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Research Article

Visual Outcome Predictors in Traumatic Cataract: A Prospective Study Using Betts Classification and Ocular Trauma Score

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Abstract

Aim: Traumatic cataract presents unique surgical challenges and strategic management is essential to achieve optimal visual rehabilitation. This study evaluates visual outcomes and identifies probable predictors of visual prognosis in traumatic cataract.

Materials and Methods: This prospective, observational, single-institution study included 43 consecutive patients with traumatic cataract. All patients underwent detailed history and clinical examination and were classified according to the Birmingham Eye Trauma Terminology System (BETTS). Visual prognosis was estimated preoperatively using the Ocular Trauma Score (OTS). Management was tailored to the type of injury, capsular status and associated ocular co-morbidities. Patients were followed for a minimum of six months. Primary and secondary surgical interventions were recorded and final Best-Corrected Visual Acuity (BCVA) was correlated with initial OTS predictions.

Results: Of 43 patients (mean age 24 years; range 8 months-68 years), 38 (88.4%) were male. Open-globe injuries (n=29, 67.4%) were more common than closed-globe injuries (n=14, 32.6%). The commonest causative agents were iron rod and wooden splinter (each 16.3%). Corneal tear (60.5%) was the most frequent associated co-morbidity and significantly influenced final visual outcome.

Penetrating injuries had the poorest recovery, with 56% achieving vision <1/60. Contusion injuries had

the best recovery, with 46.2% achieving 6/36-6/18 and 30.8% achieving ≥6/12. Thirty-nine patients (90.7%) were OTS category 2. Comparison of six-month BCVA with OTS-predicted outcomes showed concordance in most categories, with better-than-predicted results in OTS categories 1, 2 and 3 for higher vision bands.

Conclusion: Systematic classification using BETTS and prognostication with OTS are valuable preoperative tools in traumatic cataract. Associated co-morbidities-particularly corneal scarring, vitreous haemorrhage, retinal detachment and aphakia-are critical predictors of poor visual outcome. Tailoring primary and staged secondary procedures to the injury pattern improves visual rehabilitation and allows realistic counselling.

Keywords: Traumatic Cataract; Ocular Trauma Score; Birmingham Eye Trauma Terminology System; Visual Outcome; Predictors

Abbreviations

BETTS: Birmingham Eye Trauma Terminology System; OTS: Ocular Trauma Score; BCVA: Best-Corrected Visual Acuity

Introduction

Ocular trauma remains a leading cause of monocular visual impairment and blindness worldwide accounting for approximately 19 million cases of unilateral blindness and 2.3 million cases of bilateral blindness [1]. In India, the prevalence is estimated at 2.4% [2,3]. Traumatic cataract is among the commonest vision-limiting sequelae of both open- and closed-globe injuries [4,5].

Traumatic cataract is rarely isolated. It is frequently accompanied by lens subluxation, corneal laceration, hyphaema, uveal prolapse, angle recession, vitreous loss, retinal detachment, choroidal rupture or intraocular foreign body [4,6]. The spectrum of co-morbidities directly reflects the severity, mechanism and energy of the injury, making each case surgically distinct.

Primary repair alone is often insufficient and delayed secondary intervention adversely affects visual recovery [7]. Early, structured assessment using BETTS for anatomical classification and OTS for prognostication simplifies decision-making and facilitates preoperative counselling [1,7]. This study was undertaken to determine factors affecting visual outcome in traumatic cataract in relation to associated co-morbidity, interval between trauma and presentation and injury type using BETTS and OTS.

Methodology

Study Desigand Ethics

Prospective observational study conducted at a single tertiary centre in accordance with the Declaration of Helsinki, after Institutional Ethics Committee approval. Informed consent was obtained.

Participants/Subjects

Forty-three consecutive patients with traumatic cataract of varied mechanisms were enrolled.

Data Collection

Demographic data, mechanism, object, activity at injury, laterality, interval from trauma to presentation and initial visual acuity were recorded on a standardised proforma and entered into Microsoft Excel.

Data Analysis

Best-corrected visual acuity (Snellen), slit-lamp biomicroscopy, intraocular pressure and fundus examination by indirect ophthalmoscopy were performed. B-scan ultrasonography was used when media opacity precluded posterior segment view. Photographic documentation was maintained.

Classification: Injuries were classified as open- or closed-globe per BETTS [8]. OTS raw scores were calculated from presenting vision and subtracting points for globe rupture (−23), endophthalmitis (−17), perforating injury (−14), retinal detachment (−11) and relative afferent pupillary defect (−10) [1]. Scores were stratified into OTS categories 1 (0-44) to 5 (92-100).

Management strategy: Initial medical therapy included topical antibiotics, cycloplegics, intraocular pressure-lowering agents and systemic/topical corticosteroids once infection was excluded. Surgery was deferred until inflammation was controlled.

Surgical approach was individualised into four patterns: 1) Cataract without capsular rupture or co-morbidity: Managed by manual Small-Incision Cataract Surgery (SICS) or phacoemulsification with Posterior Chamber Intraocular Lens (PCIOL) implantation, based on affordability. 2) Cataract with anterior capsule rupture, intact posterior capsule: PCIOL in the bag; with <1 quadrant zonular dialysis, haptic oriented toward dialysis; with extensive zonular loss or posterior capsule rupture, sulcus PCIOL if support adequate, otherwise Anterior Chamber IOL (ACIOL). 3) Cataract with corneal tear: Intact capsule-primary corneal repair followed by secondary cataract extraction; with capsule rupture-combined corneal repair and cataract extraction as primary procedure. IOL power calculated from the injured eye when possible; otherwise, fellow-eye biometry is used. 4) Cataract with co-morbidities: Additional procedures included anterior chamber wash for hyphaema, synechiolysis, membrane peel, vitrectomy and foreign-body removal. In children <2 years, primary IOL implantation was deferred.

Follow-up: Postoperative topical steroids, antibiotics and cycloplegics were prescribed. Follow-up examinations at day 15, day 30, 2, 4 and 6 months recorded BCVA and anterior/posterior segment status.

Statistical analysis: Descriptive statistics were used. Final BCVA at six months was compared with OTS-predicted probabilities [1,9].

Results

Demographics: Thirty-eight males (88.4%) and five females (11.6%); mean age 24 years. The 21-30-year group was largest (20.9%, all male), comparable to prior Indian series (Fig. 1-8, Table 1-13) [5,10].

Presentation interval: Twenty-seven patients (62.8%) presented within five days; 14 (32.6%) within 6-10 days; mean interval 6 days. Earlier presentation correlated with greater pain and severe vision loss, consistent with Shah, et al. [7].

BETTS distribution: Open-globe 29 (67.4%)-laceration 28 (65.1%; penetrating 25, perforating 1, intraocular foreign body 2) and rupture 1 (2.3%). Closed-globe 14 (32.6%)-contusion 13 (30.2%) and lamellar laceration 1 (2.3%) [8].

Aetiology: Iron rod (16.3%) and wooden splinter (16.3%) were the commonest, followed by road traffic accident (11.6%), firecracker (9.3%), scissors (6.9%) and iron wire (6.9%), similar to rural Indian data [5].

Activity: Occupational work (25.6%) and outdoor play (25.6%) predominated, followed by household tasks (11.6%) and road traffic accidents (11.6%).

Associated co-morbidities: Corneal tear 60.5%, anterior chamber shallowing 27.9%, uveal prolapse 23.3%, hyphaema 20.9%, retinal detachment 9.3%, vitreous haemorrhage 6.9%, anterior capsule tear 6.9%, lens matter in anterior chamber 6.9%, iridodialysis 6.9%, intraocular foreign body 4.7%, hypopyon 2.3% [6,11].

Surgical interventions: Primary procedures-corneal tear repair 60.5%, cataract extraction with PCIOL 67.4%, synechiolysis 37.2%, iridodialysis repair 27.9%, vitrectomy 27.9%, foreign-body removal 4.7% [4,12].

Visual outcome by injury type: Penetrating injuries-56% achieved <1/60. Contusion injuries-46.2% achieved 6/36-6/18 and 30.8% achieved ≥6/12. Intraocular foreign body and lamellar laceration had uniform outcomes [13].

OTS correlation: Thirty-nine patients (90.7%) were OTS category 2; two each in categories 1 and 3. At six months, observed BCVA matched or exceeded OTS predictions in most groups, except OTS category 1 for the lowest vision band [1,9].

Co-morbidities affecting outcome: Eyes with final vision hand movements or perception of light showed high rates of corneal scar (70.6%), retinal detachment (58.8%), vitreous haemorrhage (29.4%), aphakia (23.5%) and foreign body (11.8%) [11,14].

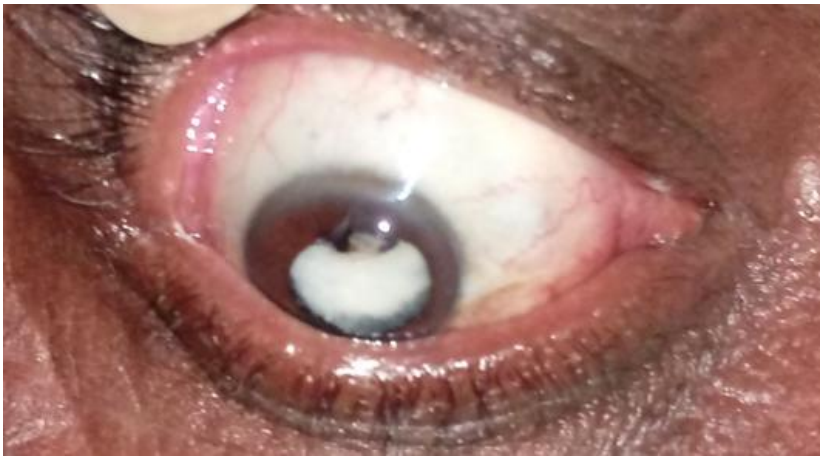

Figure 1: Traumatic cataract due to blunt trauma.

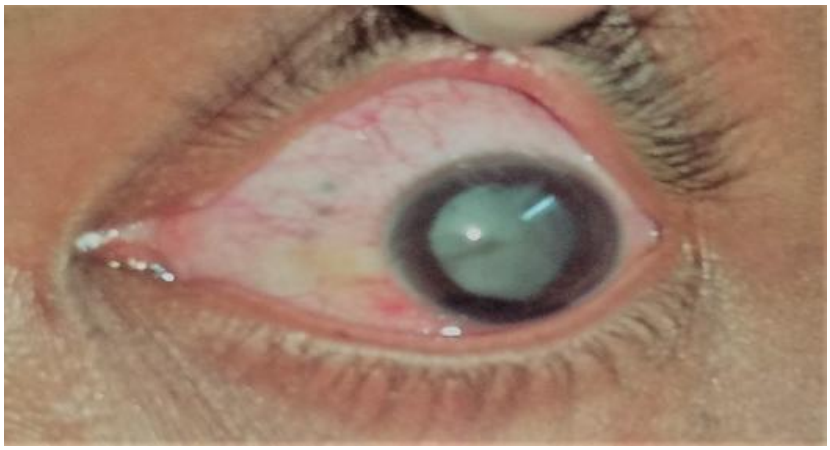

Figure 2: Traumatic cataract due to blunt injury with intact cornea and lens capsule.

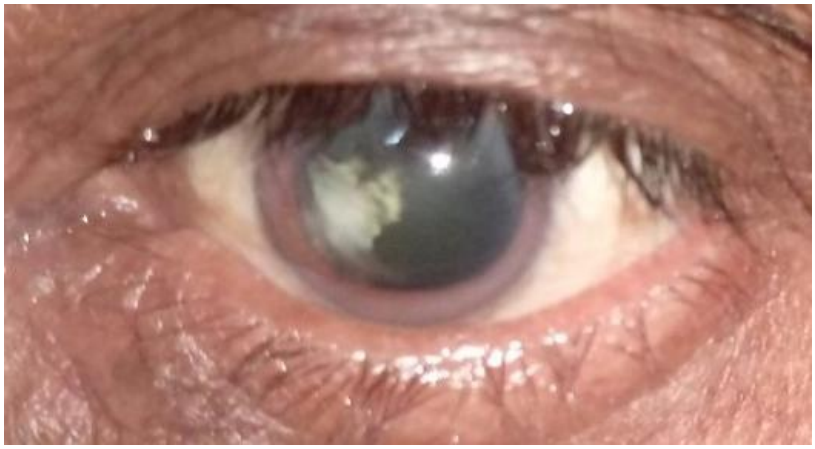

Figure 3: Focal traumatic cataract due to penetrating injury.

Figure 4: Hypopyon with traumatic cataract in penetrating trauma.

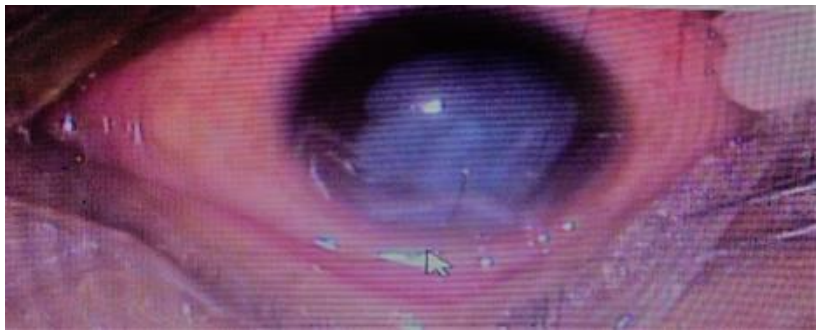

Figure 5: Corneal tear repair without anterior capsule tear.

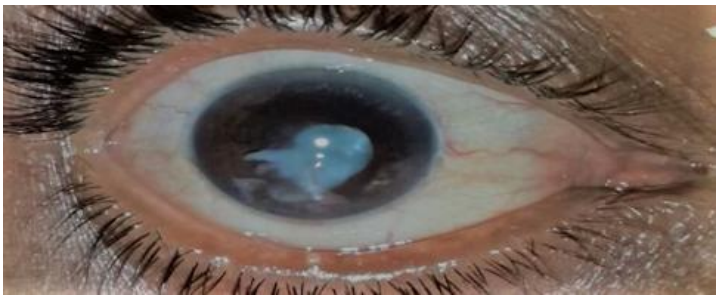

Figure 6: Anterior capsule tear with lens matter in anterior chamber without corneal tear.

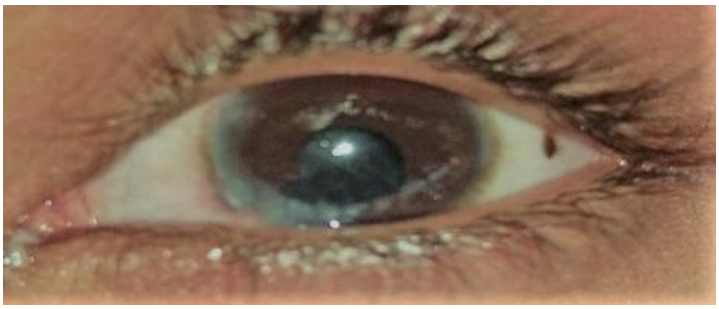

Figure 7: Post-op corneal tear repair with PCIOL.

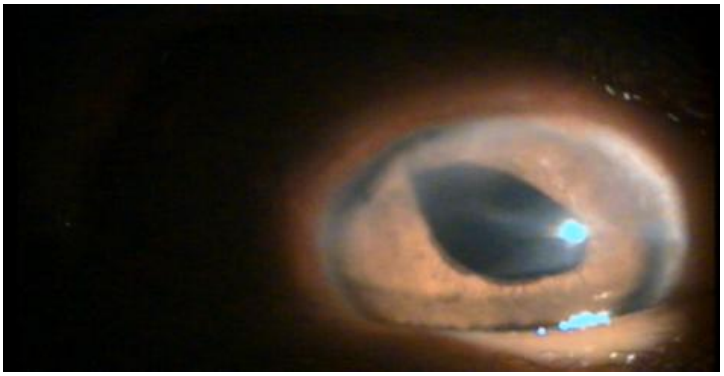

Figure 8: Post-op Iridodialysis with PCIOL.

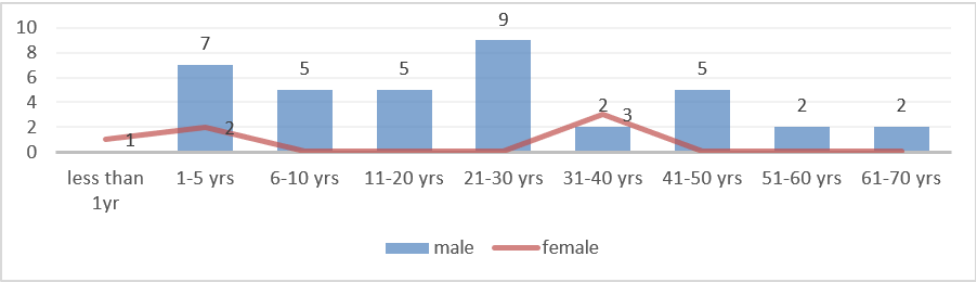

Table 1: Distribution of age and sex.

Group	No. of days	No. of cases
Group 1	1-5 days	27 (62.79%)
Group 2	6-10 days	14 (32.55%)
Group 3	11-15 days	0 (0%)
Group 4	16-20 days	1 (2.32%)
Group 5	21-25 days	0 (0%)
Group 6	26-30 days	1 (2.32%)

Table 2: Time interval between injury and presentation.

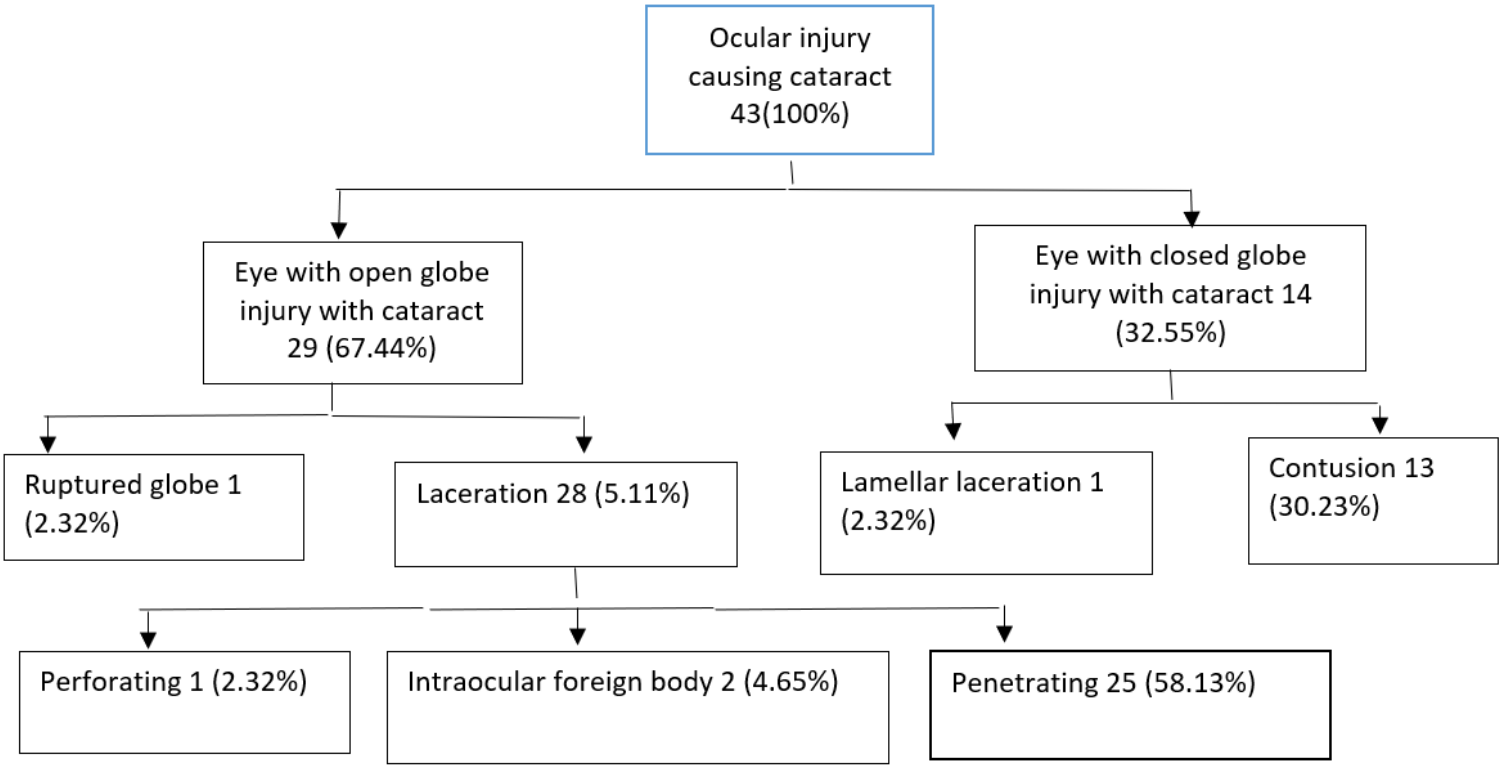

Table 3: Type of ocular trauma according to betts classification.

Mode of Injury	Number	%
Iron rod	7	16.27
Wooden chip	7	16.27
Scissors	3	6.9
Iron nail	1	2.3
Fire cracker	4	9.3
Thorn	1	2.3
Pencil tip	2	4.6
Iron wire	3	6.9
Cow horn	1	2.3
Stone	2	4.6
RTA	5	11.62
Wooden stick	4	9.3
Battery blast	1	2.3
Toy	2	4.6

Table 4: Causes of trauma.

Activity	Number	%
Fall	4	9.3
Fighting	2	4.6
Firework	3	6.9
Housework	5	11.62
Job work	11	25.58
Playing	11	25.58

RTA	5	11.62
Others	2	4.6

Table 5: Activity during injury.

Co-morbidity	Percentage%
Corneal tear	60.46
AC shallow	27.90
Lens matter in anterior chamber	6.9
Hypopyon	2.3
Iridodialysis	6.9
Intraocular foreign body	4.6
Traumatic mydriasis	9.3
Retinal detachment	9.3
Corneal hazy	9.3
Hyphema	20.93
Vitreous matter in anterior chamber	4.6
Uveal tissue prolapse	23.25
Posterior synechiae	9.3
Cystoid macular oedema	2.3
Vitreous haemorrhage	6.9
Zonular dialysis	18.60

Table 6: Co-morbidities with traumatic cataract at presentation.

Management	Primary Procedure	Secondary Procedure
Corneal tear repair	26 (60.46%)	
Cortical matter removed	16 (37.20%)	
Synechiolysis	16 (37.20%)	5 (11.62%)
Iridodialysis repair	12 (27.90%)	4 (9.30%)
FB removal	2 (4.6%)	
AC IOL		1 (2.32%)
Scleral fixation IOL		1 (2.32%)
PCIOL	29(67.44%)	8(18.60%)
AC wash	15 (34.88%)	
Vitrectomy	12 (27.90%)	13 (30.23%)

Table 7: Surgical management.

Type of Injury		Vision	After	Recovery
	< 1/60	4/60-6/60	6/36-6/18	6/12-6/6
Penetrating	14 (56%)	1 (4%)	5 (20%)	5 (20%)
Perforating			1 (100%)	
IOFB	2 (100%)			
Rupture	1 (100%)			
Lamellar laceration	1 (100%)			
Contusion	1 (7.69%)	2 (15.38%)	6 (46.15%)	4 (30.76%)

Table 8: Final visual recovery in different types of injury.

A. Initial raw score (based on initial visual acuity) NPL= no perception of light PL= perception of light HM= hand movements	NPL= 60 PL/HM= 70 1/200 to 19/200=80 20/200 to 20/50=90 >=20/40= 100
B. globe rupture	-23
C. endophthalmitis	-17
D. perforating injury	-14
E. retinal detachment	-11
F. relative afferent pupillary defect	-10
Raw score sum=sum of raw points	

Table 9: OTS raw points calculation.

Raw-Score Sum	OTS Category	NPL	PL/HM+	1/200-19/200	20/200-20/50	>=20/40
0-44	1	73%	17%	7%	2%	1%
45-65	2	28%	26%	18%	13%	15%
66-80	3	2%	11%	15%	28%	44%
81-91	4	1%	2%	2%	21%	74%
92-100	5	0%	1%	2%	5%	92%

Table 10: Estimated Probability Of Visual Acuity At 6 Months By OTS.

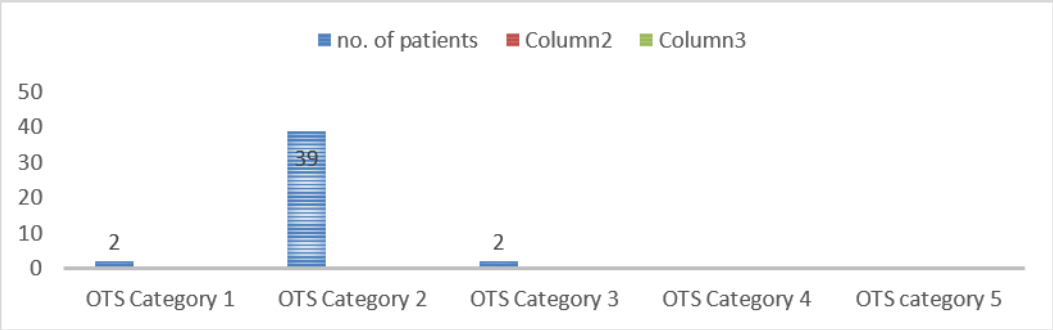

Table 11: Distribution of cases according to ots categories.

Achievement of OTS						Predicted Visual Acuity (%)					
	Group A			Group B		Group C	Group D			Group E	
	OTS	NO	PL	P L +/	HM+	1/200-	20/190	20/200-	20/50	20/40	Or above
Raw score	category	predicted	achieved	predicted	achieved	predicted	Achieved	predicted	archived	predicted	achieved
0-44	OTS-1	73	0	17	50	7	0	2	0	1	0
45-65	OTS-2	28	0	26	27	18	8	13	20	15	28
66-80	OTS-3	2	0	11	0	15	100	28	100	44	0
81-91	OTS-4	1	0	2	0	2	0	21	0	74	0
92-100	OTS-5	0	0	1	0	2	0	5	0	92	0

Table 12: OTS-predicted vision vs actual final vision.

Final Visual Outcome	Co-Morbidities
HM+, FC, PL+	Corneal scar (70.58%) Vitreous haemorrhage (29.41%), Retinal detachment (58.88%), Aphakia (23.52%),

	Foreign body (11.76%)
6/60-6/36	Corneal scar (66.66%), Vitreous haemorrhage (16.66%), Retinal detachment (16.66%)
6/24-6/18	Corneal scar (50%), Vitreous haemorrhage (12.5%), Retinal damage (12.5%)
6/12-6/9	Nebular corneal opacity (30%), CME (10%)

Table 13: Final visual impairment in correlation with ocular co-morbidity.

Discussion

Strategic surgical plan in variable ocular findings and prediction of final visual outcome in traumatic cataract is always challenging [4]. Careful examination to understand injury pattern is essential to tailor primary and staged secondary procedures to improve visual rehabilitation and allow realistic counselling [10].

Prior Indian series showed young male predominance (71 to 80%) due to occupational and outdoor exposure, which aligns with our findings [5,10]. Mean presentation interval of six days mirrors Gogate, et al. [5].

Open-globe injuries predominated (67.4%), comparable to Cheema and Lukaris (62.5%) and Gupta, et al. (52.8%) [12,15]. Unlike some Western reports of left-eye predominance, we found slight right-eye preponderance.

Mode of injury correlated with anatomy: sharp objects produced penetrating wounds; blunt high-energy objects produced contusions. Iron rod and wood-common in agrarian settings-were leading causes, consistent with previous reports [5].

Corneal tear was the dominant co-morbidity and principal determinant of poor visual outcome due to resultant scarring, as also noted by Mundada, et al. [16]. Our approach of staged surgery-primary corneal repair followed by secondary cataract extraction-aligns with Kuhn's recommendations [4].

Both phacoemulsification and SICS produced comparable results in our resource-constrained setting.

OTS proved a robust counselling tool. Predicted versus observed six-month acuities were concordant across categories, validating its utility in traumatic cataract, as reported by Shah, et al. [9,1].

Limitations include single-centre design, small sample size, lack of randomisation between surgical techniques and absence of long-term follow-up beyond six months.

Conclusion

Classifying mechanical ocular trauma by BETTS estimating prognosis with OTS and tailoring surgical timing to associated co-morbidities enables structured management of traumatic cataract [1,8]. Corneal involvement, posterior segment pathology and delayed presentation remain key predictors of suboptimal visual recovery.

Conflict of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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Acknowledgement

The authors have no acknowledgments to declare.

Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Ethical Statement

This project was granted permission by The Institute Ethical Committee (EC).

Informed Consent Statement

Informed consent was obtained from all patients included in the study.

Authors' Contributions

All authors contributed equally to this paper.

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