# Study of Final Visual Outcome in Penetrating Sub Group of Open Globe Injuries Following Surgical Treatment of Traumatic Cataract According to Birmingham Eye Trauma Terminology System

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**ABSTRACT**

**Objective:** To study final visual outcome in cases of surgically treated traumatic cataract caused by penetrating variety of Open globe group classified according to Birmingham Eye Trauma Terminology System.

**Material and Methods:** We enrolled patients with specific inclusion criteria, examined their eyes to review the co-morbidities due to trauma, performed surgery for traumatic cataracts, and implanted a lens. The patients were re-examined 6 weeks postoperatively. We divided the cases of traumatic cataract into two groups, the 'open globe' (Group 1) and 'closed globe' (Group 2) groups, We further sub divided open globe in to sub groups of open globe injuries, out of which we studied penetrating sub group of ocular trauma based on the Birmingham Eye Trauma Terminology System (BETTS) and compared the determinants of visual acuity.

**Result:** Our cohort of 687 eyes with traumatic cataracts included 496 eyes in Open globe and 191 in closed globe group. Six weeks postoperatively, Overall 373 (54.3%) eyes gained final visual acuity >20/60. Our study had 422 (61.4%) penetrating injury cases out of them 61.4% regained final visual acuity>20/60. Visual outcome was significantly better when compared amongst penetrating subgroup of open globe injury and other subgroups of BETTS.

**Conclusions:** Penetrating subgroup of open globe injury has a favorable prognosis for satisfactory (>20/60) visual recovery after management of traumatic cataracts.

**Key Words:** BETTS; Traumatic cataract; Penetrating injury; visual outcome; open globe injury.

## INTRODUCTION

Trauma is a cause of monocular blindness in the developed world, although few studies have addressed the problem of trauma in rural areas.[1] The etiology of ocular injury is likely to differ from that in urban areas and is worthy of investigation.[2-4] 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.[3]

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## PURPOSE

Ocular trauma can cause cataracts.[1] The methods used to evaluate the visual outcome in eyes managed for traumatic cataracts and senile cataracts are similar,[5] 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 cataract.

With the introduction of the BETTS (birmingham eye trauma terminology system), the documentation of ocular trauma has been standardized.[5] 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 birmingham eye trauma terminology system. Visual outcomes of traumatic cataracts have been reported in some cases.[6,7] However, most studies involved small samples or were case studies. Weinand et al.,[6] and Bayakara et al.,[7] reported series focusing on the primary management of traumatic cataracts and perforating injuries.

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.[4] 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.

## MATERIAL 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 cohort study designed in 2002. All traumatic cataracts in either eye diagnosed and managed between January 2003-December 2009 were enrolled in our study, and those consenting to participate and not having other serious body injuries were included, retrieved data from medical records and collected in specific pretested online form.

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 birmingham eye trauma terminology system format of the International Society 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 monthly family income, each patient was classified as rich (>US $300/15,000 Indian rupees [INR]), poor (US $50–300/2500–15000 INR), or very poor (<US $50/2500 INR).[10] 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 as total, when an examiner did not observe clear lens matter between the capsule and nucleus, the cataract was defined as total. , membranous, when the capsule and organized matter were fused and formed a membrane of varying density, it was defined as a membranous cataract, in which both capsules fused with scant or no cortical material, white soft cataract with ruptured capsule when loose cortical material was found in the anterior chamber together with a ruptured lens capsule, the cataract was defined as white soft cataract with ruptured capsule. , and rosette types a lens with a rosette pattern of opacity was classified as a rosette type cataract. We could cover all cataract cases presented to us under this classification. Morphology mainly influenced by type, force, object of injury and time interval between injury and examination.[11]

For a partially opaque lens, the posterior segment examination was carried out with an indirect ophthalmoscope and a +20 D lens. When the optical medium was not clear, a B-scan was performed to evaluate the posterior segment.

The surgical technique was selected according to 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 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[8,9] in such cases, when ocular media found hazy due to inflammation of the anterior vitreous, we performed a capsulectomy and vitrectomy via an anterior/pars plana route in adults.

In children younger than 2 years of age, both lensectomy and vitrectomy via pars plana route was performed leaving rim of anterior capsule for secondary implant, 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.

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 h, 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 appointment (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 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 17) to analyze the data. We used descriptive statistics and cross tabulation to compare cause and effect of different variables. 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.[5]

We have compared all variables for penetrating subgroup of open globe and other groups according to birmingham eye trauma terminology system.

## RESULTS

Our cohort consisted of 687 patients with traumatic cataracts including 496 eyes with open-globe ocular injuries and 191 (27.8%) eyes with closed-globe injuries. The patients were 492 (71.6%) males and 195 (28.4%) females. The mean patient age was 27.1±18.54 years (range, 1-80). Our study had 45 (6.7%) globe ruptures and 422 (61.4%) penetrating injury cases (Table 1).

***Table 1:*** *Age and sex distribution.*

| Age | Sex | | Total |
|---|---|---|---|
| | Female | Male | |
| 0 to 10 | 49 | 106 | 155 |
| 11 to 20 | 48 | 136 | 184 |
| 21 to 30 | 20 | 70 | 90 |
| 31 to 40 | 30 | 49 | 79 |
| 41 to 50 | 25 | 70 | 95 |
| 51 to 60 | 14 | 41 | 55 |
| 61 to 70 | 9 | 15 | 24 |
| 71 to 80 | 0 | 5 | 5 |
| Total | 195 | 492 | 687 |

Postoperatively, the visual acuity in the operated eye was >20/60 in 258 (61.4%) eyes in penetrating sub group of open globe group and 113 (42.6%) in other groups and 372 (54.1%) , which is significantly better than other groups. (p=0.000, ANOVA, X2),

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-; Pearson's $\chi^2$ test, p=0.00; ANOVA, p=0.001). An intraocular lens was implanted in 453 (82%) cases (Table 4).

We have found surgical treatment over all made significant difference in final visual outcome (Table 2 p=0.000). When we compared visual outcome following surgical treatment amongst various subgroups of open globe injuries penetrating sub group has significantly better outcome (Table 3). Visual outcome following surgical treatment of traumatic cataract following penetrating injury better than other groups (Table 4, p=0.000).

***Table 2:*** *Comparative study of pre and post treatment visual acuity.*

| Post-operative vision | Pre-operative vision | | | | | | Total |
|---|---|---|---|---|---|---|---|
| | Uncooperative | <1/60 | 1/60 to 3/60 | 6/60 to 6/36 | 6/24 to 6/18 | 6/12 to 6/6 | |
| uncooperative | 7 | 0 | 0 | 0 | 1 | 2 | 10 |
| <1/60 | 14 | 167 | 53 | 54 | 114 | 191 | 593 |
| 1/60 to 3/60 | 0 | 4 | 3 | 8 | 21 | 10 | 46 |
| 6/60 to 6/36 | 0 | 0 | 0 | 1 | 7 | 12 | 20 |
| 6/24 to 6/18 | 0 | 3 | 0 | 1 | 6 | 7 | 17 |
| 6/12 to 6/6 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 6/6 to 6/5 | 0 | 14 | 2 | 6 | 2 | 1 | 25 |
| Total | 21 | 174 | 56 | 64 | 149 | 223 | 687 |
| P=0.000 | | | | | | | |

***Table 3:*** *Comparative study of post treatment visual acuity amongst sub categories of open globe according to BETTS.*

| Post-operative Vision | BETTS Open globe subcategories | | Total |
|---|---|---|---|
| | Globe Rupture | Penetrating injury | |
| uncooperative | 1 | 13 | 14 |
| <1/60 | 16 | 83 | 99 |
| 1/60 to 3/60 | 4 | 34 | 38 |
| 6/60 to 6/36 | 4 | 33 | 37 |
| 6/24 to 6/18 | 14 | 87 | 101 |
| 6/12 to 6/6 | 7 | 172 | 179 |
| Total | 46 | 422 | 468 |
| P=0.018 | | | |

***Table 4:*** *Comparative study of post treatment visual acuity amongst penetrating category of open globe injury and other categories according to BETTS.*

| Post-operative Vision | BETTS Penetrating Vs Other | | Total |
|---|---|---|---|
| | Penetrating | Other | |
| uncooperative | 13 | 8 | 21 |
| <1/60 | 83 | 91 | 174 |
| 1/60 to 3/60 | 34 | 22 | 56 |
| 6/60 to 6/36 | 33 | 31 | 64 |
| 6/24 to 6/18 | 87 | 62 | 149 |
| 6/12 to 6/6 | 172 | 51 | 223 |
| Total | 422 | 265 | 687 |
| P=0.000 | | | |

We analyzed several demographic factors socioeconomic status (79% were from lower socioeconomic class and residence; 95% were from a rural area), and the activity at the time of the injury (p=0.120) none had a significant relationship with final visual acuity, according to cross tabulation and statistical tests. The object causing the injury (p=0.02) and patient entry (p=0.009) were significantly associated with satisfactory final visual acuity (Table 5).

We have also compared these variables in penetrating subgroup of open globe other groups. We have found significant difference in age distribution, gender, object of injury, habitat, morphology, pretreatment and post treatment vision, number of surgeries and lens implant other than final visual outcome. We did not find significant difference in of patient entry, early reporting and socio economic status (Table 6).

We have studied post operative spherical refractive status of these eyes we found 54% had refractive error between 0 to 1 diaptor, 22.7% were having between 1 to 3 diaptor and 2.5% were having refractive error >3 diaopters. On studying post operative astigmatism of these eyes we found 64% had astigmatism between 0 to 1 diaptor, 32.0% were having between 1 to 3 diaptor and 1% were having astigmatism >3 diaopters.

## DISCUSSION

Visual gain following surgery for traumatic cataracts is a complex problem. Electrophysiological[12] and radio-imaging[11-13] investigations are important tools for assessing co-morbidities associated with an opaque lens.

In our study, patients with penetrating subgroup of open globe and other groups of injuries had traumatic cataract. However, a satisfactory grade of vision following the management of traumatic cataracts was significantly better in the eyes with penetrating sub group of open globe injuries (Table 2-4). We are not aware about any study which has studied final visual outcome in penetrating subgroup of open globe injury classified by birmingham eye trauma terminology system.

Brar et al.,[16] found that postoperative complications following ocular injuries were the main factor responsible for poor outcome, 20/40 or better vision in 38.8% of eyes with closed globe injuries and in 86.4% in eyes with open globe injuries. 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. By contrast, in a case series of 60 eyes with traumatic cataracts,

***Table 5:*** *Summary of Other variables studied.*

| No | Variables | P value | Conclusion |
|---|---|---|---|
| 1 | Age | 0.000 | Younger person has better outcome |
| 2 | Sex | 0.193 | No significant difference |
| 3 | Entry | 0.009 | Self-reporting has better outcome |
| 4 | Object | 0,020 | Wooden stick/ thorn has better outcome |
| 5 | Activity | 0.120 | No significant difference |
| 6 | Morphology | 0.000 | Soft matter in anterior chamber with broken anterior capsule common has better outcome |
| 7 | Intra Ocular Lens | 0.000 | Better outcome |
| 8 | Number of surgeries | 0.000 | Better Outcome with minimum surgeries |

**Table 6:** *Comparative study of variables amongst cataract following penetrating and other categories according to BETTS.*

| No | Variable | Penetrating | Other category | P value |
|---|---|---|---|---|
| 1 | Age | Common in younger age | | 0.000 |
| 2 | Entry | No difference | | 0.502 |
| 3 | Report time | No difference | | 0.368 |
| 4 | Socio economic status | No difference | | 0.336 |
| 5 | Habitat | More | Less | 0.012 |
| 6 | Object of injury | Wooden stick-thorn | less | 0.000 |
| 7 | Activity during injury | | | 0.120 |
| 8 | Type of injury Open globe Subgroup | Common | Less Common | 0.000 |
| 9 | Pre-treatment vision | Poorer | better | 0.000 |
| 10 | Morphology | Soft matter in anterior chamber with broken anterior capsule common | | 0.000 |
| 11 | Ocular Trauma score | OTS 3 common | | 0.000 |
| 12 | Number of Surgeries | Less | More | 0.070 |
| 13 | Intra Ocular Lens | More | less | 0.000 |
| 14 | Post treatment vision | Better | Less | 0.000 |

**Table 7:** *Reasons for not improving vision.*

| | Name of complication | Total |
|---|---|---|
| 1 | Wound leak | 3 |
| 2 | Hyphema | 10 |
| 3 | Iridodialyses | 2 |
| 5 | IOL Mal position | 17 |
| 6 | Vitreous Loss | 15 |
| 7 | Infection | 6 |
| 8 | Corneal edema | 28 |
| 11 | Inflammation | 2 |
| 12 | Glaucoma | 3 |
| 13 | Retinal Detachment | 13 |
| 14 | After cataract | 1 |
| 15 | Other | 59 |

Wos et al.,[17] did not find a significant difference in visual outcome between those developing cataracts after perforating injuries and after non-perforating injuries.

Behbehani AM reported 20/40 final visual outcome in 40% cases of open globe injuries. Cillino S also reported final visual acuity 20/40 in 48.3% cases in overall injuries. Smith AR also reported 47.8% achieved 20/40 vision in combined open as well as closed globe injuries.

Wos et al.,[18] noted a large proportion of the population with traumatic cataracts in their series was male. Baclouti et al.,[19] did not find a gender difference in traumatic cataracts in their study in Tunisia. 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 increase risk for ocular injuries and traumatic cataracts, which may explain the gender variation noted in our study. We found significant (p=0.020) difference in open globe injuries gender wise, males prominently affected.

Our cohort of patients with traumatic cataracts was much younger than the patients in other studies.[20] Hence, proper intervention to avoid visual disability in our cohort would be more cost effective, and as the disability-adjusted life years saved by successful intervention would be much higher.

Using a large database, we attempted to systematically classify the morphology of traumatic cataract and to select surgical techniques accordingly. 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.[21-23] Various studies have touched on this topic.[24] Krishnamachary et al.,[25] found 52.3% total cataracts, whereas our results revealed 26.6% total cataracts. Vajpayee reported an opening in the posterior capsule with types 1 and 2 openings with penetrating injury[26], whereas we found another membranous type of cataract (12.1%) suggestive of late reporting, as membranous transformation of the lens with fusion of the anterior and posterior capsules may occur over time.

## CONCLUSION

We obtained good visual outcomes after managing traumatic cataracts caused by penetrating subgroup of open globe injury according to birmingham eye trauma terminology system. Traumatic cataract caused by penetrating ocular injury classified according to birmingham eye trauma terminology system has better prognosis than cataract caused by other type injuries.

## REFERENCES/KAYNAKLAR


1. Khatry SK, Lewis AE, Schein OD, et al. The epidemiology of ocular trauma in rural Nepal. Br J Ophthalmol 2004;88:456-60.
2. Abraham D I, Vitale S I, West S I, et al. Epidemiology of eye injuries in rural Tanzania. Ophthalmic Epidemiol 1999;6:85-94.
3. D. Virgil Alfaro, Eric P Jablon, Monica Rodriguez Fontal, et al. Fishing-related ocular trauma. American Journal of Ophthalmology 2005;139:488-92.
4. Shah M, Shah S, Khandekar R. Ocular injuries and visual status before and after Their management in the tribal areas of Western India-A historical cohort study Grafes Arch Clin Exp Ophthalmol 2008;246:191-7.
5. Kuhn F, Morris R, Witherspoon CD, et al. The Birmingham Eye Trauma Terminology system (BETT). J Fr Ophtalmol 2004;27:206-10.
6. Weinand F, Plag M, Pavlovic S. Primary implantation of posterior chamber lenses after traumatic cataract penetration. Ophthalmology 2003;100:843-6.
7. Baykara M, Dogru M, Ozçetin H, et al. Primary repair and intraocular lens implantation after perforating eye injury. J Cataract Refract Surg 2002;28:1832-5.
8. Mohammad pours M, Jafarinasab MR, Javadi MA. Outcomes of acute postoperative inflammation after cataract surgery. Eur J Ophthalmol 2007;17:20-8.
9. Khvatova AV, Kruglova TB. intraocular correction in the restorative therapy of children with congenital and traumatic cataracts. Vestn Oftalmol 1992;108:18-21.
10. Kumar N, Shekhar C, Kumar P, et al. Kuppuswamy socioeconomic status scale-updating for 2007. Ind J Pediatr 2007;74:1131-2.
11. Shah MA, Shah SM, Shah SB. Morphology of traumatic cataract: does it play a role in final visual outcome? BMJ Open 2011; 1:e000060. doi:10.1136/bmjopen-2011-000060.
12. Corbett MC, Shilling JS, Holder GE. The assessment of clinical investigations: the Greenwich Grading System and its application to electro diagnostic testing in ophthalmology. Eye 1995;9:59-64.
13. McWhae JA, Crichton AC, Rinke M. Ultrasound Biomicroscopy for the assessment of zonules after ocular trauma. Ophthalmology 2003;110:1340-3.
14. Zhang Y, Zhang J, Shi S. Determination of posterior lens capsule status in traumatic cataract with B-Ultrasonography. Zhonghua Yan Ke Za Zhi 1998;34:298-9.
15. Synder A, Kobielska D, Omulecki W. intraocular lens implantation in traumatic cataract. Klin Oczna 1999;101:343-6.
16. Brar GS, Ram J, Pandav SS, et al. Postoperative complications and visual results in uniocular pediatric traumatic cataract. Ophthalmic Surg Lasers 2001;32:233-8.
17. Wos M, Mirkiewicz-Sieradzka B. Traumatic cataract-treatment results. Klin Oczna 2004;106:31-4.
18. Gradin D, Yorston D. Intraocular lens implantation for traumatic cataract in children in East Africa. J Cataract Refract Surg 2001;27:2017-25.
19. Baklouti K, Mhiri N, Mghaieth F, et al. Traumatic cataract: clinical and therapeutic aspects. Bull Soc Belge Ophtalmol 2005;298:13-7.
20. Lacmanovic Loncar V, Petric I. Surgical treatment, clinical outcomes, and complications of traumatic cataract: retrospective study. Croat Med J 2004;45:310-3.
21. Vatavuk Z, Pentz A. Combined clear cornea phacoemulsification, vitrectomy, foreign body extraction, and intraocular lens implantation. Croat Med J 2004;45:295-8.
22. Thylefors B, Chylack LT Jr, Konyama K, et al. A simplified cataract grading system. Ophthalmic Epidemiol 2002;9:83-95.
23. Sternberg P, Jr de Juan, E Jr Michels, et al. Multivariate analysis of prognostic factors in penetrating ocular injuries. Am J Ophthalmol 1984;98:467-72.
24. Smith AR, O'Hagan SB. Epidemiology of open- and closed-globe trauma presenting to Cairns Base Hospital, Queensland. Clin Experiment Ophthalmol 2006;34:252-9.
25. Krishnamachary M, Rathi V, Gupta S. Management of traumatic cataract in children. J Cataract Refract Surg 1997;23:681-7.
26. Vajpayee RB, Sharma N, Dada T, et al.Management of posterior capsule tears. Surv Ophthalmol 2001;45:473-88.