

# Mehanizmi nastanka in preventiva odprtih poškodb očesa

## Mechanisms and Prevention of Open Globe Eye Injuries

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### **Izvleček**

**Namen:** Odprta poškodba očesa je pogost vzrok enostranske izgube vida. Namen raziskave je določitev epidemioloških parametrov nastanka odprtih poškodb očesa v 15-letnem obdobju v osrednji in vzhodni Sloveniji.

**Metode:** Retrospektivna analiza je zajela 219 bolnikov (219 oči) z odprto poškodbo očesa, ki so bili obravnavani na oddelku za očne bolezni UKC Maribor v obdobju med januarjem 1999 in januarjem 2014. V raziskavi smo obravnavali bolnike glede na spol, starost, mesec, okolje, mehanizem in obliko nastanka očesne poškodbe glede na spol.

**Rezultati:** Večina obravnavanih bolnikov je bila moškega spola (186 bolnikov, 85 %) s povprečno starostjo 38 let. Skoraj 45 % očesnih poškodb pri moških je nastalo v starostnem obdobju med 30. in 50. letom. Večina poškodb se je zgodila v hladnejšem delu leta med oktobrom in januarjem. Poškodba očesa se je najpogosteje zgodila v domačem okolju (126 oči, 66,5

### **Abstract**

**Purpose:** Open globe injuries are a frequent cause of unilateral vision loss. The purpose of our study was to determine the epidemiological data of open globe injuries during a 15-year period in Central East Slovenia.

**Methods:** A retrospective analysis of 219 patients (219 eyes) with open globe injuries admitted to the Department of Ophthalmology in the University Clinical Centre Maribor, Slovenia, from January 1999 to January 2014 was performed. We analyzed the following parameters: sex, age, month of injury, place of injury, type of injury, and mechanism of injury, grouped according to sex.

**Results:** The majority of patients were male (186 patients, 85%). The mean age of male patients was 38 years with almost 45% of injuries occurring in the age interval between 30 and 50 years. Most injuries occurred during the colder part of the year from October to January. The most common place of injuries was the home

%). Najpogostejši obliki odprte poškodbe očesa sta bili penetrantna poškodba (126 oči, 57,6 %) in ruptura zrkla (49 oči, 22,4 %). Najpogostejši mehanizem nastanka očesne poškodbe pri moških je bil z ostrim predmetom (86 oči, 46 %), medtem ko pri ženskah posledica padca (10 oči, 31 %) in topega predmeta (10 oči, 31 %).

**Zaključek:** Večina očesnih poškodb se lahko prepreči z uporabo ustreznih zaščitnih sredstev. Analiza vzrokov nastanka očesnih poškodb v določeni regiji je pomembna za načrtovanje ustreznih preventivnih ukrepov ter usmerjenega izobraževanja izpostavljenih skupin.

(126 eyes, 66.5%). The most common open globe injuries were penetrating injuries (126 eyes, 57.6%) and rupture of the globe (49 eyes, 22.4%). Males most frequently experienced open globe injuries as a result of sharp objects (86 eyes, 46%), while in females, the most common causes of injuries were falls (10 eyes, 31%) and blunt objects (10 eyes, 31%).

**Conclusions:** The vast majority of eye injuries are preventable. Studying the causes of injuries for a determined region is important to provide for preventable measures, like the use of eye protection, and to provide health education, to prevent severe vision loss or blindness.

## INTRODUCTION

Open globe injuries are one of the major causes of vision loss in modern industrialized communities worldwide, with significant socioeconomic impact. Ocular trauma is an important, preventable, worldwide public health problem.

The annual incidence rate per 100,000 people per year of hospitalization was reported as 8.1 in Scotland, 15.2 in Sweden, and 13.2 in United States (1–3). Studies performed in Australia have estimated the annual incidence rate of all injuries at 15.2 in urban settings and 11.8 in rural settings (4, 5).

The causes of ocular traumas have been changing. The proportion of injuries at the workplace in the last 20 years has decreased, whereas injuries that occurred during leisure time activities have increased, especially among “do-it-yourself” people. Globe ruptures among seniors has also increased (6–10). The increased utilization of protective eyewear at the workplace has decreased occupational eye injuries. However, the use of protective eyewear is far from universal. Lifetime prevalence of traumatic events is higher for males than females. There are numerous reports showing the predominance of male victims in ocular trauma (11–14).

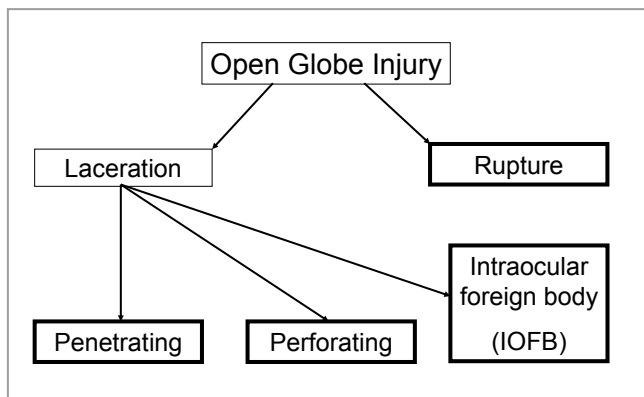
A national eye trauma registry may be used to determine the epidemiological characteristics of ocular trauma. National eye trauma registries have been established in the United States, Israel, Finland, and Hungary, but not in central Europe, where only hospital-based studies exist. From the public health and injury prevention perspective, current information on eye injury epidemiology is needed to develop effective plans for the dissemination of eye injury prevention materials to the public and to earmark adequate funds for these initiatives (7).

Little information is available regarding epidemiology of ocular trauma in Central East Slovenia. Therefore, this study was undertaken to investigate the population groups at risk, circumstances and activities at the time of accident, the mechanisms, and the types of open globe injuries occurring during a 15-year period in Central East Slovenia with a population of approximately 300,000.

### Patients and methods

This study retrospectively analyzed the epidemiology of 219 patients (219 eyes) with open globe injuries who had been treated at the Department of Ophthalmology, University Clinical Centre Maribor, from January 1999 to January 2014.

The hospital records were reviewed to identify age, sex, place of injury, type of injury, and mechanism of injury, grouped according to sex. The type of open globe injury was assessed for each case, according to the classification system of the Birmingham Eye Trauma Terminology (BETT), as penetrating injury, intraocular foreign body (IOFB), rupture of a globe, or perforating injury (Figure 1) (15, 16).



**Figure 1.** Birmingham Eye Trauma Terminology (BETT) of open globe injury

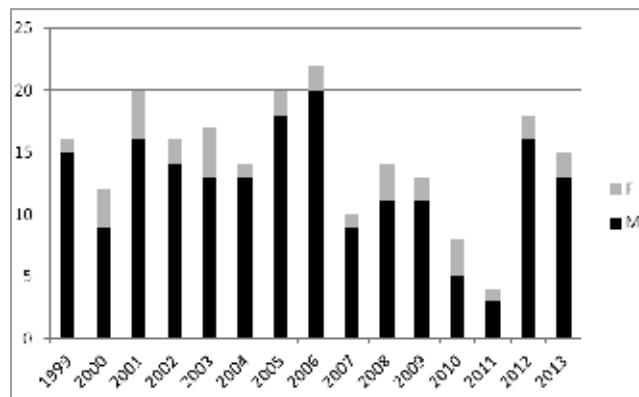
## RESULTS

Between January 1, 1999 and January 1, 2014, 219 patients were admitted to our department with open globe injuries. Of all patients, 186 were male (85%) and 33 patients were female (15%). The ratio between males and females was 6:1. The mean age of the study group was 41 years (range 2–90 years). The right eye was injured in 96 cases (44%) and the left eye in 123 cases (56%) (Table 1). From 1999 to 2006 there was a slight increase in the number of injuries

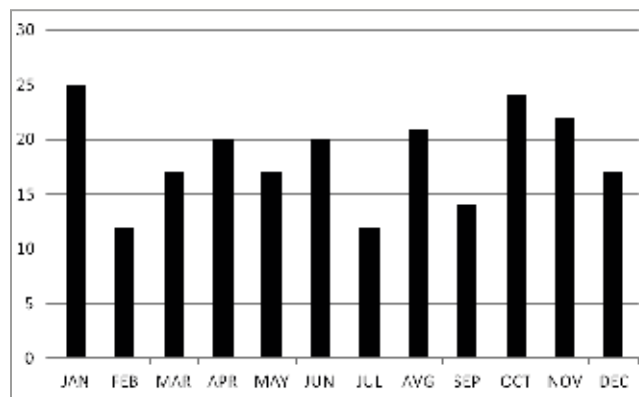
**Table 1.** Patient characteristics

	Number (%)
Number of patients	219
Number of eyes	219
Number of male patients	186 (85 %)
Number of female patients	33 (15 %)
Male:female ratio	6 : 1
Mean age, years	41 (range 2-90)
Number of injured right eyes	96 (44 %)
Number of injured left eyes	123 (56 %)

per year and from 2007 to 2011 there was a sharp fall in injuries. In the last two years, the number of injuries increased again (Figure 2). Most injuries occurred during the colder part of the year from October to January. Around the New Year, there were some additional injuries caused by fireworks. Generally, there were no specific injuries that could be related to a specific pattern (Figure 3).



**Figure 2.** Number of injuries and sex distribution per year



**Figure 3.** Number of all ocular injuries per month

The most common place of injuries was in the home (146 patients, 66.5%), followed by the workplace (45 patients, 20.5%), streets and highways (9 patients, 4%), and by sports and recreational activities (4 patients, 2%).

The most common open globe injuries were penetrating injuries (126 eyes, 57.6%) and rupture of a globe (49 eyes, 22.4%). The incidence of intraocular foreign body (IOFB) occurred in 19.5% (43 eyes)

and perforating injury occurred in less than 1% (1 eye) of the eyes.

The mean age of male patients was 38 years with almost 45% of the injuries occurring in the age interval between 30 and 50 years (Figure 4). Female patients were older than male patients. Although the mean age of female patients was 54 years, 40% of all injuries happened between 70 and 80 years of age (Figure 5).

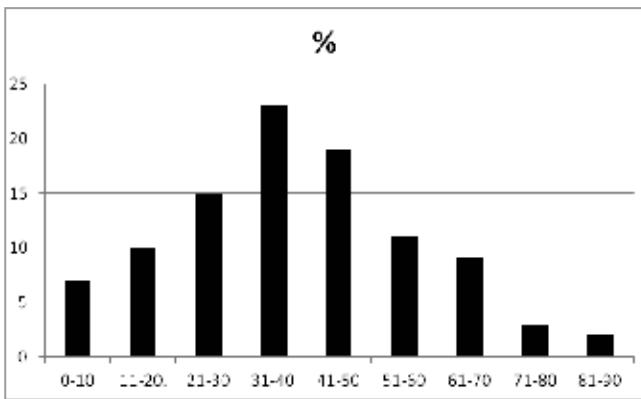


Figure 4. Age distribution – males (years)

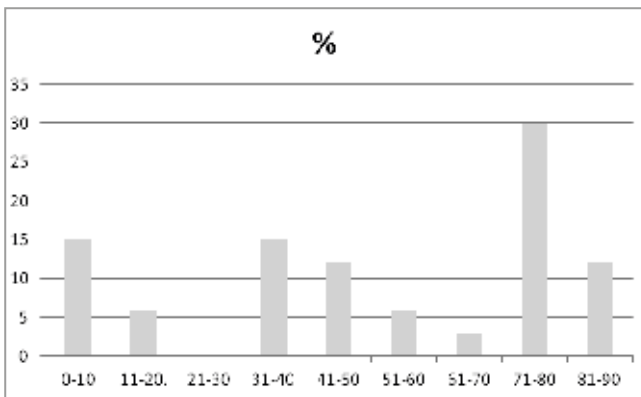


Figure 5. Age distribution – females (years)

Penetrating injury was the most frequent pattern of open globe injury experienced by males (116 eyes, 62.3%), followed by IOFB (47 eyes, 25%), and rupture of a globe (24 eyes, 13%). There were no perforating injuries in males (Figure 5). Females were more likely to suffer from rupture of a globe (21 eyes, 65%), followed by penetrating injury (9 eyes, 27%). IOFB and perforating injuries occurred in only 4% (2 eyes) of the cases (Figure 6).

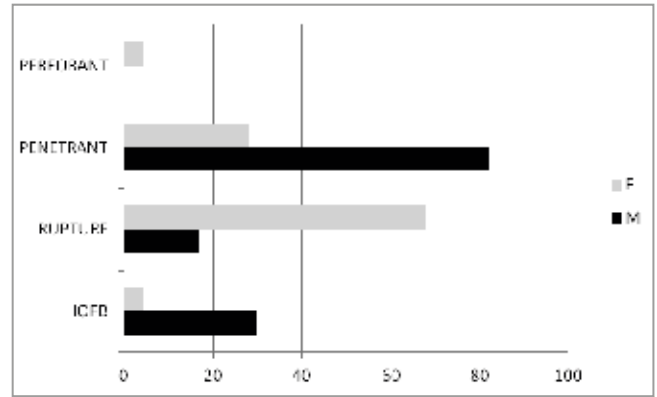


Figure 6. Age distribution – females (years)

The mechanisms of open globe injuries also varied with sex. Compared with females, males more frequently experienced open globe injuries as a result of sharp objects (86 eyes, 46%), followed by blunt objects (35 eyes, 19%), metal or stone hammering (30 eyes, 16%), explosions (11 eyes, 6%), assaults (9 eyes, 5%), and car accidents (7 eyes, 4%). The most frequent causative sharp objects were nails, screws, metal rods, wires, knives, and broken glass. Among blunt object causative agents, tree branches and pieces of wood were the most common. In contrast to females, falling was a cause of injury in only 3% of males (6 eyes). Compared with males, in females the most common causes of injuries were falls (10 eyes, 31%) and blunt objects (10 eyes, 31%), followed by sharp objects (7 eyes, 21%), and assaults (6 eyes, 17%) (Table 2).

Table 2. Cause of injury according to sex

	Male Number (%)	Female Number (%)
Sharp object	86 (46%)	7 (21%)
Blunt object	35 (19%)	10 (31%)
Hammering	30 (16%)	
Explosion	11 (6%)	
Assault	9 (5%)	6 (17%)
Car accident	7 (4%)	
Fall	6 (3%)	10 (31%)
other	2 (1%)	

## DISCUSSION

Open globe injuries are a common and often preventable cause of permanent vision impairment or vision loss. To our knowledge, this is the first study examining the epidemiology of hospitalized patients with open globe injuries in Central East Slovenia.

Our data showed that open globe injuries occurred most frequently in males between 30 and 50 years of age, a result similar to previous reports in most population-based studies (11–14). Male predominance is a universal characteristic of open globe injuries and is thought to be related to occupational exposure, participation in dangerous sports or hobbies, impaired judgement with alcohol, or other risk-taking behaviors (17, 18). Ocular trauma is the most important cause of blindness in children and adolescents (19). In the age group from 0–20 years, ocular trauma occurred more often in boys (24 eyes, 80%) compared to girls (6 eyes, 20%), which is comparable to Dorm et al., but in contrast with our previous studies where the percent for girls was greater than for boys (20, 21).

In our study, the home was the most common location for open globe injuries (66.5%). This significant shift from the workplace to the home in industrialized nations was first identified by the United States Eye Injury Registry (USEIR), a large, multicenter study (42% in the USEIR database). This has been confirmed in subsequent studies (9, 10). Schrader 8 also showed that the prevalence of injuries at work decreased and that the number of injuries that occurred during leisure time activities increased, especially among those aged over 30 years. Two societal facts appear to contribute to this development: the rising number of elderly people, and the rising popularity of the “do-it-yourself” activities that use power tools and omit safety measures (7, 9, 10). The proportion of workplace injuries shows a continuing downward trend and is relatively low (19% in the USEIR database). This reduction is due to the fewer number of workers in industry and the availability of proper eye protective devices (10, 22). Our results are comparable, with the reported 20.5% of open globe injuries occurring at the workplace. In some

rural areas in developing countries the workplace remains the most common place of eye injury (23).

Our study also demonstrates that there are differences in the types and mechanisms of open globe injuries between males and females. In the age interval between 30 and 50 years the percentage of injured males was almost twice as high as in females. This difference is probably the result of the nature of the activities, with more frequent risk-taking behaviors at home during domestic activities, and during leisure time, at the workplace, and in sports activities among males. Assaults and fighting are also more frequent with males. For females between 70 and 80 years of age, the percentage of injury was almost ten times as high as for males. This difference could be due to the longer life expectancy for older females, who are more prone to injuries and who spend most of their time at home. Females are typically injured at home because of a fall, and the main cause is a blunt object such as a door knob or the edge of a piece of furniture. Penetrating injury with a sharp object was the most frequent cause of open globe injury experienced by males, while females were more likely to suffer from rupture of a globe. Results similar to our study were also demonstrated by the studies of Koo et al (24). showing that the causes and patterns of open globe injuries differed between males and females. In their study, the majority of patients were males (78.6%), and females with open globe injuries were older (mean age 73 years) than males (mean age 36 years). Males were more likely to suffer from penetrating injuries (69,9%), while females were more likely to experience blunt globe rupture (68.1%). Projectile objects accounted for the majority of open globe injuries in males and were mostly work-related, while in females, open globe injuries most often resulted from a fall (24).

Studying the causes of ocular injuries and identifying the high-risk groups is important in terms of directing preventable measures, because the vast majority of eye injuries can be prevented (23). Certain individuals continue to be at high risk (males aged between 30 and 50 years, and females aged between

70 and 80 years) and are the populations to whom prevention resources should be mainly directed. Serious ocular trauma most frequently occurs at home. Health and safety strategies aimed at preventing eye injury should now include the home as a high risk environment in addition to the workplace and sports/leisure activities or facilities (26–28). The prevention measures could include requiring certified eye protection devices at home, at the workplace, and for sports activities whenever possible, rather than making their use voluntary (6, 29). Lack of eye protection was a risk factor identified in previous studies. Most high velocity fragment injuries are preventable by the correct use of polycarbonate protective eyewear (30, 31).

Adequate supervision and appropriate ocular protection for children must be stressed, especially when using sharp tools, scissors, or knives. Safer tools, such as blunt nosed scissors, should be provided to children, and access to sharp or dangerous household utensils should be restricted. Furniture with rounded corners are more desirable for households with children. Children playing with pets require supervision and education on how to treat their pets.

Games involving throwing projectiles should be disallowed.

According to the results of our investigation in the region of Central East Slovenia, open globe injuries remain an important cause of vision impairment or blindness, with the majority of all open globe injuries occurring in young male adults at home.

We conclude that a national eye injury registry should be introduced for all eye injuries in Central East Slovenia. Regular analyses of causes could contribute to better prevention of ocular trauma. Prevention of ocular trauma should be introduced in schools as a part of the educational program. Attention should be directed towards the education of children in the avoidance of potentially dangerous activities. The foremost factor which needs to be employed is education, because a healthy population is an indispensable prerequisite for a flourishing and healthy society (32).

#### Conflicts of interest

The authors had no conflicts of interest to declare in relation to this study.

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