



## Pediatric Open Globe Injuries Occurring at Home: A 12-Year Case Series

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### Abstract

**Objectives:** In children, ocular trauma occurs disproportionately in the home. The purpose of this study is to evaluate the epidemiology, characteristics, and outcomes of pediatric traumatic Open Globe Injuries (OGI) occurring at home, and to compare the observed final Visual Acuity (VA) to the Ocular Trauma Score (OTS) expected VA.

**Methods:** Retrospective chart review of pediatric (ages 0-19) patients with traumatic OGI that presented to University Hospital, Newark and Rutgers New Jersey Medical School between 1997-2008.

**Results:** Eighty-nine pediatric OGI were identified of which 42 (47%) occurred at home (mean age 5.8 years [range 1-19], 64% male). Penetrating injuries represented 79% of cases, while ruptures comprised the remaining 21%. The most common cause of injury was poking with a sharp object (38%). The most common objects involved in these injuries included broken glass, pens, furniture, knives, screwdrivers, wooden sticks, and toys. Self-injury occurred in 57% cases; siblings were involved in 19% of cases. Retinal detachment occurred in 9 (21%) cases. A comparison with 47 pediatric OGIs that occurred outside of home revealed that injuries at home are more likely to occur in younger children, have better initial and final VA, and are more likely to be penetrating injuries.

**Conclusions:** Nearly half of the pediatric OGI in this study occurred at home. Self-injury was the most common cause (57% cases), which emphasizes the need for close supervision of young children. Visual prognosis for pediatric OGI remains poor. The final VA predicted by OTS correlated with the observed final VA.

**Keywords:** Eye injuries; Ocular trauma; Open globe injury; Vision; Pediatric

### Introduction

Open Globe Injury (OGI) is defined as a full-thickness wound of the eye wall, [1] the most common cause of monocular blindness [5]. 2.4 million Eye injuries occur annually in the United States [3-5] with 13.2 hospitalizations for eye trauma per 100,000 [5]. Over 7,500 hospitalizations costing more than \$88 million occur annually for pediatric eye trauma [2]. Visual prognosis after OGI depends on factors such as wound location, extent, and severity; and infection. Eye trauma classification systems, especially the Ocular Trauma Score (OTS), [1] can be used to predict final visual outcome. Only 4 pediatric studies have been published since 2000 describing U.S. populations with OGI. Farr et al. [5] reported on 180 eyes treated from 1970-1993; Hill et al. [4] on 59 eyes from 1990-2002; Acuna et al. [3] on 13 eyes with delayed presentation from 2002-2007, and Lesniak et al. [9] on 89 eyes at our institution from 1997-2008. Narang et al. [6] reported on OGI in India that occurred at home versus outside. Armstrong et al. [10] described characteristics of over a million eye injuries presenting to U.S. emergency departments from 2001-2007; this study included mainly closed globe injuries without separate analysis of OGIs (termed "laceration/puncture," noted in 3%). Our study evaluates the epidemiology, characteristics, and outcomes of pediatric traumatic OGIs sustained at home, and compares observed final Visual Acuity (VA) to that predicted by the OTS.

### Materials and Methods

Rutgers Health Sciences, Newark Campus Institutional Review Board approval was obtained for retrospective chart review of patients aged ≤19 years presenting with OGI to University Hospital and

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**Received Date:** 11 Oct 2016

**Accepted Date:** 30 Nov 2016

**Published Date:** 07 Dec 2016

#### Citation:

Lesniak SP, Li X, Bauza A, Son JH, Zarbin MA, Langer P, et al. Pediatric Open Globe Injuries Occurring at Home: A 12-Year Case Series. *Clin Surg.* 2016; 1: 1220.

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**Table 1:** Causes and outcomes of open globe injury in this series by age group.

	Mean Age	# of Males	Penetration	Rupture	IOFB	Perforation	Initial VA (logMAR)	Final VA (logMAR)
<b>At Home (n=42)</b>	5.8	27 (64%)	30 (71%)	12 (29%)	0 (0%)	0 (0%)	1.725	1.16
<b>Outdoors (n=47)</b>	13.2	38 (80%)	19 (40%)	18 (38%)	6 (13%)	4 (9%)	2.076	1.579

**Table 2:** Comparison of pediatric open globe injury cases sustained at home versus outdoors that presented to at our institution from 1997-2008.

Age	Most Common Causes of Injury	Final VA (Snellen)
≤1 (infant)	fall (75%)	20/6005
1-3 (toddler)	poke (58%), fall (33%)	20/600
4 - 10	fall (37%), poke (37%), projectile (16%)	20/150
> 10	projectile (43%), fall (29%), poke (29%)	20/200

Rutgers New Jersey Medical School, Newark, NJ, USA from January 1997 – December 2008. OGI diagnosis was made upon clinical or intraoperative finding of a full-thickness break in the globe. Data extracted from charts included age, race, gender, wound location, injury mechanism, trauma classification, initial and final VA, ocular examination, time from injury to first surgery, and additional surgeries performed. Cases with missing variables were omitted from analysis of that variable. Ocular examination variables included Afferent Pupillary Defect (APD), lens status, Retinal Detachment (RD), Vitreous Hemorrhage (VH), choroidal detachment, injury zone, intraocular foreign body (IOFB), endophthalmitis, and Sympathetic Ophthalmia (SO).

OTS was calculated [3] while assuming presence of APD in eyes with no light perception (NLP). Briefly, VA was grouped into NLP, light perception (LP)/hand motion (HM), 1/200 – 19/200, 20/200 – 20/50, or ≥20/40. Scoring based on prognostic factors then assigned each eye into an OTS category. Final observed VA outcomes in each OTS category were compared to expected VA outcomes using the Fisher's exact test. Statistical significance was defined as  $p < 0.05$ . For statistical calculation, VA was converted into logMAR from Snellen VA or as follows: counting fingers (CF)=1.6, HM=2.0, LP=2.5, and NLP=3.0 logMAR units [7]. Inclusion criteria for this analysis were complete data on the OTS variables and ≥3 months of follow-up.

Zone 1 of injury included the cornea and limbus, zone 2 within 5 mm beyond the limbus, and zone 3 as anywhere posterior to zone 2 [1]. OGI was further classified as penetration (sharp object: single wound), perforation (sharp object: separate entrance and exit wounds), IOFB, and rupture (blunt object) [1,3].

## Results

One hundred and three (14%) of 757 total OGIs treated at University Hospital from 1997 – 2008 occurred in patients aged ≤19 years. 89 (86%) of these charts were complete with 42 occurring at home [47%, mean age: 5.8 years (range: 1-19); 64% male]. African-American patients represented 33%, Hispanics 21%, and Caucasians 12% of the study population. Penetrating injuries comprised 71% of cases and ruptures the remaining 29%, with no perforations or IOFBs. 57% of injuries occurred in zone 1, 29% in zone 2, and 14% in zone 3. Traumatic cataract was noted in 25 cases (60%), with all eyes phakic at injury. Lens was dislocated in 2 cases (5%) and extruded in 1 case (2%). Cataract extraction was performed with primary globe repair in 3 cases (7%), while 18 (72%, mean age 5.7 years) had it as a subsequent procedure averaging 78 days after primary repair. 4 eyes (10%) underwent intraocular lens (IOL) implant. Posterior segment complications noted <10 days after presentation included VH in 11

cases (26%), hemorrhagic choroidals in 7 (17%), and RD in 6 (14%). ≤6 months of injury, there were a total of 9 (21%) RD cases. OGI was most commonly due to poking by a sharp object (16 eyes, 38%), followed by 12 falls onto object (29%), 6 projectile injuries (14%), 5 falling object injuries (12%), and 3 blunt hits (7%). Self-injury occurred in 57% of cases, while sibling-perpetrated injury comprised 19%. Table 1 presents age group-specific causes of injury and final VA.

Forty-one patients (98%) underwent primary open globe repair, while 1 patient (2%) underwent primary enucleation due to irreparable anatomy. Thirty (71%) patients underwent surgery within 24 hours of injury, while 39 (93%) underwent surgery within 48. In 3 (7%) cases, the initial surgery occurred 7 days post-trauma due to delayed presentation. Twenty-one (50%) patients required additional surgeries following initial repair: 15 (36%) underwent 1 additional surgery, 5 (12%) had 2 additional surgeries and 1 (2%) underwent 3 additional surgeries. Secondary surgeries included 9 Pars Plana Vitrectomies (PPV), 11 Cataract Extractions (CE), 8 Pars Plana Lensectomies (PPL), 1 Penetrating Keratoplasty (PKP), and 1 open globe revision. Seven of 9 RD patients (78%) underwent PPV, 1 (11%) was enucleated, and 1 (11%) was lost to follow-up. Five of 7 (71%) patients who underwent PPV for RD achieved anatomic success, averaging 1.6 PPVs. No cases of endophthalmitis or SO were noted in this series.

Initial and final VA recorded ≥3 months post-trauma was available in 26 cases. Mean initial VA was 1.73 logMAR (Snellen equivalent 20/1074); mean final VA was 1.16 logMAR (Snellen equivalent 20/289). 8 patients were excluded from OTS calculation (final n=18). In each category, the number of expected patients closely predicted actual observations ( $p > 0.05$  for each).

Table 2 compares this series with 47 cases of OGI occurring outside the home from the same population; these two groups were previously reported together [14].

## Discussion

To our knowledge, this is the first study to focus specifically on the epidemiology, characteristics, and visual outcomes of OGI in children that happened at home. Pediatric OGI occurred in 13.6% of all OGI cases at our institution; approximately half occurred at home. Narang et al. [6] reported that only 14% of pediatric OGIs occurred at home, while Armstrong et al. [10] reported that 66% of pediatric open and closed globe injuries occurred at home.

Self-injury occurred in 57% of cases here, while 19% of cases were sibling-perpetrated. Most cases involved penetration with sharp objects such as broken glass (mostly from broken light bulbs), pens, furniture, knives, screwdrivers, wooden sticks, and toys. These objects are easily accessible to young children, emphasizing the need to ensure a safe home environment with supervision of young children and limiting access to both sharp household items and potentially dangerous toys.

In our study, 64% of OGIs occurred in males, which is slightly lower than previously reported rates (74-83%) [4-6]. This rate is,

however, very close to the overall rate of closed and open eye injuries among males at 66% [10]; boys may be more likely to engage in activities leading to eye injuries.

Pediatric OGIs sustained at home averaged 5.8 years old versus 13.2 years among those with injuries occurring elsewhere, which likely reflects the tendency for older children to spend more time outdoors than younger children. Most OGIs that occurred at home were penetrating injuries (71%), while ruptures (29%) comprised the rest. Outdoor injuries were more evenly split between penetrating injuries (40%) and ruptures (38%), while also including perforations (13%) and IOFBs (9%).

Infants were most commonly injured as a result of falls and toddlers were more likely to be poked by sharp objects, underscoring the importance of safeguarding cribs and keeping sharp objects away from toddlers. Children >10 years old were most likely to be injured by projectiles. The youngest children had the worst final VA, possibly due to amblyopia.

Most injuries involved zone 1 (57%), yet only 1 eye underwent subsequent PKP. In our study, mean follow-up was 22 months. No eyes developed infectious endophthalmitis or SO. One patient underwent primary enucleation during initial surgery due to irreparable anatomy.

Mean final VA was poor, which may be due to aphakia (90% of patients), persistent RD (5%), and/or amblyopia (difficult to quantify in this study).

Final VA predicted by the OTS correlated well with observed final VA; OTS was reliable in predicting final VA in this series of pediatric OGI at home from our urban institution.

Limitations in this study originate from the inherent difficulty in obtaining complete variables in retrospective analyses. OTS was computed in 18 of 42 eyes (43%), mainly due to difficulty assessing VA in young patients.

Visual prognosis in eye injuries in children remains guarded, even after prompt surgical intervention. Prevention may lie in greater awareness of the common causes of ocular injury occurring at home and frequent inspection of the environment.

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