

# Open-Globe Injuries: The Experience at Hospital Sultanah Aminah, Johor Bahru

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## Summary

Between 1st January 1999 and 31st December 2000, 152 patients (156 eyes) with open-globe injuries were treated in the Department of Ophthalmology, Hospital Sultanah Aminah, Johor Bahru. The majority were male (88.2%), Malay (63.2%), from the Johor Bahru district (51.3%) and aged between 21 and 30 years (23.7%). Most injuries were workplace-related (41.4%). Lens injury, retinal detachment, endophthalmitis, intraocular foreign bodies and phthisis occurred in 40.4%, 15.4%, 14.7%, 12.2% and 11.5% of eyes respectively. A favourable visual outcome occurred in 55.4% of eyes. Prognostic factors for visual outcome include presenting visual acuity, relative afferent pupillary defect, wound location, lens injury, retinal detachment and endophthalmitis.

**Key Words:** Ocular trauma, Open-globe injury, Visual outcome, Aetiology

## Introduction

Open-globe injuries constitute an important worldwide cause of preventable, usually monocular, visual morbidity. Despite advances in ophthalmic surgery such as operating microscopes and advanced vitreoretinal techniques, the visual outcome can be disappointing.

Little data is currently available on open-globe injuries in Malaysia. This study investigated the demographics of patients presenting with open-globe injuries to Hospital Sultanah Aminah, Johor Bahru, and factors affecting their visual outcome.

Hospital Sultanah Aminah (HSAJB) is a 989 bed<sup>1</sup> general hospital serving the district of Johor Bahru.

It is also the tertiary referral center for the state of Johor (population 2.74 million<sup>2</sup>).

The Department of Ophthalmology in HSAJB treated 15,259 new outpatients and 2,996 inpatients between 1st January 1999 and 31st December 2000. Some 2,032 elective and 260 emergency surgical operations were performed during this period.

## Materials and Methods

A retrospective study was done on all patients presenting at the Department of Ophthalmology with open-globe injuries between 1st January 1999 and 31st December 2000. An open-globe injury

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was defined as a full-thickness injury of the eyeball. Patients were identified from outpatient, inpatient and operating theatre records and their case notes retrieved. Patients with a history of previous ocular surgery were excluded from the study.

Details such as age, sex, race, time of injury to presentation, district of origin, cause of ocular injury, eye(s) involved, presenting Snellen visual acuity, final Snellen visual acuity, extent of ocular injury, surgical intervention and outcome were recorded.

The patient's Snellen visual acuity was graded as good (6/6 to 6/12 inclusive), moderately impaired (6/18 to 6/60 inclusive) or severely impaired (5/60 or worse). Patients followed up for a minimum of 60 days were analysed for factors affecting visual outcome. A favourable visual outcome was defined as a final best corrected Snellen visual acuity of 6/60 or better, while an unfavourable visual outcome was defined as a final best corrected Snellen visual acuity of 5/60 or worse.

Group differences were tested using the chi-square method. Statistical significance was defined as a probability (p) value less than 0.05.

## Results

A total of 152 patients were included in the study. Eighty-one patients presented in 1999 and 71 patients presented in 2000. They represented some 1.0% of new outpatients and 5.1% of inpatients treated in the Department of Ophthalmology during the period. Fifteen patients (9.9%) were managed jointly with other surgical specialties. The follow up period for the patients ranged from 1 day to 644 days (mode 75 days). The patients accounted for a total of 1216 days of inpatient stay (mode 5 days).

There were 134 male patients (88.2%) and 18 female patients (11.8%). This represented a statistically significant gender difference taking

into account that the Johor state population has a male: female ratio of 1.074<sup>1</sup> (p<0.001).

Figure 1 illustrates the age distribution of the patients. The age range was 0.5 years to 77 years (mean age 27.8 years). The peak age range was 21 to 30 years (23.7%), followed by the 0 to 10 years age range (19.7%). Some 116 patients (76.3%) fell within the economically active 15 to 64 year age range.

The ethnic distribution of the patients was Malays 63.8% (97 patients), Chinese 19.1% (29 patients), Indians 9.2% (14 patients) and others 7.9% (10 Indonesian nationals and 2 Bangladeshi nationals). The Chinese accounted for a lower proportion of open-globe injury cases seen in HSAJB than expected from Johor population census data (19.1% versus 33.4%, p<0.001) with a correspondingly higher proportion of cases amongst the Malays, Indians and other ethnic groups.

One hundred and thirty-one patients (86.2%) presented within 1 day of their ocular injury occurring, while 21 patients (13.8%) presented more than 1 day after their ocular injury (range 2 to 60 days).

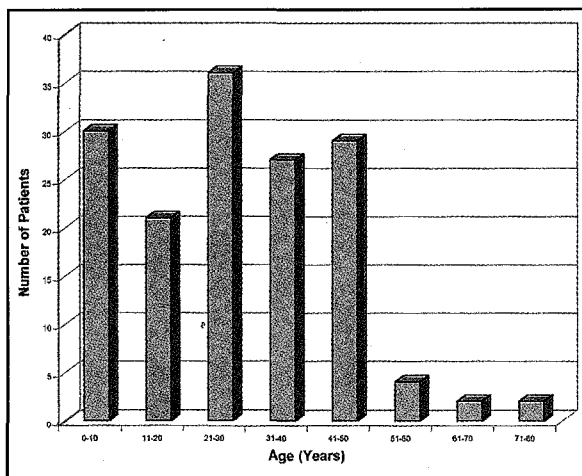


Fig. 1: Age Distribution of Patients

Figure 2 illustrates the district of origin of the patients. All 8 districts of Johor state were represented, with the majority of patients originating from the district of Johor Bahru (51.3%).

Workplace-related injuries accounted for the majority of the ocular injuries seen (41.4%), followed by motor vehicle accidents (25.7%). Domestic accidents (22.4%), assault (7.9%), sports accidents (2.0%) and school-related accidents (0.6%) accounted for the remaining ocular injuries seen in the study patients. Thirty-nine patients (25.7%) sustained injuries associated with organic matter.

A total of 156 eyes were included in the study; the right eye alone was involved in 76 patients (50.0%), the left eye alone in 72 patients (47.4%) while 4 patients (2.6%) had bilateral ocular involvement. All 4 patients with bilateral open-globe injuries had been involved in motor vehicle accidents.

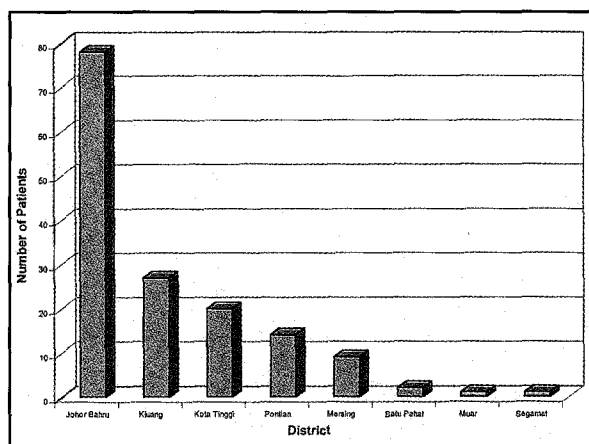


Fig. II: District of Origin

In terms of wound location, 77 eyes (49.4%) had wounds confined to the cornea (anterior injury), 43 eyes (27.6%) had wounds whose posterior-most aspect extended to within 5 millimetres of the corneal limbus (mid-zone injury), while 36 eyes (23.0%) had wounds whose posterior-most aspect

extended beyond 5 millimeters of the corneal limbus (posterior injury).

Lens injuries were noted in 63 eyes (40.4%). Five eyes were rendered aphakic by the initial injury. Lens extractions were performed in 42 eyes with lens injury.

Intraocular foreign bodies were present in 19 eyes (12.2%). Workplace-related injuries accounted for 15 cases, while domestic accidents and sports accidents (fish-hook injuries) each accounted for 2 cases seen. Eight of the intraocular foreign bodies (42.1%) were associated with organic matter.

Endophthalmitis as evidenced by the presence of ocular discomfort, hypopyon and vitreous opacities developed in 23 eyes (14.7%). All patients presented within 1 day of their ocular injuries. Table I summarises the microorganisms isolated from the vitreous tap samples of the 23 eyes. Eight of the eyes had associated intraocular foreign bodies, 11 had associated lens injury while 4 eyes had associated retinal detachment. Fourteen of the eyes had contact with organic matter during the initial injury.

Table I: Microorganisms Isolated From Eyes With Endophthalmitis

Microorganism isolated	Number of eyes
<b>Gram positive organisms</b>	<b>4</b>
<i>Coagulase-negative Staphylococci</i>	2
<i>Bacillus sp</i>	2
<b>Gram negative organisms</b>	<b>5</b>
<i>Acinetobacter sp</i>	3
<i>Enterobacter sp</i>	1
<i>Pseudomonas sp *</i>	1
<i>Klebsiella sp *</i>	1
<b>Fungi</b>	<b>1</b>
<i>Monilia sp</i>	1
<b>No organisms isolated</b>	<b>13</b>
<b>Total</b>	<b>23</b>

\* Both *Pseudomonas sp* and *Klebsiella sp* were isolated together from 1 eye

Endophthalmitis was more likely to develop in eyes with intraocular foreign bodies compared to eyes without intraocular foreign bodies (42.1% versus 11.0%,  $p < 0.001$ ), and in eyes that came into contact with organic matter during the initial injury than eyes that had had no contact with organic matter (35.9% versus 7.8%,  $p < 0.001$ ). Eyes with intraocular foreign bodies associated with organic matter were more likely to develop endophthalmitis than eyes with intraocular foreign bodies not associated with organic matter (75.0% versus 18.2%,  $p < 0.025$ ). Endophthalmitis was not significantly associated with lens injury in this study.

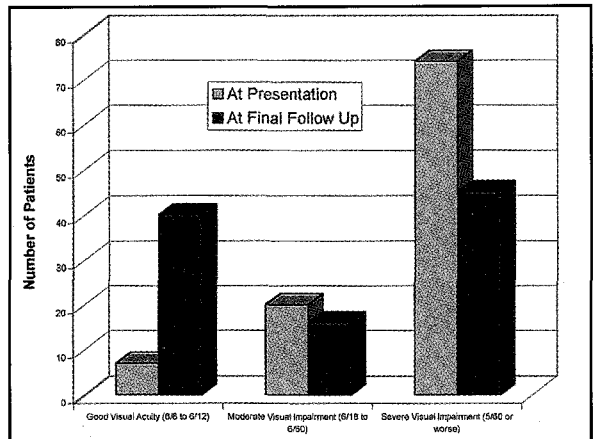
Retinal detachment was present in 24 eyes (15.4%). Twelve of the eyes were associated with lens injury and 6 with phthisis. Eighteen eyes (11.5%) became phthisical during the course of follow up. Ocular phthisis was more likely to develop in eyes with retinal detachment compared to eyes without retinal detachment (25.0% versus 9.1%,  $p < 0.025$ ).

None of the patients developed sympathetic ophthalmia during the course of follow-up. 90.4% of the eyes underwent primary surgical repair of the ocular wound. 69.9% of the eyes underwent 1 surgical procedure, 23.7% underwent 2 surgical procedures, 3.8% underwent 3 surgical procedures and 1.9% underwent 4 surgical procedures. One eye (0.7%) was managed conservatively. Two eyes (1.3%) underwent secondary evisceration. A total of 213 emergency operations were performed; these represent some 9.3% of all operations and 81.9% of emergency operations performed in the Department of Ophthalmology during the study period.

A total of 101 eyes were analysed for visual outcome at 60 days or more post-injury. Fifty-six eyes (55.4%) had a favourable visual outcome while 45 eyes (44.6%) had an unfavourable visual outcome.

Figure 3 illustrates the visual status of the patients at presentation and at their last follow up appointment. The proportion of patients with good visual acuity improved from 6.9% to 39.6%

after treatment ( $p < 0.001$ ), while the proportion of patients with severe visual impairment decreased from 73.3% to 44.6% after treatment ( $p < 0.001$ ).



**Fig. III: Visual Status of Patients**

Table II summarises the prognostic factors significantly affecting the final visual outcome. Age, sex, ethnicity, duration of hospital stay, aetiology of the ocular injury, number of surgical interventions performed, intraocular foreign bodies and ocular contact with organic matter at the time of injury had no statistically significant effect on visual outcome.

Of the 4 eyes with endophthalmitis and a favourable visual outcome, 2 had no organisms isolated, 1 had *Acinetobacter* sp endophthalmitis and 1 had coagulase-negative *Staphylococcus* endophthalmitis.

Of the 12 eyes with endophthalmitis and an unfavourable visual outcome, 5 had no organisms isolated, 2 had *Bacillus* sp endophthalmitis and 2 had *Acinetobacter* sp endophthalmitis; *Enterobacter* sp endophthalmitis, coagulase-negative *Staphylococcus* endophthalmitis and combined *Pseudomonas* sp and *Klebsiella* sp endophthalmitis were each present in 1 eye.

All patients who underwent cataract extraction with intraocular lens implants for their lens injury attained a favourable visual outcome. All patients with traumatic aphakia or subluxated lenses had an unfavourable visual outcome.

**Table II: Prognostic Factors Affecting Visual Outcome**

Factor	Favourable (No of Eyes=56)	Visual Outcome Unfavourable (No of Eyes=45)	Chi-square p-value
<b>Presenting Snellen Visual Acuity</b>			
6/60 or better	24	3	} p<0.001
5/60 or worse	32	42	
<b>Relative Afferent Pupillary Defect*</b>			
Present	1	10	} p<0.01
Absent	7	3	
<b>Wound Location</b>			
Anterior	32	16	} p<0.001
Mid-zone	20	6	
Posterior	4	23	
<b>Lens Injury</b>	18	26	p<0.01
<b>Retinal Detachment</b>	1	17	p<0.001
<b>Endophthalmitis</b>	4	12	p<0.01

\* Only 21 of the eyes analysed for visual outcome had been tested for a relative afferent pupillary defect on admission.

## Discussion

This study elucidates the demographic characteristics of patients presenting to HSAJB with open-globe injuries and factors affecting their visual outcome. The majority of patients were young males aged between 21 to 30 years. This finding concurs with other studies that determined that young males are more prone to ocular trauma, regardless of their country of origin or activity at the time of injury<sup>3-23</sup>.

The reason why fewer than expected Chinese patients presented with open-globe injuries to HSAJB can be speculated upon. Data as regards

the incidence of open-globe injuries in the state of Johor, employment trends among the different ethnic groups in Johor and patterns of utilisation of ophthalmic services among the different ethnic groups in Johor is not available. It could well be that Chinese individuals were less likely to undertake high-risk employment or activities, or they were more scrupulous in use of protective eye wear at work and at play. They could also have preferred to seek treatment for their open-globe injuries in other medical institutions.

While the majority of patients presented within one day of their ocular injury, 13.8% presented more than a day after their injury. Clearly, patients'

attitudes and perceptions with regard to the potential consequences of ocular trauma vary in their depth and scope. Although the time to presentation had no statistically significant effect on visual outcome in this study, this does not mean that a real effect does not exist. As such, educating the general public to seek medical help promptly following an ocular injury should be reinforced.

The trend for the majority of patients to originate from the district of Johor Bahru probably stems from the fact that the majority (42.3%) of the population of Johor resides in the district<sup>2</sup>, that industrial projects tend to be concentrated in the district<sup>24</sup> and the proximity of HSAJB to the populace residing in the district. Relatively few patients presented from the Muar, Segamat and Batu Pahat districts as government ophthalmic services are available locally in those districts.

In this study, workplace-related injuries were the commonest cause of open-globe injuries. Better education of workers as regards workplace safety and the provision and use of protective eye wear<sup>6,11,13,18,22</sup> will help reduce the incidence of open-globe injuries in the workplace.

The incidence of open-globe injuries due to motor vehicle accidents could be reduced with better education of the public on the Highway Code, more rigorous enforcement of seatbelt usage and the adoption of laminated glass rather than tempered glass in the manufacture of car windscreens, mirrors and windows.<sup>25</sup> The development of better protective wear for motorcyclists could also reduce the incidence of open-globe injuries in that cohort.

Parental education and closer supervision of children in and outside the home<sup>26</sup> and the use of protective eye wear in sports activities<sup>8</sup> should also reduce the incidence of injuries in children and sports enthusiasts.

Other studies on open-globe injuries showed the incidence of lens injury ranged from 17.7% to 56.7%<sup>13, 14, 28</sup>, the incidence of retinal detachment

ranged from 8.8% to 36.3%<sup>7, 9, 13, 14, 28</sup>, the incidence of endophthalmitis ranged from 0% to 13%<sup>9, 20, 23, 27, 28, 29</sup> and the incidence of intraocular foreign bodies ranged from 6.6% to 67.5%<sup>5, 7, 13, 14, 15, 28</sup>. The rates found in our study are within these ranges.

Some 42.1% of patients with intraocular foreign bodies developed endophthalmitis in this study. This rate is higher than the rates of 0% to 13% observed in other studies<sup>9, 19, 20, 23, 27</sup>. This could have been due to the fact that many of the intraocular foreign bodies in this study were associated with organic matter which itself is associated with endophthalmitis. In view of these findings, the authors recommend that eyes with open-globe injuries associated with organic matter and/or intraocular foreign bodies be meticulously examined at regular intervals for signs of endophthalmitis and the appropriate action taken if there is any evidence of endophthalmitis.

This study did not detect a significant association between lens injury and endophthalmitis, which has been observed in other studies<sup>27, 29</sup>. This study determined that the presenting visual acuity, the presence of a relative afferent pupillary defect, wound location, lens injury, retinal detachment and endophthalmitis were factors all significantly affecting the visual outcome. These findings are corroborated in other studies<sup>4,15, 23</sup>. The majority of eyes with poor final vision sustained severe injuries or had a combination of factors associated with an unfavourable visual outcome.

The finding that *Bacillus* sp. was associated with an unfavourable visual outcome in this study corresponds with previous reports<sup>9, 27, 30, 31</sup>. Gram-negative organisms in general and *Streptococci* sp. have also been associated with poor visual outcome in one study<sup>31</sup>, while coagulase-negative *Staphylococci* have been associated with a more favourable visual outcome in other studies<sup>27, 29</sup>.

The finding that patients with traumatic aphakia or subluxated lenses had an unfavourable visual outcome compared to patients who underwent

successful cataract extraction with intraocular lens implant for their lens injury concurs with similar findings in another study<sup>4</sup>.

In view of the fact that only 55.4% of eyes with open-globe injuries had a favourable visual outcome, emphasis should be given to the prevention of ocular trauma and to the education of the public as regards eye protection at work and at play. The preoperative counseling of patients with open-globe injuries as regards their potential visual outcome should take into account the factors found to affect visual outcome in this study.

In conclusion, open-globe injuries constitute an important cause of preventable visual morbidity

amongst young, economically active males in the state of Johor. Public education on the prevention of ocular injury should be given priority in order to reduce the personal, social and economic impact of open-globe injuries on individuals and their families.

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