1	0.2	13	2.3
School	2	0.4	0	0	2	0.4
Self	284	51.1	108	19.5	392	70.6
Total	394	70.9	161	29.0	555	100
<b>Previous treatment</b>						
No	349	62.8	142	25.6	491	88.5
Yes	45	8.1	19	3.4	64	11.5
Total	394	70.9	161	29.0	555	100
<b>Previous surgery</b>						
Corneal wound repair	5	0.9	1	0.2	5	0.9
Ecce+ intraocular lens	1	0.2	2	0.4	3	0.5
No surgery	386	69.5	153	27.6	539	97.1
Other	2	0.4	5	0.9	7	1.3
Total	394	70.9	161	29.0	555	100
<b>Age distribution (years)</b>						
0-5	27	4.9	6	1.1	33	5.9
6-10	79	14.2	13	2.3	92	16.6
11-15	61	10.9	17	3.1	78	14.1
16-20	53	9.5	15	2.7	68	12.6
21-25	29	5.2	9	1.6	38	6.8
26-30	25	4.5	9	1.6	34	6.1
31-35	28	5.0	12	2.2	40	7.2
36-40	15	2.7	11	1.9	26	4.7
41-45	22	3.9	23	4.1	45	8.1
51-55	9	1.6	9	1.6	18	3.2
56-60	13	2.3	15	2.7	28	5.0
61-65	7	1.3	3	0.5	10	1.8
66-70	5	0.9	4	0.7	9	1.6
71-75	0	0	2	0.4	2	0.4
76-80	1	0.2	1	0.2	2	0.4
Total	394	70.9	161	29.0	555	100
<b>Time interval between injury and operative treatment</b>						
0-1	116	20.9	40	7.2	156	28.1
2-4	54	9.7	8	1.4	62	11.2
5-10	69	12.4	21	3.8	90	16.2

**Table 7: Contd...**

Parameter	Open globe		Closed globe		Total	
	No.	%	No.	%	No.	%
11-30	55	9.9	9	1.6	64	11.5
30-15,000	85	15.3	72	12.9	157	28.3
Total	379	68.3	150	27.0	529	95.3
<b>Residence</b>						
Rural	376	67.7	146	26.3	522	94.1
Urban	18	3.2	15	2.7	33	5.9
Total	394	70.9	161	29.0	555	100
<b>Morphology</b>						
Membranous	55	9.9	17	3.1	72	12.9
Rosette	5	0.9	2	0.46	7	1.3
Soft fluffy	254	45.8	73	13.2	327	58.9
Total	77	13.9	68	12.2	145	26.1
<b>Surgical technique</b>						
Aspiration	235	42.3	48	8.6	283	50.9
Lenectomy and vitrectomy	79	14.2	27	4.9	106	19.1
Delivery and vitrectomy	90	16.2	86	15.5	176	31.7
Total	394	70.9	161	29.0	555	100
<b>Primary posterior capsulectomy and vitrectomy</b>						
Not performed	306	55.1	124	22.3	430	77.5
Performed	88	15.9	37	6.7	125	22.5
Total	394	70.9	161	29.0	555	100
<b>Final visual outcome</b>						
<1/60	95	17.1	56	10.1	151	27.2
1/60 to 3/60	21	3.8	12	2.2	33	5.9
20/200 to 20/80	74	13.3	38	6.8	112	20.2
20/60 to 20/40	98	17.3	24	4.3	122	21.9
20/32 to 20/20	95	16.6	25	4.3	120	21.6
Uncooperative	4	0.7	7	1.3	11	1.9
Total	394	70.9	161	29.0	555	100

of injury were predictors of the final visual outcomes.<sup>[17]</sup> In contrast, in a case series of 60 eyes with traumatic cataracts, Wos *et al.* did not find a significant difference in the visual outcome between those developing cataracts after perforating injuries and after nonperforating injuries.<sup>[18]</sup> Gradin *et al.* defined excellent vision as 20/60 or better visual acuity at 4 weeks after cataract surgery and noted excellent vision in 108 (64.7%) of 215 eyes with traumatic cataracts.<sup>[19]</sup> Lacmanovic Loncar *et al.* also reported good visual outcome following surgical treatment for traumatic cataract.<sup>[20]</sup>

Wos *et al.* noted that a large proportion of the population with traumatic cataracts in their series was male.<sup>[18]</sup> In contrast, Baclouti *et al.* did not find a gender difference in traumatic cataracts in their study in Tunisia.<sup>[21]</sup> Although we had a large proportion of males in our cohort, the difference between the numbers of males and females was not statistically significant.

Many working females in the tribal area may be at an increased risk for ocular injuries and traumatic cataracts, which may explain the gender variation noted in our study.

Our cohort of patients with traumatic cataracts was much younger than the patients in other studies.<sup>[22]</sup> Hence, proper intervention to avoid visual disability in our cohort would be more cost effective, as the disability-adjusted life years saved by successful intervention would be much higher.

We used a practical grading of cataracts to enable ophthalmologists to determine the best mode of managing the cataracts. This grading differs from the standard grading used for senile cataracts.<sup>[23]</sup> We could not find a similar grading of traumatic cataracts in the literature. Hence, further studies with larger cohorts should evaluate visual acuity according to the grade of traumatic cataracts.

In another study conducted at our institute, we evaluated the profiles and visual outcomes of ocular trauma management in relation to ocular trauma groupings based on BETTS nomenclature.<sup>[4]</sup> However, other studies have used the ocular trauma score (OTS).<sup>[24]</sup> It would be interesting to study the visual outcomes of traumatic cataract surgery using the OTS to grade ocular trauma.

Stenberg reported that the initial visual acuity and patient age were predictors.<sup>[25]</sup> In our study, patient age was a predictor, but the initial visual acuity was not. This contrasts with observations in the literature. This apparent discrepancy may be due to the high frequency of penetrating injuries in our study [Fig. 4], which usually presented early and achieved satisfactory visual acuity following proper management (343 eyes). It may also be true that eyes with closed globe injuries have poor visual outcomes compared with eyes with open globe injuries and cataracts.

Posterior capsulectomy and primary anterior vitrectomy proved to be useful for obtaining good visual outcomes in cataract surgery, especially in children and severely inflamed eyes.<sup>[24,25]</sup>

In most of our cases, the traumatic cataracts affected only one eye. We evaluated the effect of late treatment on visual outcome. Using specific exclusion criteria, we studied far fewer cases at risk for poor vision. This might have led to a significant bias that might have skewed the final results toward satisfactory vision.

We obtained good visual outcomes after managing traumatic cataracts. Satisfactory visual acuity following cataract surgery was associated with eyes having open globe injuries and managed using a primary posterior capsulectomy and vitrectomy as the primary procedure.

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