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# EVALUATION OF EPIDEMIOLOGICAL ASPECTS AND PROGNOSTIC FACTORS DETERMINING FINAL VISUAL OUTCOME IN PATIENTS OF BLUNT OCULAR TRAUMA: A PROSPECTIVE STUDY OF 250 PATIENTS

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**ABSTRACT**

**AIM:** To analyze the epidemiological factors, study clinical aspects and different factors affecting final visual outcome in blunt ocular trauma in Indian setup.

**PATIENTS AND METHODS:** This prospective study included 300 eyes in 250 patients who sustained blunt ocular trauma and visited casualty/ OPD in Department of Ophthalmology of our institution. These patients were appropriately treated and followed at regular intervals to assess their visual outcome.

**RESULTS:** Out of 667 cases of mechanical ocular trauma reporting to our institution, blunt trauma accounted for 44.97% of cases. The majority of the patients were between 21 and 40 years old (63.15%) with male preponderance (83.6%). Most of them were laborers and industrial workers (35.6%). The principal cause of injuries was assault with stone (45%). Majority of grievous injuries with Ocular trauma score of 1and 2 were caused by stone and iron rod. Most of the patients (69.66%) presented within 24 hours of injury. Lids and adnexa involvement was seen in 75.33% eyes in form of edema and ecchymosis. Most common anterior segment involvement findings were conjunctival congestion and chemosis (71.33%) followed by traumatic uveitis (27%) and corneal edema (13.33%). Commotion retinae (10.33%) was most common posterior segment finding

Poor visual outcome statistically correlated with poor initial visual acuity [chi sq = 92.58, degree of freedom=2, p<0.000], patients having OTS grade of 1 and 2 [chi sq = 106.23, degree of freedom=2, p<0.0001], delay in onset of treatment [chi sq = 50.99, degree of freedom = 2, p< 0.0001] and with ocular conditions like globe rupture, subluxated lens with secondary glaucoma, posterior segment involvement and endophthalmitis.

**CONCLUSIONS:** Our study shows that final visual outcome predominantly depends upon mode of injury, initial vision after injury, nature of ocular damage and grades of OTS. We conclude that timely intervention holds the crux for determining the final visual outcome.

**KEYWORDS :** blunt ocular trauma, closed globe injury

## INTRODUCTION

The global annual incidence of ocular trauma is around 55 million, of which 750,000 cases require hospitalization each year. [1] Ocular trauma is a preventable public health problem throughout the world. It is one of the common causes of ophthalmic morbidity and monocular blindness in all parts of the world.[2]

Blunt ocular trauma comprises all closed-globe injuries in which mechanical deformation and/or direct energy delivery causes ocular damage.[3] Blunt ocular trauma causes ocular damage by the coup and contrecoup mechanism or by ocular compression. The concept of coup and contrecoup injury was first introduced to explain brain damage caused by blunt trauma to the head by Courville.[4][5] This was later used by Wolter to explain eye injuries.[6] Coup injuries refer to local trauma at the site of impact (e.g., subconjunctival hemorrhage, corneal abrasions, subretinal and choroidal hemorrhages, etc.). Contrecoup refers to injuries at the opposite site of the impact caused by shock waves that traverse the eye (e.g., commotio retinae). Blunt ocular trauma can result in a wide spectrum of ocular complications ranging from trivial injuries like subconjunctival hemorrhage to grievous sight-threatening injuries such as optic neuropathy, retinal detachment, and traumatic cataract. Apart from obvious ocular damage, blunt trauma may result in long-term effects like traumatic cataract and angle recession glaucoma which can make the prognosis guarded and warrant a vigilant long-term follow-up which has to be emphasized to the patients. Proper assessment of ocular damage and starting treatment immediately after an injury has an important impact on the final outcome. Therefore, early diagnosis and appropriate treatment are imperative to prevent visual morbidity caused by ocular trauma.

Unlike other major blinding disorders such as cataract, glaucoma, age related macular degeneration or diabetic retinopathy, where epidemiological studies have contributed significantly to a better understanding of disease patterns; epidemiological data in the case of ocular injuries are scarce in developing countries [7]

Ocular injuries assume unusual social and economic importance involving a huge cost in human unhappiness, economic insufficiency and monitory loss. Therefore knowledge of causes of ocular trauma and their effects is essential for their proper management and prevention. Though there are a number of studies determining the epidemiological aspect of ocular trauma, very few have highlighted the prognostic factor determining the final visual outcome, after the initial injury. There is lack of correct prognostic factor which corelates with the final visual outcome. The purpose of this study was to analyze the epidemiological factors, study clinical aspects and determine different factors affecting final visual outcome in Indian setup.

## MATERIAL AND METHOD:

After appropriate clinical ethical committee approval, we performed a prospective study involving 300 eyes in 250 patients, visiting our institution, casualty/ OPD in Department of Ophthalmology over a period of 18 months with the diagnosis of blunt ocular trauma. Only patients with diagnosis of blunt ocular trauma and, who were ready to participate for the study were included.

### Exclusion criteria:

1. Patients with penetrating ocular injury
2. Patients with corneal or conjunctival foreign body
3. Patients with chemical ocular injuries.

A detailed history was taken to know the demographic data, mode of injury, and the duration between injury and presentation. The examination began with examination of the face, orbital area, eyelids, and eyeball, followed by record of visual acuity with Snellen's chart, anterior segment examination by slit lamp biomicroscopy, pupillary evaluation (reactivity to light,presence of afferent pupillary defect), assessment of extraocular movements and confrontational visual fields. Intraocular pressure measurement and gonioscopy were done after ruling out globe rupture. Posterior segment examination was done by direct and indirect ophthalmoscopy. Investigation like X-ray orbit and/or computed tomography scan and/or ultrasound B-scan was done as and when indicated by examination. All the cases received treatment according to the injury and were followed at regular intervals to assess the visual outcome and complications.

These patients were followed at 1 week, 1 month, and 6 months, and results were tabulated in Microsoft Excel 2007 worksheet. Patients were categorized according to the OTS scale and documented.

### Statistical Analysis:

The statistical analysis was carried out using SPSS 16.0 and MS Excel 2007. Statistical analyses tested the correlation between variable studied and visual outcome at 95% significance level ($p < 0.05$). Chi square test was used to evaluate possible statistical significance between the variables and outcomes.

## RESULTS

**Incidence**: Out of 667 eyes traumatized due to mechanical injuries reporting to department of Ophthalmology, blunt trauma accounted for 300 eyes (44.97%). This excluded the cases of conjunctival or corneal foreign bodies.

**Sex an age distribution:** Out of total 250 patients, >50 % patients were less than 30 years of age with 36.8% patients were aged between 21-30 years. 26% patients presented between 31-40 years. There were 18% patients above 41 years of age. Out of 250 patients, 83.6% patients were male whereas 16.4% patients were females. Thus Male: Female ratio =5:1.

**Table no. 1: Age and sex distribution in blunt ocular trauma**

| Age | Male | Female | Total | % |
|---|---|---|---|---|
| 0-10 yrs | 09 | 04 | 13 | 5.2% |
| 11-20 yrs | 33 | 03 | 36 | 14.4% |
| 21-30yrs | 78 | 14 | 92 | 36.8% |
| 31-40 yrs | 54 | 11 | 65 | 26% |
| 41-50 yrs | 18 | 02 | 20 | 8% |
| 51-60 yrs | 12 | 06 | 18 | 7.2% |
| >61 yrs | 05 | 01 | 6 | 2.4% |
| **Total** | **209** | **41** | **250** | **100%** |

**Occupation:** According to Table 2 which shows the correlation of Occupation with blunt ocular trauma, out of 250 patients 35.6% were laborers and industrial worker, 23.6% were students, 15.2% were farmers and 11.6% were housewives. 6% were mechanics, 5% were office bearer and 1.2% belonged to driver and other miscellaneous group each.

**Table no. 2: Occupations of patients**

| Occupations | No. of patients | % |
|---|---|---|
| Labourer and industrial worker | 89 | 35.6% |
| Student | 59 | 23.6% |
| Farmer | 38 | 15.2% |
| Housewife | 29 | 11.6% |
| Office bearer | 14 | 5.6% |
| Mechanic | 15 | 6% |
| Driver | 03 | 1.2% |
| Miscellenous | 03 | 1.2% |
| **Total** | **250** | **100%** |

**Nature of object:** According to Table 3, injuries due to stone were 45%, 41.33 % were injured by wooden object, injuries due to assault with fist or slap of hand were 5%, injuries due to iron rod were 3.66%, injuries due to footwear were 1.66%, while 1% was injured by tennis ball. Incidence of injuries due to cricket ball and mud ball were 0.66% each, whereas incidence of injuries due to bottle cork, rubber belt, rubber wire and nylon rope were 0.33% each.

**Table no 3: Object causing blunt ocular trauma**

| Objects | No. of eyes | % |
|---|---|---|
| Wooden object | 124 | 41.33 % |
| Iron object | 11 | 3.66% |
| Stone | 134 | 45% |
| Fist | 15 | 5% |
| Footwear | 05 | 1.66% |
| Tennis ball | 03 | 1% |
| Cricket ball | 02 | 0.66% |
| Mud ball | 02 | 0.66% |
| Bottle cork | 01 | 0.33% |
| Rubber wire | 01 | 0.33% |
| Rubber belt | 01 | 0.33% |
| Nylon rope | 01 | 0.33% |
| **Total** | **300** | **100%** |

**Duration of injury at time of presentation:** Majority of patients i.e. 69.32% reported to us within first 24 hours, out of which 47.66% reported within 6 hours. 25.33 % cases reported within 1st week. 3.66 % cases were reported between 2nd and 4th week and 1.66% cases reported after 1 month.

**effect of blunt ocular trauma on anterior segment structures:** Lids and adnexa was involved in 75.33% cases in form of lid edema. Lid ecchymosis was present in 58.6% cases and lid tear was seen in 11.66% cases.

Conjunctival congestion is involved in 71.33% cases, chemosis is found in 29% cases and subjunctival haemorrhage is found in 47.33% cases. Conjunctival tear is found in 3.66% cases.

Corneal involvement was seen in 16.33 %, in form of corneal edema (13.33%), corneal abrasions (3.33%) and lamellar corneal tear (1%). Sclera involvement was seen in total 8 cases i.e. 2.66%. 2% cases were having full thickness scleral tear in form of globe rupture and 0.66% cases were having lamellar scleral tear. 5.33% eyes had hyphaema and 0.33% eyes had hypopyon with endophthalmitis. Traumatic uveitis was noted in 27% cases. Secondary glaucoma was noted in 5.33% eyes including 6 eyes having angle recession. Traumatic mydriasis was found in 4% cases while RAPD was seen in 2% eyes of traumatic neuropathy.

Lens involvement in form of traumatic cataract seen in 3.66% cases, and posterior sublxation with cataract in 2% cases was noted.

**Effect of blunt trauma on posterior segment:**
Macular Edema is the commonest mode of presentation (10.33%).

**Effect table no 4: ocular structures involvement seen in our study**

| Structures Involved | Complications | % Of Eyes | Treatment given |
|---|---|---|---|
| Lid | Lid edema | 75.33% | Medical |
| | Lid ecchymosis | 58.6% | Medical |
| | Lid tear | 11.66% | Surgical repair |
| Conjunctiva | Chemosis+ congestion | 71.33% | Medical |
| | Sub conj h'age | 47.33% | Medical |
| | Conj tear | 3.66% | Surgical repair |
| Cornea | Corneal edema | 13.33% | Medical |
| | Corneal abrasions | 3.33% | Medical |
| | Lamellar corneal tear | 1% | Medical + BCL |
| Sclera | Full thickness sclera tear | 2% | Surgical repair |
| | Lamellar sclera tear | 0.66% | Medical |
| Anterior Chamber | Hyphaema | 3.33% | Medical |
| | Hypopyon | 0.33% | Medical |
| | Traumatic uveitis | 27% | Medical |
| Pupil | Traumatic mydriasis | 4% | Medical |
| | RAPD | 2% | Medical |
| Lens | Traumatic cataract | 3.66% | Surgical |
| | Subluxated lens | 2% | Surgical |
| Posterior segment | Commotion retinae | 10.33% | Medical |
| | Vitreous h'age | 5.33% | Medical |
| | Retinal detachment | 1.66% | Surgical |
| | Traumatic optic neuropathy | 2% | Medical |
| | Choroidal tear | 1.66% | Observation |
| Secondary glaucoma | Glaucoma | 5.66% | Medical |

**Visual acuity at the time of presentation:** According to table 5, Visual acuity was < CF 3ft in 7.33% of cases with no perception of light was found in 1 % cases. Visual acuity > CF 3ft – 6/60 was found in 10% cases whereas vision > 6/36- 6/9 was present in 35% cases. Visual acuity was found to be normal in 46.33% cases whereas vision could not be tested in 1% cases.

**Table no. 5: Visual acuity at presentation**

| Visual acuity | No. of eyes [N= 300] | Anterior segment involvement | Posterior segment involvement | P value |
|---|---|---|---|---|
| No PL | 03 | 38% | 65% | P<0.0001 |
| PL (+nt)- CF< 3FT | 19 | | | |
| Counting finger>3ft-6/60 | 30 | | | |
| 6/36- 6/9 | 106 | 51% | 5% | |
| 6/6 | 139 | | | |
| Uncooperative | 03 | | | |

**Correlation between visual acuity at presentation and significant intraocular manifestations**: According to Table 5, Eyes with vision

<6/60, posterior segment was involved in 65% eyes. Eyes with vision >6/60, posterior segment was involved only in 5% eyes and anterior segment was involved in 51% eyes. The difference between anterior and posterior segment involvement (except lid) in two group of vision <6/60 and > 6/60 was found to be statistically significant. [chisq= 12.56, degree of freedom = 1, p< 0.0001, highly significant]. Thus poor visual acuity at time of presentation is statistically correlated posterior segment involvement.

**Correlation between object causing injury and OTS**

OTS 1 and 2 groups nearly 50% injuries are caused by stone and nearly 25% are caused by iron rod. This indicates that majority of grievous injury are caused by stone and iron rod. Injury caused by wooden objects are seen as most common mode of injury in OTS 3 (30%), OTS 4, (40.62%) and in the least severe injuries i.e. OTS 5, (41.73%) suggesting that less severe injuries are caused by wooden objects.

**Management:** Out of 300 eyes, 24.66% cases required surgical management along with medical treatment. In 67.33% cases only medical management was required. 2.66% eyes were referred to higher centre whereas 5.33% eyes were lost to follow up.

**Final visual outcome**

After completion of treatment, out of 300 eyes, 68.66% had visual acuity 6/6, 10 % had vision 6/9, 5.33% had vision between 6/36 – 6/12. 2.66% eyes had vision between >CF 3ft- 6/60 whereas 2.33% eyes had vision less than CF 3 ft and 2 eyes had visual acuity of no perception of light. In 3 cases vision could not be recorded whereas 16 patients were lost to follow up and 8 were referred to higher centers.

**Correlation between OTS and final visual outcome**: Among 14 cases present in OTS 1,2 and 3; 76.89% eyes had final visual acuity <6/ 60, 7.68% eyes had vision <6/18 and 23.07% had final vision as >6/18. Among 255 cases grouped in OTS 4 and 5; 2.74% eyes had final visual acuity <6/ 60, 4.32% eyes had vision <6/18 and 92.94 % had final vision as >6/18.

**Table no 6: Correlation between OTS and final visual outcome**

| OTS | final visual outcome | | |
|---|---|---|---|
| | **<6/60** | **<6/18** | **>6/18** |
| **1,2,3** | 76.89% | 7.68% | 23.07% |
| **4,5** | 2.74% | 4.32% | 92.94% |

Difference in OTS grades in various groups of final visual acuity (<6/60, <6/18, >6/18) was found statistically significant. [ chisq = 106.23, degree of freedom = 2, p< 0.0001, highly significant.] Thus OTS is significantly correlated with final visual outcome.

**Relationship of duration of initiation of treatment and final visual outcome:**

Difference between final visual acuity in all the three group of duration of initiation of treatment i.e. within 1day, within 1 week and more than 1 week was found statistically significant. [ chi sq = 50.99, degree of freedom = 2, p< 0.0001, highly significant. Thus a statistically significant correlation was established that patient receiving early treatment had more chances of having good final visual acuity and vice a versa.

**correlation betwen initiation of treatment and final visual outcome**

| Time of presentation | Final visual outcome | |
|---|---|---|
| | Vision > 6/18 | Vision < 6/18 |
| Within 24 hrs | 168 | 11 |
| Within 1 wk | 68 | 6 |
| >1 wk | 7 | 11 |

**Correlation between common mode of presentation and final visual outcome**

Visual improvement was seen in>90% cases of corneal tear repair, corneal abrasion, keratitis, traumatic cataract traumatic iritis , secondary glaucoma and hyphaem with timely management. In posterior segment involvement visual improvement was less from 50-70%. In globe rupture and subluxated lens visual improvement was seen in 16.66% cases. In endophthalmitis no visual improvement was seen.

## DISCUSSION

Worldwide there are approximately 6 million people who are blind from ocular injuries, 2.3 million people who are visually impaired bilaterally; these facts make ocular trauma one of the most common causes of unilateral blindness[1] Ocular trauma is a major cause of preventable monocular blindness and visual impairment in the world[6,8,] Despite its public health importance, there irrelatively less population based data on the magnitude and risk factors for ocular trauma, especially from developing countries.[9,10,]

In our study, out of 667 cases of mechanical ocular trauma, which visited our institution, blunt trauma accounted for 300 cases (44.97%). We excluded the cases of conjunctiva or corneal foreign bodies. The incidence of blunt ocular trauma in our study, 44.97%, is comparable to earlier studies in the literature.[11,12,13].

In our study, we found 168 (56%) patients were below 30 years which is less than study of ethiopia [14] where 63.8% patients were below 30 years of age. Male to female ratio was found to be 4.5:1. The higher rate of ocular trauma among males may be attributed to the propensity of males to choose hazardous jobs and also to participate in risk taking and aggressive outdoor activities, all of which puts them at greater risk of injury. The higher rates of trauma among males and laborers, that we report are consistent with other studies worldwide [15]. It is interesting to know that; majority of our patients reported us within 24 hours seeking treatment for their eye injury, which was also found in study by Nirmalan [16]. Most common mode of injury causing blunt trauma was found to be direct hit by stone or fall or stony /hard surface followed by hit by wooden object.

Blunt ocular trauma can affect any ocular structure. The most common ocular structure involved in our study was lids and adnexa (75.33% eyes involvement) in form of lid edema. Intraocular structures anterior to posterior lens capsule and pars plicata were labeled as anterior segment and anything posterior to posterior lens capsule was considered posterior segment structures. conjunctiva ( 71.33% eyes) in anterior segment was most commonly involved structure in our study in form of conjunctival chemosis and congestion which is comparable to Maiya et al who also had conjunctival involvement as most common structure involved in their study.

Subconjunctiva l hemorrhage ( 47.33% eyes) was not sight threatening and were managed conservatively. Traumatic uveitis (27% eyes) was treated medically with topical steroid and cycloplegic eyedrops. Corneal edema (13.33% eyes) was also treated medically with topical antibiotic steroid combination and anti glaucoma eyedrops.

In our study, hyphema was seen in 10 eyes (3.33%) of which three patients had total hyphema. Conservative management with bed rest, pressure bandage and topical steroids, cycloplegics and antiglaucoma therapy helped in the resolution of hyphema without any sequelae.

Secondary glaucoma noted in 17 eyes (5.66%). Blunt trauma damages ciliary body resulting in bleeding inside the eye. The excess amount of blood, plasma and debris can accumulate and clog the drainage system which leads to an increase in eye pressure. In some cases, the damaged drainage canals in the eye can build up excess scarring which blocks fluid flow and can lead to glaucoma. This type of glaucoma, called angle recession glaucoma was seen in 6 patients in our study. Glaucoma was treated with topical anti glaucoma eyedrops. The elevated eye pressure following blunt trauma was temporary in most cases but regular follow up was advised especially in angle recession cases. Filtering surgery was not required in any case in study.

Vitreous hemorrhage was noted in 11 patients in our study, which was diagnosed on B-scan and managed conservatively. Ocular trauma accounts for 12%–31% cases of vitreous haemmorahge (in various studies) and is the most common cause of vitreous hemorrhage in younger patients.[15,16] Commotio retina, also known as “Berlin's edema,” is characterized by a transient, well defined grayish white opacification of the retina occurring after blunt ocular trauma. We found 31 cases of commotio retinae which were managed conservatively.

Surgical management was required in 24.66% cases. Conditions like lid tear (35 eyes) and conjunctival tear (11 eyes) were surgically managed with primary suturing. Globe rupture seen in 6 eyes were repaired with 9-0 ethicon sutures with iris / ciliary tissue abscission. Traumatic cataracts ( 11 eyes ) and posterior subluxated ( 6 eyes) cataract were managed by cataract extraction + anterior vitrectomy + IOL implantation. Retinal detachment (5 eyes) was managed with sclera bukling + silicon oil+ endolaser.

Ocular trauma score(OTS) was calculated for every patient included in the study. On first examination, an initial raw score based on the initial visual acuity (VA) –is assigned as shown in step1. From this initial raw score, points are subtracted for each of the following conditions if present in eyes (starting with the worst prognosis and ending with the least poor prognosis): globe rupture, endophthalmitis, perforating injury (with both an entrance and an exit wound), retinal detachment, and relative afferent papillary defect (RAPD) as mentioned in step 2. Once the raw score sum has been calculated, the relevant category in table B is found and read off the corresponding OTS score. For each OTS score, Table B gives the estimated probability of each follow-up visual acuity category.

**Table A: Calculation of OTS score**

| Initial visual factor | Raw points |
|---|---|
| STEP 1: Initial visual acuity category | NO PL= 60 |
| | LP to HM= 70 |
| | 1/200 to 19/200 = 80 |
| | 20/200 to 20/50 = 90 |
| | >20/40 = 100 |
| STEP 2 | |
| Globe rupture | -23 |
| Endophthalmitis | -17 |
| Perforating Injury | -14 |
| Retinal detachment | -11 |
| Afferent papillary defect | -10 |

**Table B: Probability of visual outcome**

| Sum of raw points | OTS | No PL | 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% |

Ocular Trauma Score (OTS), which is used to predict the visual outcome of patients after ocular trauma. The score's predictive value is used to counsel patients and their families and to manage their expectations. It provides guidance for the clinician before pursuing complex, sometimes expensive interventions, particularly in resource-limited settings. OTS scores range from 1 (most severe injury and worst prognosis at 6 months follow-up) to 5 (least severe injury and least poor prognosis at 6 months). Each score is associated with a range of predicted post-injury visual acuities. It has a predictive accuracy of approximately 80%, which means that the OTS will be accurate 4 out of 5 times.

OTS once calculated for all the patients, data were compiled in Microsoft excel 2007 and certain factors like object causing injury and final visual outcome were compared. Eyes that fell in category OTS 1 had very poor visual outcome whereas those with OTS 5 had good final visual outcome. 50% injuries in category OTS1 were caused by stone (direct hit /fall on stony surface) and 25% due to iron rod indicating injuries caused due to stone and iron rod result in grievous injuries and eventually poor final visual outcome.

After 6 month of treatment final visual outcome was calculated in all the cases and results were compiled. Final visual outcome was statistically directly correlated with initial visual acuity and OTS grading as explained above. Early initiation of treatment showed better visual outcome which was statistically significant. Ocular conditions involving anterior segment had better visual outcome than posterior segment involvement.

## CONCLUSION

Eye care programs in India need to consider ocular trauma as a priority alongside other chronic diseases of the eye. Preventive eye care programs should consider ocular trauma in the population as a priority. Use of safety glasses in industrial and agricultural work this should be mandatory.

There are a very few studies available in the literature which shows the corelation of prognostic factor determining final visual outcomes in Indian subcontinent. This is a prospective study conducted in urban population. The weakness of this study lies in the fact that this is not a randomized controlled study; the studied population did not comprise of the whole population of the place, but only patients seeking medical advice in a tertiary care center. Further large series randomized controlled studies need to be undertaken to determine the factors influencing final visual acuity.

Our study shows that final visual outcome predominantly depends upon: Mode of injury, Initial vision after injury, Nature of ocular damage and Grades of OTS. Timely intervention holds the crux for determining the final visual outcome.

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