

*Originalni članci/  
Original articles*

EYE INJURIES IN TRAFFIC ACCIDENTS

POVREDE OČIJU U SAOBRAĆAJNIM  
NESREĆAMA

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*Ključne reči*

Povrede očiju, saobraćajni udes, mere  
prevencije

*Key words*

eye injuries, traffic accidents, prevention.

*Apstrakt*

*Uvod* Povrede očiju u saobraćaju se dešavaju kao odvojene povrede ili u sklopu poli-  
traume. Mogu biti ozbiljne sa krajnje negativnim rezultatom po funkciju vida.

*Cilj* Cilj rada je bio da se analiziraju različiti faktori koji dovode do povećanog rizika koji  
dovode do povreda očiju pri saobraćajnim udesima.

*Metode* Radom su obuhvaćeni pacijenti koji su bili hospitalizovani na Klinici za očne  
bolesti KCS u Beogradu u periodu od 1. januara 2000 do 31. decembra 2008. godine.  
Analizirani su pol, godine starosti, vreme povređivanja, mesto sedenja u automobilu u  
momentu nastajanja povrede, vezivanje ili nevezivanje sigurnosnim pojasem, vrsta  
povrede očiju i krajnji funkcionalni ishod na povređenom oku.

*Rezultati* Za nalizirani period od 9 godina ukupno je bilo hospitalizovano 138 bolesnika sa  
povredom oka u saobraćajnim udesima i 174 povređenih očiju. Bilo je 101 (73,2%)  
muškaraca. Preko polovinu povređenih su činile mlađe odrasle osobe od 21-40 godina  
starosti u 55,8% slučajeva. Povrede su se najčešće dešavale u decembru mesecu - 15,2%,  
nedeljom - 27,5% i u noćnim časovima vožnje od 18 -06 časova u 63,8% slučajeva.  
Uglavnom su povrede očiju zadobijali putnici koji su sedeli na prednjim sedištima u auto-  
mobilu i to vozači u 50,0% i suvozači u 41,1% slučajeva. U 30,4% slučajeva povređeni su  
bili pijani. Penetrantne povrede očiju su bile prisutne kod 118 (67,8%) a kontuzione kod 56  
(32,2%) slučajeva. Vidna oštrina na povređenom oku, određena na otpustu ili pri kasnijim  
kontrolama je bila amauroza - 25,9%, bolja od 0,1 kod 64,4%, normalna kod 42,0%  
slučajeva.

*Zaključak* Iz rada se može zaključiti da su se češće povređivali muškarci, da su se povrede  
češće dešavale u zimskim mesecima, nedeljom i u toku noći, da su riziko faktori za nastajanje  
povreda očiju bili sedenje na prednjim sedištima u automobilu, nevezivanje sig-  
urnosnog pojasa i vožnja u pijanom stanju. Izbegavanjem tih riziko faktora smanjio bi se  
broj povreda očiju pri saobraćajnim udesima.

*INTRODUCTION*

In recent years, a lot of effort has been made to find out new solutions for evading all types of injuries, including also the eye injuries of car passengers in traffic accidents. New technical designs have been developed in car industry, and special technology is used to make all glasses (windshield, door glasses, mirrors) [1], seat-belts are provided for all car seats [2], and air-bags are built-in [3,4,5].

These technical improvements were followed by legal provisions related to car passenger safety such as compulsory use of seat-belts[2], placing the ban on 12-year old and younger children to sit in the front passenger seat, speed limit under different driving conditions and situations. All these measures, both technical and legal, led to reduced

number of the eye injuries in traffic accidents, but unfortunately these injuries still happen, even the severest ones with the loss of sight and the eye as an organ [6,7]. This is rather disturbing, particularly because the eyes of younger people are injured [6], who thus become permanently disabled persons, separated too early from their profession they had been trained for and wished to be occupied with for lifetime.

AIM

The objective of our paper was to determine the risk factors causing the eye injuries incurred in traffic accidents, with a view to influence on them for prevention of these injuries.

## MATERIAL AND METHODS

This study included the patients with severe injuries incurred in traffic accidents in 9-year period (January 1 to December 31, 2008), who were treated at the Clinic of Eye Injuries, Clinic Center of Serbia in Belgrade. The Clinic of Eye Injuries, Clinic Center of Serbia in Belgrade is a reference institution for management of severe eye injuries in Belgrade.

The following parameters were analyzed: sex, age, place of residence, frequency of injuries by months in a year, by days in a week and different day time. In addition, the analyses included the types of the injuries (eyeball penetrating injuries, contusion ones, ocular adnexa), time from the injury to the surgery (if surgery was required), visual acuity of the injured eye on admission and visual acuity at discharge and following controls. Special analyses referred to information where the injured person was sitting at the time of the accident (driving seat, passenger or back seat) as well as whether he/she fastened his/her seat belt and if it was the question of drunken driving.

Table 1 Age of patients with the eye injuries incurred in traffic accidents

Age	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79
No. of patients	2	19	48	29	14	16	6	4
Percent of pts.	1.4	13.8	34.8	21.0	10.1	11.7	4.3	2.9

Table 2 Number of patients with the eye injuries incurred in traffic accidents by months/year

Months	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
No. of patients	9	10	7	10	12	8	10	13	10	15	13	21
Percent of pts.	6.5	7.3	5.1	7.3	8.7	5.8	7.3	9.4	7.3	10.7	9.4	15.2

Table 3 Number of patients with the eye injuries incurred in traffic accidents by days/week

Days/week	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
No. of pts.	19	10	17	21	15	18	38
Percent of patients	13.8	7.3	12.3	15.2	10.9	13.0	27.5

Table 4 Number of patients with the eye injuries incurred in traffic accidents by different day time

Day time in h	06-10	10-14	14-18	18-22	22-02	02-06
No. of pts.	16	10	24	28	36	24
Percent of pts.	11.6	7.2	17.4	20.3	26.1	17.4

Table 5 Number of patients with the eye injuries incurred in traffic accidents by riding in different car seats

Car seat	Driver	Front passenger	Behind the driver's seat	Behind the front passenger's seat
No. of pts.	69	57	6	6
Percent of pts.	50.0	41.1	4.3	4.3

Table 6 Bulbar wall perforation site in penetrating injuries incurred in traffic accidents (n=118)

Bulbar perforation site	Cornea	Sclera	Cornea and sclera
Number of eyes	32	28	58
Percentage of eyes	27.1	23.7	49.2

Table 7 Different lesions of the intraocular structures in contusion bulbar injuries incurred in traffic accidents (n=56)

Type of injuries	Hyphema	Iridodialis	Iridorrhexis	Lens subluxation	Lens luxation	Hemophthalmus	Edema, retinal bleeding	Bulbar rupture
No. of the eyes	34	7	5	10	5	9	10	17
Percent of the eyes	60.7	12.5	8.9	17.9	8.9	16.1	17.9	30.4

## RESULTS

In the analyzed period of 9 years, a total of 2915 patients were hospitalized at the Clinic of Eye Injuries, Clinic Center of Serbia in Belgrade, due to mechanical eye injuries incurred by different causes and occurred in different ways. Among them, 138 (4.7%) patients were hospitalized for mechanical injuries occurred in traffic accidents. There were 101 (73.2%) men and 37 (26.8%) women. The right and the left eyes were injured in 51 patients, respectively, and both eyes were injured simultaneously in 36 (26.1%); therefore, there were totally 174 injured eyes. Out of 138 wounded persons, 45 (32.6%) lived in country and 93 (67.4%) in town.

The number of the injured by age was presented in Table 1, and it was very different. The injuries by months in a year ranged from at least 7 in March to 21 in December at most (Table 2).

The eye injuries incurred in traffic accidents by days in a week ranged at least from 10 on Tuesdays to 38 on Sundays most (Table 3).

During day-time, the injuries were inflicted in a varying number of cases in various time periods (Table 4).

Concerning the seat where the injured was sitting at the time of accident, 69 (50.0%) were driving, 57 (41.1%) were sitting on the passenger seat, 6 (4.3%) were sitting behind the driver and the remaining 6 (4.3%) were sitting behind the front passenger seat (Table 5).

Out of 138 persons with the injured eyes in traffic accidents, 117 (84.8%) were not fastened by seat belts, 21 (15.2%) were fastened and 42 (30.4%) were driving under the influence of alcohol.

Out of 174 injured eyes, 118 (67.8%) were penetrating injuries, and 56 (32.2%) were contusion injuries of the eyeball. In patients with contusion injuries, 17 of them had ruptured eyeballs with the intraocular structure lesions. Sixty-five patients had also the injuries of ocular adnexa and 8 experienced the fractures of some parts of the orbital walls.

In 118 eyes with penetrating injuries of the eyeballs, wall penetrations (entry wounds) were located on different sites. The perforations were located on the cornea in 32 (27.1%) cases, on the sclera in 28 (23.7%), and together on cornea and sclera in 58 (49.2%) patients (Table 6).

In 56 eyes with contusion injuries of the eyeballs, different intraocular structures were injured: hyphema was manifested in 34 (60.7%), iridodialysis in 7 (12.5%), iridorrhexis in 5 (8.9%), lens subluxation in 10 (17.9%), lens luxation in 5 (8.9%), hemophthalmus in 9 (16.1%), retinal edema and hemorrhage in 10 (17.9%) and ruptured eyeballs in 17

(30.4%) eyes (Table 7). The sum of percentage is over 100.00%

because several different injuries could be found for the very same eye.

On admission, the visual acuity of the injured eyes was varying: amaurosis in 30 (17.2%), light sensation with accurate projection in 56 (32.2%), visual acuity below 0.1 in 15 (8.6%), from 0.1-0.3 in 20 (11.5%), from 0.4-0.7 in 11 (6.3%) and visual acuity from 0.8-1.0 in 42 (24.2%) eyes (Table 8).

The visual acuity at discharge or following controls was changed: amaurosis in 45 (25.9%) eyes, light sensation with accurate projection in 6 (3.4%), visual acuity below 0.1 in 11 (6.3%), from 0.1-0.3 in 15 (8.6%), from 0.4-0.7 in 24 (13.8%) and visual acuity from 0.8-1.0 in 73 (42.0%) eyes (Table 9).

Out of 174 eyes, 124 required some of the urgent surgical interventions on admission. These operations were performed at different times in relation to time of the injuries: within the first 8 hours, 19 (15.3%) eyes were operated, 8-24 hours - 73 (58.9%) eyes, in 24-28 hours - 15 (12.1%) and after 48 hours 17 (13.7%) eyes were operated.

### DISCUSSION

The Clinic of Eye Diseases, Clinical Center of Serbia in Belgrade is a reference ophthalmological institution for treatment of severe eye injuries on the territory of the whole Serbia. A total of 7.5 million of inhabitants live in Serbia. According to Republic Traffic Police Department data, about 150 traffic accidents occur in Serbia every day, resulting in about 50 injured car passengers. It means that about 18.250 persons are injured in traffic accidents on the territory of the Republic of Serbia. Given that our study analyzed the period of 9 years (January 2000 to December 2008), a total number of the injured persons accounted for 164.250. Out of this number, there were 138 persons with severe eye injuries, on what account they were hospitalized and treated at the Clinic of Eye Diseases. It is 0.1% of all injuries incurred in traffic accidents.

The ratio of eye injuries by gender was 2.7:1 in favor of males, and similar ratio by gender distribution was reported by other authors [6,8]. The percentage of the right and the left eye injuries was similar, and concomitant injuries of both eyes were reported in one-quarter (26.1%) of cases. Around two-thirds of the injured (67.4%) lived in town and the rest of them (32.6%) in country.

Among the injured patients, the largest number was recorded in young adult individuals between 20 and 39 years of age (55.8%). There were only 2 (1.4%) children younger than 9 years. Others were persons up to 79 years of age.

The frequency of injuries by months in a year was different and ranged from 5.1% in March to 15.2% in December. Such difference in frequency of the injured could not be found in other studies[1]. Concerning the days in a week, the highest frequency of injuries was reported during the weekends (40.5%), especially on Sundays (27.5%). Reason for that might be more frequent driving and longer stay in a car during the weekend days, as well as driving under the influence of alcohol. The eye injuries occurred as twice as often during night driving, between 6 p.m. to 6 a.m. - (63.8%) in comparison to day hours from 6 a.m. to 6 p.m. (36.2%).

Table 8 Visual acuity of the injured eyes in traffic accidents on admission (n=174)

Visual acuity	Amaurosis	L+P+	< 0.1	0.1-0.3	0.4-0.7	0.8-1.0
No. of eyes	30	56	15	20	11	42
Percent of eyes	17.2	32.2	8.6	11.5	6.3	24.2

Table 9 Visual acuity of the injured eyes in traffic accidents at discharge (n=174)

Visual acuity	Amaurosis	L+P+	< 0.1	0.1-0.3	0.4-0.7	0.8-1.0
No. of eyes	45	6	11	15	24	73
Percent of eyes	25.9	3.4	6.3	8.6	13.8	42.0

Table 10 Time in hours of the urgent surgical interventions of the injured eyes in traffic accidents (n=124)

Time of surgery	< 8	8-24	24-48	> 48
Number of eyes	19	73	15	17
Percent of eyes	15.3	58.9	12.1	13.7

Similar result of the injury frequency regarding the day time was described by Schrader and assoc. in their study [8].

The seats wherein passengers were sitting during the car accident were of a great importance. In the largest number of cases, 126 (91.1%), the injured passengers were those sitting in the front/passenger car seats, either they were drivers - 69 (50.0%) or passengers - 57 (41.1%). Some authors reported that their patients exclusively occupied the front seats [1,8]. In our study, 12 (8.6%) passengers sat on the back seats, i.e. 6 (4.3%) behind the driver and 6 (4.3%) behind the front passenger.

Very significant information is that out of 138 persons with the injured eyes, as high as 117 (84.4%) were not fastened by seat belts during traffic accidents.

In the world, Mandatory Seat Belt Law was passed in the State of Victoria, USA, in 1970. At the very beginning, this Law did not apply for children under 8 years of age, but in 1975 another Law on prohibiting children from riding in the front seat was enacted [2]. The largest number of authors has unquestionably similar attitude that the highest protection from getting the eye injury at the time of traffic accident lies in fastening one's seat belt [3,6,8,9].

Driving under the influence of alcohol is an important factor of the eye injuries. In our study, out of a total number of the injured, 42 (30.4%) were intoxicated drivers while other authors reported that this number amounted over one half of a total number of the injured [8].

Out of 138 injured patients, 36 (26.1%) had the injuries of both eyes, therefore, a total number of the injured eyes was 174. There were 118 (67.8%) penetrating eyeball injuries and 56 (32.2%) contusion injuries. More frequent incidence of penetrating eyeball injuries over contusion injuries in traffic accidents was compatible with other authors' studies. Accordingly, Pangiotidis et al [6] reported 79.1% of the penetrating injuries in their study.

Out of all penetrations, 32 (27.1%) were the bulbar penetrations on the cornea, 28 (23.7%) on the sclera, and 58 (49.2%) cases involved both the cornea and sclera. All these were severe eye injuries, requiring one surgical intervention in 49.2%, two interventions in 38.1% and three and more operations in 12.7% of the time.

Contusion bulbar injuries were usually associated with forehead and lid injuries, incurred by hitting one's head against the control panel or steering wheel. These were always the patients not fastening their seat belts. Contusion bulbar injuries caused the damage of various intraocular structures, and most frequently hyphema was developed - in

39 (60.7%) cases. Very high percent of the ruptured eyeballs was recorded as well - 17 (30.4%) and they were commonly the severest contusion injuries with very poor functional outcome. Visual acuity on admission and at discharge was different because the applied medicamentous and surgical treatment resulted in improvement.

Extremely striking is the high percentage of amaurosis - 25.9%. However, 64.4% of cases had visual acuity at discharge and following controls better than 0.1, while 55.8% had it over 0.4, and 42.0% had visual acuity from 0.8-1.0. These findings were compatible with other study results of visual acuity [6,9].

Timing of primary surgical intervention in relation to time of the injury played an important role in improvement and preservation of visual acuity in those patients who definitely needed surgery. Within the first 8 hours, 15.8% and in the following 24 hours 74.2% of patients were operated on, respectively. Such facts were satisfactory. Nevertheless, we were not satisfied with the percentage of patients operated after that time period, especially with those 13.7% of patients who underwent intervention after 48 hours. The respective reasons were different, such as late admission of patients from the country, previous management of polytraumatic patients being vitally jeopardized beforehand, and other technical problems.

## CONCLUSION

It may be concluded that the number of eye injuries in relation to a total number of other injuries incurred in traffic accidents is relatively small. However, if they occurred they would be with severe sequelae such as impaired visual function. The injuries were almost three times more frequent in males, with equal involvement of the right and the left eyes, and with significant concomitant injuries of both eyes. Most commonly, younger adults were injured. The injuries were more frequent in winter months, on Sundays and during night. The most noticeable risk factors of the eye injuries in traffic accidents were sitting in the front car seat, not fastening the seatbelt and drunken driving.

Penetrating bulbar injuries accounted for two-thirds of all cases, and contusion injuries were reported in one-third of the time.

One-fourth of the injured eyes resulted in permanent loss of sight (amaurosis).

In the light of all the above-mentioned, the eye injuries incurred in traffic accidents were extremely serious resulting in permanent disablement. Contribution to prevention of these injuries would be technical improvements of car construction aiming at safety of passengers and strict respect of all legal provisions related to safety car driving and riding.

## Abstract

**Introduction** Eye injuries in traffic accidents occur as separate injuries or within polytrauma. They may be severe with extremely negative outcome regarding the vision.

**Aim** The aim of our study was to analyze different factors causing the increased risk of eye injuries in traffic accidents.

**Methods** The study included the patients hospitalized at the Clinic of Eye Diseases, CCS in Belgrade, in the period January 1, 2000 to December 31, 2008. Sex, age, time of injury, car seat at the time of injury, seat-belt fastening, type of the eye injuries and final functional outcome of the injured eye were analyzed.

**Results** In the analyzed 9-year period, there was a total of 138 hospitalized patients with the eye injuries in traffic accidents and 174 injured eyes. There were 101 (73.2%) men. Over a half of the injured were younger adults from 21 to 40 years, accounting for 55.8% of cases. The injuries were more frequent in December - 15.2%, on Sundays - 27.5% and in night hours of driving from 6 p.m. to 6 a.m. in 63.8% of the time. Most injuries incurred in patients sitting in the front car seat, i.e. drivers in 50.0% and front passengers in 41.1%. Drunken driving was recorded in 30.4% of cases. Penetrating injuries were reported in 118 (67.8%), and contusion ones in 56 (32.2%) of cases. Visual acuity of the injured eye, measured at discharge and following controls was manifested as amaurosis - 29.9%, better than 0.1 in 64.4%, and normal in 42.0% of cases.

**Conclusion** It may be concluded that the injuries occurred more frequently in men, in winter months, on Sundays and during night; the risk factors included riding in the front car seat, non-fastening the seat belt and drunken driving. Evasion of these risk factors would contribute to lesser number of the eye injuries in traffic accidents.

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