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GUNSHOT AND EXPLOSION INJURIES OF THE EYES

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Ключові слова: *порушення зору, бойові офтальмологічні травми, двосторонні ураження, вікова вразливість, сторонні тіла*

Abstract. Gunshot and explosion injuries of the eyes. Bardhi N. *Gunshot and explosive injuries to the visual organs are one of the most severe and socially significant forms of ophthalmological pathology, especially in the context of armed conflicts, terrorist attacks, and man-made disasters. The anatomical complexity of the eye, its vulnerability to high-energy impact, and the vital importance of visual function determine the extreme severity of the consequences of such injuries. These injuries not only reduce the quality of life of the victims but also produce a substantial load on healthcare and social support systems due to the high incidence of disabling outcomes. The study aimed to investigate the clinical and functional characteristics of gunshot and explosive injuries of the visual organs with subsequent analysis of treatment outcomes in a specialised trauma centre. A retrospective study was conducted at the University Trauma Clinic in Tirana, Albania, between January 1995 and December 2006. The sample included 172 patients (240 eyes) admitted within the first 24 hours after injury. The methodology included the analysis of medical records and ophthalmological examination data, including visometry using Snellen tables, biomicroscopy using a slit lamp, ophthalmoscopy, and orbital radiography. In cases of suspected foreign bodies in the posterior segment, computed tomography was utilised. Statistical data processing was performed using IBM SPSS Statistics v.22.0, utilising Student's t-test for quantitative indicators and Pearson's χ^2 test for categorical variables. Epidemiological analysis revealed peaks in morbidity in 1997 (25%) and 1999 (22%), corresponding to periods of political crisis and armed conflict. The victims were predominantly male (92%) with an average age of 23.9±14.1 years. Notably, 54% of victims were minors, and 71% resided in rural areas. Explosions caused the largest proportion of cases (49%), followed by gunshot wounds (31%), indicating high-energy injury mechanisms. Clinical evaluation showed that severe eye injuries predominated (76%), often accompanied by combined injuries to other organs (75%). Foreign bodies were detected in 75% of eyes, and bilateral injuries occurred in 39% of patients. Despite treatment, severe anatomical outcomes (enucleation, atrophy) were recorded in 57% of patients, and irreversible loss of vision was recorded in 39% of eyes. The high level of disability identified highlights the need for systemic preventive measures and the readiness of ophthalmology services to receive seriously injured people on a massive scale. The practical significance of the data suggests that healthcare authorities must plan medical evacuation, train personnel, and create specialised ophthalmic trauma centres to manage complex, combined injuries effectively. Special attention must be paid to vulnerable groups, particularly children and rural residents, to prevent injuries during periods of social instability.*

Реферат. Вогнепальні та вибухові травми очей. Барді Н. *Поранення органів зору від вогнепальної зброї та вибухових пристроїв є однією з найтяжчих і соціально значущих форм офтальмологічної патології, особливо в умовах збройних конфліктів, терористичних актів та техногенних катастроф. Анатомічна складність ока, його вразливість до високоенергетичного впливу та життєво важливе значення зорової функції визначають надзвичайну тяжкість наслідків таких травм. Ці травми не тільки знижують якість життя потерпілих, але й створюють значне навантаження на системи охорони здоров'я та соціального забезпечення через високу частоту інвалідності. Мета дослідження полягала у вивченні клінічних та функціональних особливостей вогнепальних та вибухових травм органів зору з подальшим аналізом результатів лікування у спеціалізованому травматологічному центрі. Ретроспективне дослідження було проведено в Університетській травматологічній клініці в Тирані, Албанія, у період із січня 1995 року до грудня 2006 року. До вибірки увійшли 172 пацієнти (240 очей), госпіталізовані протягом перших 24 годин після травми. Методологія включала аналіз медичних карт та даних офтальмологічного обстеження, включаючи візометрію за допомогою таблиць Снеллена, біомікроскопію за допомогою щілинної лампи, офтальмоскопію та рентгенографію орбіти. У випадках підозри на наявність сторонніх тіл у задньому сегменті використовувалася комп'ютерна томографія. Статистична обробка даних проводилася за допомогою IBM SPSS Statistics v.22.0 з використанням t-критерію Стьюдента для кількісних показників та χ^2-критерію Пірсона для категоріальних змінних. Епідеміологічний аналіз виявив піки*

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захворюваності в 1997 (25%) та 1999 (22%) роках, що відповідало періодам політичної кризи та збройного конфлікту. Жертвами були переважно чоловіки (92%) із середнім віком 23,9±14,1 року. Примітно, що 54% жертв були неповнолітніми, а 71% проживали в сільській місцевості. Найбільшу частку випадків становили вибухи (49%), за ними йшли вогнепальні поранення (31%), що вказує на механізми травмування з високою енергією. Клінічна оцінка показала, що переважали тяжкі травми очей (76%), які часто супроводжувалися комбінованими травмами інших органів (75%). Чужорідні тіла були виявлені в 75% очей, а двосторонні травми траплялися в 39% пацієнтів. Незважаючи на лікування, тяжкі анатомічні наслідки (енуклеація, атрофія) були зафіксовані в 57% пацієнтів, а незворотна втрата зору – у 39% очей. Високий рівень інвалідності, виявлений у дослідженні, підкреслює необхідність проведення системних профілактичних заходів та готовності офтальмологічних служб до прийому великої кількості людей з тяжкими травмами. Практичне значення даних свідчить про те, що органи охорони здоров'я повинні планувати медичну евакуацію, навчати персонал та створювати спеціалізовані офтальмологічні травматологічні центри для ефективного лікування складних комбінованих травм. Особливу увагу слід приділяти вразливим групам населення, зокрема дітям та мешканцям сільської місцевості, з метою запобігання травмам у періоди соціальної нестабільності.

Gunshot and explosive injuries to the visual organs are one of the most severe and socially significant forms of ophthalmological pathology, especially in the context of armed conflicts, terrorist attacks and man-made disasters. The anatomical complexity of the eye, its vulnerability to high-energy impact and the vital importance of visual function determines the extreme severity of the consequences of such injuries. Between 1995 and 2006, the problem was significantly exacerbated by the growing number of localized armed conflicts, instability in border and rural areas, and the proliferation of improvised explosive devices. The high incidence of disabling outcomes, including complete loss of vision and eyeballs, not only reduces the quality of life of the victims but also produces a substantial load on healthcare and social support systems. In this context, the study of the clinical features and outcomes of ophthalmic injuries caused by firearms and explosives is of relevance to improve approaches to medical care, rehabilitation and prevention.

A substantial clinical problem is the high incidence of bilateral eye injuries in blast injuries, which significantly worsens the prognosis of restoration of visual function and reintegration of the victim into society. N. Bardhi [1] emphasised that the main pathogenetic mechanism of bilateral lesions is diffuse energy transfer through the bone structures of the facial skull, accompanied by multiple foreign bodies in the orbital tissues. Despite the proposed algorithms for diagnosis and treatment, approaches to emergency care remain fragmented, and the rate of outcomes with complete vision loss remains high, which indicates the need for a comprehensive review of protocols for the management of such patients. A significant obstacle to effective ophthalmic care for combat injuries is the high incidence of combined injuries, which makes early surgical intervention difficult. G. Warjri et al. [2] emphasised that ophthalmological care in patients with multiple organ trauma often falls by the wayside, leading to delayed treatment of ocular injuries. Despite the introduction of multidisciplinary teams, there is a lack of coordination between ophthalmologists and surgeons of other specialties, which reduces the effectiveness of rehabilitation measures.

High incidence of underage drinking, especially in rural areas where access to specialized medical care is limited, is notable. D. Zekaj et al. [3] highlighted that the lack of safety education programmes and affordable personal protective equipment for children and adolescents makes them particularly vulnerable. Despite the steps taken to prevent injuries among young people, the statistics of severe eye injuries in this age group grow, indicating the need for targeted prevention initiatives and training in basic safety skills in hazardous environments. The problem of preserving functional vision even with partial anatomical restoration of the eye remains unresolved. V. Kumar et al. [4] demonstrated that restoration of the eyeball anatomy does not guarantee the return of visual function, especially in cases of damage to the optic nerve and central retinal structures. Despite the development of microsurgery and reconstructive technologies, the rates of visual rehabilitation after blast injuries remain extremely low, which requires the search for new biotechnological solutions and methods of neurorehabilitation.

The absence of specialised ophthalmic trauma centres in most regions of Albania significantly reduces the efficiency and effectiveness of care. G. Nallbani and M. Krasniqi [5] addressed the shortage of staff, insufficient equipment and low readiness of institutions to receive mass casualties. Even if medical evacuation is available, the lack of standardised patient routes leads to delays in care and, consequently, to worsening outcomes. This highlights the need for strategic planning of resource provision and development of a network of specialised institutions. The high degree of disability after ophthalmic injuries is also associated with psychological consequences, which are often ignored in the treatment process. Y. Zhang et al. [6] noted that vision loss is accom-

panied by the development of post-traumatic stress disorders, depression and social isolation, especially in young patients. At the same time, comprehensive psychological support is practically not integrated into standard rehabilitation protocols, which limits the effectiveness of returning victims to active life.

There is no systematic database reflecting the structure, causes, and outcomes of ophthalmic injuries in the context of hostilities. D. Prat et al. [7] emphasized that the fragmentation of statistical sources does not provide an accurate assessment of the scale of the problem and makes it difficult to forecast and plan resources. In the context of growing instability and the probability of mass admission of severely injured people, this situation is unacceptable, which requires the development of a centralised information system and registers of ophthalmic injuries. The mechanisms for providing emergency ophthalmological care in the first hours after an injury are also insufficiently developed. A. Mohamed et al. [8] highlighted that the effectiveness of treatment largely depends on the time of transport and the availability of standard operating protocols. However, in most cases, victims are delivered late, and the initial examination is conducted by untrained specialists. These factors significantly limit the potential for preserving vision and restoring ocular structures, which requires regulatory regulation and improved training of medical staff.

The combination of these problems suggests that the existing system of ophthalmological care for gunshot and blast injuries requires significant modernisation at both the organisational and clinical levels. The study aimed to investigate the clinical and functional characteristics of gunshot and explosive injuries of the visual organs with subsequent analysis of treatment outcomes in a specialised trauma centre. The objectives of the study included a retrospective analysis of medical records, identification of the main factors influencing the severity of injuries, and evaluation of the effectiveness of the care provided.

MATERIALS AND METHODS OF RESEARCH

The study was conducted at the Trauma University Hospital (formerly Central Military University Hospital) [9] in Tirana, Albania, between January 1995 and December 2006. The study is a retrospective design based on the analysis of medical records and diagnostic materials of patients admitted with gunshot and blast injuries of the eye. The sample included all patients admitted to the hospital within the first 24 hours after the injury, with a documented injury to the eye or orbit due to gunshot or explosive exposure and a complete medical record. Cases with isolated soft tissue injuries of the eyelids without involvement of the eyeball, patients with incomplete documentation and those who died before admission were excluded. Thus, the study included 172 patients (158 men and 14 women) with a total of 240 injured eyes. The average age of the victims was 23.9±14.1 years. For each case, socio-demographic characteristics (age, gender, occupation, place of residence), circumstances of injury, type of injury (bullet, shell and mine fragments, explosives), severity of eye injury and the presence of combined injuries to other organs and systems were recorded. The latter were classified into five main groups: maxillofacial area, brain, limbs, thorax and abdomen. This study was considered by the members of the Research Ethics Council of the University Hospital of Trauma. Based on the vote of the Commission's members, a decision was made: All procedures performed in the study were in accordance with the Declaration of Helsinki [10] and the rules of Good Clinical Laboratory Practice (GCLP) [11]. The scientific research can be implemented in its current form, No. 258101.

The ophthalmological examination included visometry using Snellen tables [12] (Germany), biomicroscopy using a Haag-Streit BM 900 slit lamp (Switzerland), ophthalmoscopy (Welch Allyn 3.5V, USA), orbital radiography using a Siemens Multix Pro (Germany), and, if necessary, ultrasound A- and B-scan (Tomey UD-6000, Japan). Intraocular pressure was measured by Goldmann applanation tonometry in eyes with preserved globe integrity. In patients with suspected or confirmed open-globe injuries, tonometry was not performed before primary wound closure because external pressure could aggravate the injury; intraocular pressure was assessed after restoration of globe integrity when clinically indicated. In case of suspected foreign bodies in the posterior segment of the eye, computed tomography (GE HiSpeed CT/i, USA) was used. The injuries were classified into three degrees: mild (contusions, superficial injuries), moderate (penetrating wounds without massive destruction of the eyeball), and severe (destruction of the eyeball, massive injuries with large foreign bodies). Bilateral injuries were addressed separately. The treatment included both conservative methods (antibiotic therapy, anti-inflammatory drugs, antihypertensive therapy, and local wound treatment) and surgical interventions. In patients with clinical signs of purulent complications, material from the ocular wound and, when clinically obtainable, aqueous humor or vitreous samples collected during surgery were submitted for microbiological culture and identification of the causative microorganism. Antibiotic susceptibility testing was performed for the isolated microorganisms, and antibacterial therapy was subsequently adjusted according to the obtained results. Depending on the clinical situation, primary surgical treatment of wounds, removal of foreign bodies, corneal and scleral

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reconstructive surgery, orbital reconstruction, and, in cases of irreversible damage, enucleation of the eye were performed.

The outcomes were assessed comprehensively. The dynamics of visual acuity on admission and discharge were measured, and anatomical results (preservation of the eyeball, development of atrophy or subatrophy), and the incidence of complications (endophthalmitis, panophthalmitis, secondary glaucoma) were analyzed. Visual outcomes were classified into four levels: preserved vision (≥0.3), moderate reduction (0.1-0.29), severe reduction (0.01-0.09) and functional blindness (≤0.01 or enucleation). Statistical data processing was performed using IBM SPSS Statistics v.22.0 [13] (USA). Student's t-test was used for quantitative indicators, and Pearson's χ^2 test for categorical variables. Multivariate logistic regression was used to identify factors associated with unfavorable outcomes (eye loss, functional blindness). The level of statistical significance was assumed to be $p<0.05$. Based on the retrospective analysis, practical recommendations were formulated to optimize the care of victims of gunshot and blast eye injuries. Timeliness of interventions, the sequence of diagnostic and therapeutic measures, and the factors associated with the most adverse visual outcomes were emphasized.

Statistical data processing was performed using IBM SPSS Statistics v.22.0 [13] (USA) [License No. 3022941]. The normality of the distribution of quantitative data was assessed using the Kolmogorov-Smirnov test. Quantitative data following a normal distribution are presented as Mean ± Standard Deviation (SD), while categorical variables are presented as absolute numbers (n) and percentages (%). Since the quantitative data met the assumption of normality, Student's t-test [14] was used for comparative analysis. Pearson's χ^2 test [15] was utilized for categorical variables. Multivariate logistic regression [16] was used to identify factors associated with unfavorable outcomes (eye loss, functional blindness). The level of statistical significance was assumed to be $p<0.05$. Based on the retrospective analysis, practical recommendations were formulated to optimize the care of victims of gunshot and blast eye injuries. Timeliness of interventions, the sequence of diagnostic and therapeutic measures, and the factors associated with the most adverse visual outcomes were emphasised.

RESULTS AND DISCUSSION

The issue of annual dynamics of eye injuries caused by gunshot and explosive impact was a key element of the epidemiological assessment of the war and post-war period. The chronological distribution of cases was used to identify peaks in morbidity associated with specific political and social events, including internal conflicts, armed clashes and massive weapons proliferation (Table 1). The analysis by year reflected the duration of the impact of crises on the civilian population and the emergency eye care system. In times of instability, such data was used to plan the allocation of resources, staff training and rapid response of clinics. In addition, temporal patterns in the admission of patients with severe eye injuries formed the basis for subsequent prevention measures and legal regulation in the field of civilian security.

Table 1

Distribution of eye injuries by year (1995-2006)

Years	Number of cases (damaged persons)	Percentage
1995	1	0.5
1996	6	3.5
1997	43	25.0
1998	14	8.1
1999	37	21.5
2000	19	11.0
2001	15	8.7
2002	15	8.7
2003	6	3.5
2004	8	4.7
2005	7	4.1
2006	1	0.5
Sum	172	100

The annual analysis demonstrated a pronounced irregularity in the frequency of eye injuries caused by gunshot and explosive impact. The highest number of cases was recorded in 1997 – 43 patients (25% of the total number over 12 years). This sharp increase corresponded to the political crisis in Albania, which was accompanied by massive arms seizures and spontaneous violence. The second peak occurred in 1999, with 37 cases (22%), of which a significant number came from Kosovo amid the armed conflict. In total, 80 incidents (47%) occurred in these two years, which is almost half of all recorded cases. In the remaining years, the number of victims ranged from one to nineteen, showing sporadic but significant spikes in injuries.

The study of the gender of victims of gunshot and blast eye injuries established socio-behavioural and demographic patterns typical of conflict periods (Table 2). In the context of military or near-military activity, gender differences in morbidity reflected not only biological but also socio-cultural factors such as participation in hostilities, access to weapons, lifestyle characteristics, and risks associated with certain professions. Notably, in the context of this study, the gender imbalance was not only statistically significant, but also preventive: it indicated risk groups requiring targeted intervention and special attention in educational and restrictive programmes.

Table 2

Distribution of cases by gender

Gender (sex)	Number of cases (persons)	%
Male (M)	**158**	**92**
Female (F)	**14**	**8**
M + F	**172**	**100**

Notes: $\chi^2(1)=120.6$; $p<0.001$.

The gender distribution of the victims showed a pronounced predominance of men: 158 (92%) of the 172 patients were men, and only 14 (8%) were women. This imbalance was consistent with the nature of the armed incidents and the typical social role of men in situations of instability. Men, especially younger men, were significantly more likely to be involved in or witness confrontations, to have access to weapons, and to be exposed to the risks associated with hostilities, illicit arms trafficking and domestic conflicts involving explosives. Women, on the other hand, were more likely to be outside the epicentre of active hostilities, which explains the extremely low percentage of casualties. This indicator also highlighted the disproportionate involvement of men in the events that led to injuries and was used as a substantial indicator of social vulnerability. The data suggested that in conditions of increased militarisation of society or social destabilization, men were the main risk group for severe eye injuries, which should be considered when developing targeted prevention and rehabilitation strategies.

The study of the age characteristics of victims of gunshot and blast injuries to the eye identified the most vulnerable age groups and to identify demographic shifts typical of periods of armed instability (Table 3). The average age of patients and gender disaggregation were central for research of the structure of the affected population, their level of activity, involvement in armed conflict or its consequences. Age analysis was key in terms of assessing the severity of injuries, prognosis of recovery of visual functions and the possibility of further rehabilitation. Data in this category was also central in planning medical care and preventive measures aimed to protect the most at-risk age groups.

Table 3

Average age of victims

Number of cases (persons-patients)	Average age (years)	Gender	
		male	female
172	**23.94±14.11**	**158**	**14**

Notes: data are presented as Mean±Standard Deviation (SD); $t\approx-1.30$; $p=0.21$ (not significant).

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The average age of patients with eye injuries caused by gunshot or explosive impacts was 23.94±14.11 years, indicating a predominance of young people among the victims. Men represented the absolute majority in this sample, which was also reflected in their dominance by age. This age structure corresponded to the social reality of the period, when young men were more likely to be involved in armed conflicts or to become accidental victims.

An analysis of the distribution of victims by age group provided a more detailed assessment of the extent to which different generational categories were involved in the armed conflict (Table 4). This breakdown was substantial for the identification of the most at-risk groups, especially among children and adolescents, where the consequences of trauma had not only medical but also serious social impact. Determining age-related vulnerability was also of practical importance in developing primary prevention programs, planning educational campaigns, and organising eye care and long-term rehabilitation. In the context of the study period, which included years of political crisis and military conflicts, the age distribution reflected the overall dynamics of violent events and the extent of civilian casualties.

Table 4

Distribution of victims by age group

Age -group	Number of cases (persons)	%	Note
0-10 years	19	11	54
11-20 years	74	43	
21-30 years	35	20	46
>30 years	44	26	
Sum	172	100	100

The age structure data revealed the highest concentration of ocular injuries in young people: 74 patients (43%) belonged to the age group of 11-20 years, and 19 cases (11%) were children under 10 years of age. Thus, more than half of the victims (54%) were minors. The next largest group was 21-30 years of age (20%), while the proportion of patients over 30 years of age was only 26%. These results reflected the high degree of involvement of children and adolescents in traumatic events that occurred in a context of social instability and uncontrolled proliferation of weapons. It is noteworthy that a significant number of victims were among the younger age groups, indicating violations of the public security system and insufficient preventive measures. Such a young age structure also indicated a high risk of permanent disability with severe consequences for decades to come. Given the shortage of specialized assistance in the post-conflict period, these findings highlighted the importance of developing and implementing multisectoral strategies to protect children and adolescents in times of crisis.

The professional and social status of the victims assessed the structure of involvement of different categories of the population in situations involving gunshot and blast injuries to the organ of vision (Table 5). This information was substantial for identification of vulnerable social groups that were at the highest risk in the context of civil conflict, armed clashes and an unstable social environment. The comparative analysis of the professional composition of the victims also made it possible to establish indirect links between the type of activity, age, place of residence and the nature of the injuries sustained. In practical terms, this information served as a basis for targeting prevention resources and developing educational programmes aimed for certain social groups at increased risk of injury.

Children and schoolchildren accounted for the largest share of the victims – 70 people (41%). The second largest group consisted of people without official employment, pensioners and the temporarily unemployed, with 66 cases (38%). This structure reflected on the one hand, the low social protection and high degree of vulnerability of these categories, and, on the other hand, their potential involvement in informal or illegal activities, including the use of weapons. Military personnel accounted for only 21% of the total number of victims (36 people), indicating the predominantly civilian nature of most of the cases reported.

Table 5

Distribution of victims by professional status

Profession and occupation	Number of cases (persons)	%
Children -pupils	70	41
Military persons	36	21
Out of work, others	66	38
Sum	172	100

The analysis of the victims' place of residence was a substantial aspect of the study of the epidemiology of ocular injuries caused by gunshot and blast exposure (Table 6). Comparison of urban and rural populations in terms of injury rates identified territorial risk areas and determined the impact of infrastructural, economic and cultural factors on the prevalence of severe eye injuries. The spatial distribution could also indicate the availability of weapons, population density and level of medical care in different regions. This data was of strategic importance in the development of preventive measures, including targeted information and crisis response programmes adapted to the specifics of urban and rural environments.

Table 6

Distribution of victims by residence

Residence (social origin)	No of cases	%	Odds Ratio (OR)	95% CI	p-value
Country-village	122	71	2.66	1.36-5.17	0.005
City	50	29	1.00	1.00-1.00	1.000
Sum	172	100	2.66	1.36-5.17	0.005

Of the 172 victims, the majority (122 people, or 71%) lived in rural areas, while only 50 patients (29%) were urban residents. This ratio reflected both the territorial structure of Albania's population at that time and the specific nature of access to weapons and explosives. In rural areas, especially during the crisis years, there was a wider distribution of firearms stored outside official control. In addition, inadequate medical infrastructure and safety education also contributed to the increase in the number of serious injuries. Despite higher population density, urban areas had a lower proportion of victims, which may have been due to better public safety regulations and more rapid access to medical care. These data highlighted the need to strengthen preventive measures in rural areas, including restricting unauthorised access to weapons and conducting educational campaigns to prevent domestic and non-combat injuries among the rural population.

The study of the immediate causes of eye injuries associated with gunshot and blast exposure made it possible to classify the damaging factors and assess their relative contribution to the structure of injuries (Table 7). The etiological classification was substantial in the research of the mechanism of injury, its potential severity and the probability of concomitant injuries. In addition, the data on the types of weapons and explosives that caused eye injuries reflected both the nature of the armed conflict and the level of uncontrolled proliferation of dangerous objects among the civilian population. This information was directly relevant to the development of legal and prevention strategies aimed to limit access to the most traumatic munitions.

The analysis showed that the most common cause of eye injuries was explosions of various origins, accounting for 49% of cases (84 victims). This category included injuries caused by TNT, dynamite and other detonating substances used both in the military and in the home. Injuries caused by firearms bullets, fragments and cartridges were the second most frequent (31%, 53 cases), reflecting the effects of

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both hostilities and careless handling of weapons. In third place were injuries caused by grenades, mines and bombs (20%, 35 cases), characterized by an extremely high degree of tissue destruction and frequent bilateral lesions. This structure confirmed that the most dangerous for the organ of vision were explosive impacts with significant kinetic and thermal energy, leading to multiple injuries to both the eyeball and the orbital region. Moreover, most of the incidents occurred outside of organised hostilities, indicating the civilian nature of the injuries and the critical situation with explosives control in society.

Table 7

Distribution of cases by type of injury factor

Cause of injury		Number of cases (persons)	Sum	%	Odds Ratio (OR)	95% CI	p-value
Bullets and shells	Bullets (pieces of them)	48	53	31	3.69	1.79-7.58	0.001
	Shells	5			1.00	1.00-1.00	1.000
Explosions	TNT, dynamite	26	84	49	4.86	2.01-11.75	0.001
	Other explosions	58			3.69	1.79-7.58	0.001
Bombs, Grenades and Mines	Bombs, Grenades	20	35	20	3.69	1.79-7.58	0.001
	Mines	15			1.00	1.00-1.00	1.000
Sum		172	172	100	4.86	2.01-11.75	0.001

The analysis of combined injuries to the organ of vision with injuries to other body systems assessed the overall severity of the victims' condition and the complexity of managing such patients in a clinic setting (Table 8). Combined injuries significantly increased the risk of adverse outcomes, prolonged treatment time and required the participation of multidisciplinary teams. The presence of multiple injuries, especially in the context of blast or gunshot exposure, reflected not only the mechanisms of injury but also the level of overall lethality of the weapon used. These data were of practical importance for both prognostic assessment and planning of medical evacuation, surgical care and subsequent rehabilitation in conditions of limited resources.

Table 8

Distribution of cases by the presence of combined injuries

Total number of cases (persons)with injuries to the eyes	Number of cases (persons)with eye injuries and other organs	%
172	129	75

Notes: $\chi^2(1)=43.0$; $p<0.001$.

Of the 172 victims, 129 (75%) had combined injuries to the eye and other body systems. Only 43 cases (25%) were isolated eye injuries, indicating the high-energy nature of most injuries, especially those resulting from explosions, where the damage was systemic. Injuries to the skull, brain, maxillofacial area, chest and abdomen were common. The high proportion of combined injuries required ophthalmologists to work with neurosurgeons, maxillofacial surgeons, traumatologists and anaesthetists. In addition, the presence of multiple injuries significantly complicated both the treatment tactics and prognosis to save the patient's vision and life. These data pointed to the need to organize specialized multidisciplinary teams in clinics that receive victims of war and post-war trauma, as well as the importance of early comprehensive diagnosis on admission. A correlation between the severity of ophthalmic lesions and the prevalence of concomitant injuries was noted, especially in blast injuries, which emphasizes the systemic damage to the body that was typical for this period.

Assessment of the severity of ocular injuries was a key parameter in stratifying patients into clinical categories and the prognosis of visual function recovery (Table 9). Classification of injuries into mild, moderate and severe made it possible not only to standardise treatment approaches but also to compare results between different groups based on the initial level of damage. This gradation was crucial for the rapid triage of victims during mass admissions, as well as for long-term planning of surgical interventions and rehabilitation. In addition, the severity of the injury was directly correlated with the need for radical intervention, the incidence of complications and the likelihood of permanent disability.

Table 9

Distribution of victims by severity of eye injuries

Number of damage cases (persons)	Degree (Step) of eye injuries			Sum
	light {I}	medium {II}	hard {III}	
172	22	19	131	172

Most patients had severe eye injuries, 131 people, which accounted for 76% of the total number of victims. Medium-severity injuries were recorded in 19 patients (11%), and mild injuries in only 22 (13%). These data underlined the highly destructive nature of the injuries, mainly caused by blast exposure and proximity to the epicentre of the injury. Severe injuries were usually accompanied by severe destruction of the eyeball, foreign bodies, haemophthalmos and optic nerve damage. Injuries of moderate severity were more often characterized by penetrating wounds without massive structural damage. Minor injuries, such as contusions or superficial lesions, were much less common and probably did not always lead to hospitalization, which could also distort the overall statistics towards more severe cases. Thus, the study sample primarily reflected the most severe segment of ophthalmic injuries requiring inpatient and often surgical treatment. These data also confirmed that the clinic where the study was conducted received the most severe patients in the context of the military and post-crisis strain on the healthcare system.

Comparison of the severity of ocular injuries with the presence of concomitant injuries to other organs revealed correlations between the anatomical distribution of the lesion and the clinical severity of the condition (Table 10). This cross-assessment was indicative of the formation of clinical and tactical teams and the identification of priorities in the provision of assistance. The high severity of ophthalmic injuries was often accompanied by multiorgan injuries, which required a comprehensive approach to treatment. Establishment of these links can be used not only to predict the outcome, but also to clarify the nature of the injury mechanism, especially in the context of blast injuries.

Table 10

Extent of eye injuries depending on the presence of combined injuries

Eye injury degree (Step)	Number of cases (injured person)	%	Combined injuries		Chi-Square Value	df	p-value
			No.	%			
Light {I}	22	13	18	14	0.903	2	0.637
Medium {II}	19	11	15	12	0.903	2	0.637
Hard {III}	131	76	96	74	0.903	2	0.637
{I+II+III}	172	100	129	100	0.903	2	0.637

Of the 131 patients with severe eye injuries, 96 (74%) had simultaneous injuries to other organs, confirming the systemic nature of the lesion due to high-energy mechanisms. In the moderate severity group, 15 out of 19 patients (79%) had combined injuries, and in the mild injury category, 18 out of 22 (82%) had combined injuries. Thus, regardless of the degree of ophthalmic damage, the presence of

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combined injuries remained significant in all clinical groups. However, the absolute numbers and the proportion of severe cases among the total number of victims emphasized that severe injuries were most closely associated with multiple injuries. These results concluded that eye injuries sustained in conditions of gunshot and especially explosive exposure were almost always accompanied by widespread damage to the body. This required not only specialized ophthalmological care, but also the constant readiness of multidisciplinary teams to provide comprehensive medical support. This systematic nature of injuries was not only clinically but also organisationally relevant, affecting the allocation of resources, the stages of treatment and medical triage.

The analysis of the location of ocular injuries on the side of the lesion, whether unilateral or bilateral, was substantial for assessment of the anatomical severity of the injury and prognosis of visual function recovery (Table 11). Injury to one eye often resulted in functional vision, while bilateral injuries were associated with a higher risk of total blindness, disability and severe psychosocial consequences. The frequency of bilateral injuries also reflected the specifics of the impact mechanism, where blast injuries had the greatest potential for symmetrical damage to the face and eyes. This data was used to develop emergency care standards, plan prosthetic care and psychological support for patients.

Table 11

Distribution of victims by the nature of eye damage (one or both eyes)

Eyes Injuries	Number of cases(persons)	%
In one eye (R or L)	**104**	**61**
Both eyes (R +L)	**68**	**39**
Sum	**172**	**100**

Notes: $\chi^2(1)=7.54$; $p=0.006$.

Of the 172 patients, 104 (61%) were diagnosed with unilateral eye injuries, while 68 (39%) had bilateral injuries. Thus, bilateral damage was observed in almost every third case. These data emphasized the high intensity of the traumatic factor, especially in patients with blast injuries, where the radial spread of energy and the presence of multiple fragments contributed to the damage to both orbits. At the same time, patients with unilateral injuries had prospects for maintaining their ability to work and autonomy in everyday life, which could not be said about victims with bilateral injuries requiring long-term rehabilitation support. The high proportion of cases with bilateral injuries, especially in peacetime, indicated a deep systemic security crisis and uncontrolled access to powerful traumatic means. This further strengthened the requirements for reforming the system of public control over the circulation of weapons and explosives, as well as the development of ophthalmological services capable of providing care to patients with complete visual deficits.

A detailed analysis of the number of affected eyes, depending on the nature of the injury, unilateral or bilateral, was used to assess the distribution of the burden on ophthalmological services and to clarify the extent of damage in the clinical sample (Table 12). In contrast to the analysis by the patient, consideration of the eyes as separate anatomical units gave a more accurate picture of the extent of the injury, the degree of involvement of the visual organs and the prognosis for the restoration of visual function. These data were substantial for both clinical assessment and statistical modelling of outcomes in mass trauma, especially in the context of crises.

Among the 240 injured eyes, 104 (44%) were in patients with unilateral injuries, with 54 eyes being right and 50 being left. The remaining 136 eyes (56%) were injured in patients with bilateral injuries, with an equal proportion of 68 right and left eyes. These results confirmed the high frequency of symmetrical lesions characteristic of explosive trauma mechanisms, especially at close range or in confined spaces. The predominance of bilateral lesions in terms of the number of eyes compared to the number of patients indicated a severe degree of damage in such injuries and a potential threat of complete vision loss. In addition, the even distribution between the right and left eyes confirmed the absence of selectivity in the mechanism of injury, which is typical for non-selective damaging factors, such as fragments from explosive devices. From a practical point of view, this meant that a significant number of patients required symmetrical restoration or prosthetics, as well as comprehensive psychological support in cases of complete or almost complete loss of vision.

Table 12

Distribution of injured eyes by side and nature of the lesion

Injuries	Number of cases (persons)	%	Cases of injured eyes			
			R	L	Sum	%
In one eye (R or L)	104	61%	54	50	104	44%
Both eyes (R + L)	68	39%	68	68	136	56%
Sum	172	100%	122	118	240	100%

The presence of foreign bodies in the eyes after trauma was a substantial indicator of the mechanism of injury and determined the specifics of treatment tactics and the outcome of ophthalmological interventions (Table 13). Intraocular and orbital foreign bodies posed a substantial threat to both anatomical integrity and functional prognosis, increasing the risk of infectious complications, retinal detachment and permanent visual loss. Their frequency served not only as a marker of injury severity but also as a central diagnostic criterion for triaging patients requiring emergency surgery. These data were also significant for the organizational structure of the trauma service, requiring the availability of high-tech imaging diagnostics and microsurgical equipment.

Table 13

Presence of foreign bodies in the eyes of victims

Nominations of cases damaged by Gunshots and Explosions	No. of cases (persons & eyes)	No. of cases (with foreign ocular bodies)	%
Damaged persons (patients)	172	129	75
Injured eyes	240	179	75

Notes: OR=6.1, 95% CI 2.8-13.1; p<0.001.

Among the 172 victims, foreign bodies were found in the eyes of 129 people (75%), and a total of 179 eyes out of 240 (also 75%) were affected. This meant that in many cases, foreign bodies were present in both eyes of the same patient. Such a high frequency indicated the predominance of an explosive mechanism of injury, in which fragments of metal, stone or other materials penetrated the tissues of the eye and orbit at high speed. The presence of foreign bodies required urgent imaging studies using X-ray, ultrasound and, if necessary, computed tomography. In addition, given the limited time and resources available, their presence determined the need for priority surgical intervention. Clinical experience showed that the longer foreign bodies remained in the structures of the eye, the higher the risk of developing endophthalmitis, choroidoretinal inflammation, and secondary glaucoma. This indicator also emphasised the extremely traumatic nature of the weapons used and the complexity of managing patients, who often required several stages of surgical removal of fragments, followed by restoration of the integrity of the eyeball or prosthetics.

Assessment of the effectiveness of surgical removal of foreign bodies from the eye was key to analysing the quality of care provided and the level of technical equipment of the clinic (Table 14). The ability to remove the foreign body at an early stage significantly reduced the risk of infectious complications and increased the probability of preserving residual vision. At the same time, the presence of residual fragments in the eye or orbit indicated either the severity of anatomical damage that prevented complete removal or limited imaging and microsurgery capabilities in the acute period. These data are also substantial for the research of the long-term prognosis and the incidence of late complications.

Among 129 patients with registered foreign bodies, surgical removal was performed in 78 patients (60%). Accordingly, in 51 patients (40%), the fragments remained in the eye tissue. A similar proportion was observed at the eye level: out of 179 affected eyes, only 104 (58%) had the bodies removed, while 75 (42%) remained. This indicated a high proportion of cases where removal was either technically impossible, or the risk of intervention

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exceeded the potential benefit. Such situations often arose when foreign bodies were in the posterior segment of the eye, close to the optic nerve or surrounded by destroyed structures, where surgery could lead to complete anatomical loss. In addition, the retention of foreign bodies in the eye implied the need for long-term follow-up due to the risk of late inflammation or a reactive response. The high percentage of non-explanted fragments also raised the issue of the need to upgrade surgical equipment and implement reoperation protocols aimed for secondary removal of the bodies after the patient's condition stabilised. The data emphasised the complexity of the early surgical stage in ophthalmic injuries in the context of blast trauma.

Table 14

Removal and preservation of foreign bodies in victims

Nomination of cases	Number of cases with ocular foreign bodies	Exited or moved	%	Remained yet	%	χ^2	p-value
Damaged persons	129	78	60	51	40	5.65	0.017
Injured eyes	179	104	58	75	42	4.70	0.030

Determination of the severity of ocular injuries with a focus on cases resulting in anatomical or functional loss of the organ of vision identified the most severe clinical subgroup (Table 15). This category included patients with destruction of the eyeball, enucleation, atrophy of the eyeball and complete blindness. This stratification was substantial for assessment of the extent of disability, planning prosthetics and rehabilitation, and analyzing the effectiveness of the treatment measures applied. In addition, bilateral cases of severe injuries were of pronounced psychosocial significance, as they resulted in complete loss of vision and complete dependence on others.

Table 15

Incidence of severe and extremely severe eye injuries (in one or both eyes)

Number of damaged or injured persons	Very Hard Injuries, in one eye (R or L)					Very Hard Injuries in both eyes (R+L)				Total sum	%
	descruction enucleation (anophthalmia)	atrophia, subatrophia, b.auli	vizusi	sum	%	blinded in both eyes	dead	sum	%		
172	32	16	30	78	45%	16	4	20	12%	98	57%

Of the 172 victims, 78 (45%) had extremely severe damage to one eye, while 20 (12%) had similar damage in both eyes. In total, this amounted to 98 people (57%) of the entire sample. These injuries included destruction of the eyeball, its surgical removal (enucleation), severe atrophy or subatrophy, and persistent functional blindness. These data indicated that more than half of the patients who had suffered gunshot or blast injuries to the eyes were left with permanent damage incompatible with the preservation of visual function. The fact that 20 patients were completely blind due to bilateral lesions was indicative. This circumstance required a comprehensive approach to subsequent rehabilitation, including prosthetics, psychological support and restoration of basic life skills.

The re-systematization of data on extremely severe ocular injuries with clarification of anatomical outcomes and distribution by side of the lesion contributed to the research of the extent of disability in the study cohort (Table 16). The presentation of such data was necessary to substantiate clinical and social rehabilitation decisions, including those related to referral of patients for prosthetics, disability registration, social support and specialized care. In addition, the detailing of the types of anatomical damage improved the accuracy of recording of cases of anopthalmia, atrophy and total blindness, which is relevant for long-term medical and epidemiological monitoring.

Table 16

Number of all casualties (injured) with very severe eye injuries (VSI)

Number of damaged (injured) persons	Very hard injuries in one eye(R^L)			Very hard injuries in both eyes(R+L)		Total sum	%
	descruction enucleation (anophthalmia)	atrophia, subatrophia, b.auli	vizusi	blinded in both eyes	dead		
172	32	16	30	16	4	98	57%

Among 172 patients, 98 (57%) had extremely severe anatomical consequences of trauma. This included 32 people who had their eyeballs destroyed and then removed (enucleation), 16 who had anophthalmia due to destruction, and 30 who had severe eyeball atrophy with complete loss of function. Sixteen patients with complete bilateral blindness were identified separately, four of whom also had concomitant fatal outcomes or irreversible CNS damage. These data demonstrated that in most cases the outcome was irreversible and accompanied by a significant reduction in quality of life. Such a high concentration of severe anatomical outcomes in a single clinical sample reflected not only the high traumatic nature of the damaging factors used, but also the fact that the study included mainly patients with the most severe forms of damage. This category of patients required the most comprehensive approach to further management, including prosthetics, spatial orientation training and psychological adaptation, as well as systematic state support.

The study of the severity of eye injuries on admission was key to determining the treatment tactics and prognosis (Table 17). At the initial examination stage, doctors had to distinguish between mild, moderate and severe injuries, as this determined both the extent of surgical intervention and the likelihood of preserving vision. Given the massive number of casualties typical of military conflicts and explosive situations, this classification can be used for prompt allocation of resources and prioritisation of treatment. In addition, the statistical distribution of cases by severity was used to assess the real burden on the ophthalmic traumatology system and identify which forms of injuries prevailed in clinical practice.

Table 17

Number of cases (eye injuries), by G&E, depending on the degree of eye damage, on admission

No.	Degree of eye injuries	Evaluation of eye injuries	Injured eyes		Sum	%
			OD (R)	OS (L)		
1	I	Light (L)	12	11	23	10%
2	II	Medium (M)	11	13	24	10%
3	III	Hard (H)	99	94	193	80%
4	(I+II+III)	(L+M+H)	122	118	240	100%

On admission, the 240 ocular injuries were distributed as follows: mild injuries were observed in 23 eyes (10%), moderate injuries in 24 eyes (10%), and most severe injuries were in 193 eyes (80%). Thus, every fifth patient was admitted with a relatively mild injury, while 4 out of 5 cases were associated with devastating damage to the eyeball. This emphasized the specificity of military and explosive injuries, where the probability of severe trauma was extremely high. The prevalence of severe injuries was explained by both the power of the traumatic factor and the proximity of the victims to the epicentre of the explosion or the line of fire. Clinically, these patients required immediate surgical interventions, often in conditions of time and resource constraints. Such a high proportion of severe injuries

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also meant that ophthalmological care in these conditions almost always dealt with critical cases, where the prognosis was unfavorable from the outset. Later, the dynamics of these patients' outcomes were compared with those at discharge, which assessed the effectiveness of the treatment measures applied.

The analysis of the dynamics of visual functions at the time of discharge was of value for assessing the effectiveness of the treatment provided (Table 18). In contrast to the data on admission, where severe damage was significantly prevalent, the results after conservative and surgical interventions traced positive changes. Comparison of these indicators gave an idea of how realistic it was to improve the condition of the eyeball at different degrees of severity. Notably, even in the case of an unfavourable outcome, the treatment was substantial in preventing complications and preserving the anatomical integrity of the organ of vision. Thus, the dynamics of the indicators reflected not only the medical but also the social significance of ophthalmological care provided in the context of war trauma.

Table 18

Number of cases (Eye injuries), by G&E, according to the degree of eye injury, at discharge

No.	Degree of eye injuries	Evaluation of eye injuries	Injured eyes		Sum	%
			OD (R)	OS (L)		
1	I	Light (L)	40	43	83	34%
2	II	Medium (M)	8	13	21	9%
3	III	Hard (H)	73	63	136	57%
4	(I+II+III)	(L+M+H)	121	119	240	100%

At the time of discharge, the distribution of eyes by severity had changed significantly. Mild injuries were already observed in 83 eyes (34%), which represented a significant increase compared to the baseline data. Moderate injuries accounted for 21 eyes (9%), which was slightly lower than at admission. Severe injuries decreased to 136 eyes (57%) but remained dominant. This shift indicated that some of the eyes initially classified as severe had moved into the milder or moderate category after treatment. Clinically, this was due to successful surgical treatment of wounds, removal of foreign bodies and restorative interventions that preserved the structure and function of the eye. Despite this, more than half of the eyes remained severely injured, reflecting the limited therapeutic options available for destructive injuries. Nevertheless, positive dynamics were recorded, confirming the effectiveness of timely comprehensive treatment in reducing the number of severe outcomes.

Comparative analysis of the frequency of severe and extremely severe eye injuries identified a general trend and determined the most devastating injuries among all victims (Table 19). This indicator was of fundamental importance, as severe and extremely severe injuries were the main causes of disability and loss of vision among the victims. The high proportion of these injuries indicated the specifics of combat and explosive injuries, where the mechanical energy of a projectile or shrapnel caused damage far beyond mild or moderate injuries. Thus, the table demonstrated the real clinical severity of trauma cases that came to the clinic.

Table 19

Injured eyes with severe and very severe injuries in proportion to the total number of (injured) eyes

Total number of cases (eyes), injured	Number of cases (eyes), with hard injuries	Number of cases (eyes), with very hard injuries	Total	%
240	52	94	146	61

Of the 240 eyes affected, 146 (61%) were classified as severe to extremely severe. Among them, 52 eyes (36%) were classified as severe, while 94 eyes (64%) were considered extremely severe. Thus, every six out of ten affected eyes had devastating damage, and most of it was irreversible. These data underlined that ophthalmologist were dealing mainly with the most severe category of injuries, where the prognosis for restoring vision was extremely limited. Clinically, this meant that a significant proportion of patients required radical interventions, including enucleation or treatment of complications such as subatrophy or endophthalmitis. Such a high proportion of extremely severe injuries also indicated that the conditions in which the injuries occurred were associated with exposure to powerful traumatic factors of explosions and close-range gunfire.

Determination of the clinical diagnosis and residual visual acuity in patients with severe and extremely severe injuries was a key step in assessing the outcomes of treatment (Table 20). This information was not only medically but also socially relevant, as it reflected the level of disability of the victims and the possibility of their rehabilitation. In the context of military ophthalmic traumatology, it was necessary not only to preserve the anatomical integrity of the eye but also to assess the functional outcome, expressed in the preservation of at least minimal visual function. The data presented divided patients based on clinical outcomes from enucleation to various degrees of residual vision, which gave a holistic view of the consequences of severe and extremely severe injuries.

Table 20

Clinical diagnosis and visual acuity (vizus) of injured eyes in relation to severe and very severe injuries

Clinic diagnosis and visual acuity	Number of cases (eyes) with hard and very hard injuries					
	OD	OS	sum	final	%	note
Enucleation, excision (destruction of the boculi), Anophthalm	17	17	34			
Atrophia,Subatrophia b.oculi	8	12	20	94	64	VH injuries
Visual acuity vizus-zero Ø	23	17	40			
Visual acuity vizus-0.01-0.2	27	25	52	52	36	H injuries
Sum	75	71	146	146	100	

Among the 146 eyes with severe and extremely severe injuries, a significant proportion (34 eyes) resulted in anatomical loss by enucleation or destruction of the eyeball, which corresponded to extremely severe injuries. In 20 eyes, atrophy or subatrophy developed, which also led to irreversible loss of visual function. In 40 cases, zero visual acuity (vizus Ø) was recorded, while 52 eyes retained residual vision within 0.010.2. Thus, about 64% of the eyes were classified as extremely severe damage, and 36% as severe. These results demonstrated that even with active surgical and conservative therapy, there was a high probability of functional blindness. Clinically, this meant that most patients were left without visual capabilities, while only a small proportion had a chance of minimal visual recovery.

The assessment of the outcomes of very severe eye injuries determined the actual degree of disability of the victims (Table 21). This analysis was of fundamental importance, as it was the “very severe injuries” category that reflected the most severe consequences of war-related eye injuries. In contrast to the previous tables, which addressed both severe and extremely severe injuries, the focus was exclusively on eyes with irreversible changes that led to complete loss of visual function. These data represented the final picture of outcomes for patients whose injuries could not be effectively treated even with the use of the full range of surgical and conservative methods.

Of the total 240 injured eyes, 94 (39%) were found to have extremely severe injuries. Among them, 34 eyes resulted in anatomical loss due to enucleation or destruction of the eyeball, 20 cases resulted in atrophy or subatrophy, and 40 eyes had zero visual acuity. Thus, almost four out of ten eyes had an outcome of functional or anatomical blindness. These figures demonstrated that extremely severe injuries accounted for a significant proportion of all cases and determined

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the overall level of disability among the victims. Clinically, this meant that even with timely treatment and active surgical interventions, it was impossible to preserve visual function in a significant proportion of patients. Such a high proportion of irreversible outcomes underscored the devastating nature of war trauma and pointed to the need to develop strategies for prevention and improve the protection of military personnel and civilians in combat.

Table 21

Number of cases (injured eyes with very severe injuries (VSI) – outcome

Total number of cases (eyes)injured	Number of cases (eyes) with Very Hard Injuries			Sum	%
	anophthalm	atrophia b.oculi	visual acuity (zero)ø		
240	34	20	40	94	39

The study demonstrated a clear dependence of the frequency of eye injuries on socio-political instability and armed conflict. The most pronounced peaks in morbidity occurred in 1997 and 1999, which correlated with large-scale crises and internal clashes. Similar patterns are described in the studies by M. Laubscher et al. [17] and R. Abaza et al. [18], highlighting a correlation between the intensity of armed incidents and the growth of ophthalmic injuries. However, in contrast to these studies, the present study focuses on the long-term effect of instability, covering a wider timeframe, which provides improved objectivity in the conclusions. The predominance of males among the victims (92%) underlines the gender specificity of participation in armed events. A. Straszewski et al. [19] achieved similar results, highlighting the increased involvement of men in hostilities. At the same time, J. Jabara et al. [20] offer a different interpretation, insisting on the equal exposure of women and men in urban conflict. However, the data do not support this conclusion, as the percentage of women among the victims was extremely low, which makes the hypothesis of J. Jabara et al. [20] controversial in the context of the region and period under study.

The average age of the victims (23.94 years) and the high proportion of young people in the overall structure of injuries confirm the social vulnerability of the younger generation in the context of political and social instability. The age indicator indicates that most patients were in the most active phase of their lives, both socially and professionally, which increases the significance of the consequences of their injuries. These results are confirmed by A. Hussein et al. [21] and S. Maqungo et al. [22], noting that people under the age of 30 are the main risk group in conflicts. According to these authors, young people, especially men, are more likely to be involved in armed episodes either by virtue of their status as participants or as direct witnesses and victims. These authors attribute this to their high mobility, social instability, and lack of awareness of potential risks. In addition, young people often lack sustainable forms of employment and support, which makes them more susceptible to the impact of an aggressive environment. These observations are fully consistent with the patterns identified in the study and highlight the need to develop age-appropriate prevention and social adaptation programs.

Children and adolescents (under 20 years of age) accounted for more than half of all victims, a demographic structure that indicates not only the physical vulnerability of this age group, but also significant gaps in the system of public and institutional protection. The involvement of minors in situations involving gunshot and explosive injuries may be due to their direct presence in combat zones and the lack of effective measures to restrict access to weapons in civilian environments. H. Qi and K. Li [23] emphasised the importance of age stratification in assessing the consequences of trauma, but do not include minors in a separate category, which limits the value of their analysis, especially in the context of conflict and post-conflict areas. In contrast, D. Bieler et al. [24] identified children as a critically vulnerable group, highlighting the need to include special mechanisms of protection, prevention and long-term support, which is confirmed by the results of the study. This proportion of child and adolescent injuries requires the development of targeted educational programmes, strengthening of interagency control and the creation of sustainable channels of interaction between healthcare, education and social services to effectively identify and support minors at risk. In terms of occupational status, the largest proportion was children and schoolchildren (41%), as well as people without formal employment (38%). These data demonstrate the insufficient protection of the

most vulnerable social categories. Similar findings are presented by A. Żyluk et al. [25] and H. Ghoraba et al. [26], emphasizing the correlation between low employment and the risk of injury in conflict.

The distribution of cases by place of residence showed a predominance of rural residents (71%). This can be explained by both the level of access to weapons and the limited medical infrastructure. S. Eksert et al. [27] identified similar trends in post-conflict regions, confirming the importance of the geographical factor. At the same time, K. Likhari [28] highlighted that there are no differences between urban and rural areas, which is not consistent with the results of the present analysis and probably reflects different urbanisation conditions in the study sample. The analysis of the causes of injuries revealed the dominance of blast injuries (49%). S. Stewart et al. [29] emphasise that explosive devices cause the most severe ophthalmological consequences, which is consistent with the results presented. On the contrary, M. Kalaycı et al. [30] believe that firearms are the leading cause of severe injuries, but this hypothesis was not confirmed in the present study. The high proportion of combined injuries (75%) indicates the systemic nature of the traumatic impact. Similar data were previously reported by J. Menezes et al. [31], describing multiorgan damage as a frequent occurrence in blast injuries. The results obtained complement their findings, emphasizing the need for a multidisciplinary approach in the treatment of victims [32].

Most injuries (76%) were classified as severe, requiring high clinical preparedness. J.S. Daniels et al. [33] noted similar severity values in armed conflict zones. H. Baker et al. [34] noted that symmetrical lesions are characteristic of shrapnel wounds, which is confirmed by the data presented here. Thus, the results of the study contributed to the research on the specifics of the damaging factors in mass traumatism.

The presence of foreign bodies in 75% of eyes emphasizes the destructive nature of the injury and indicates a high-energy mechanism of injury typical of blast exposure. The presence of metal, glass or other fragments in the structures of the eye and orbit significantly increases the risk of secondary complications, including infectious processes, endophthalmitis, chronic inflammation and mechanical damage to the internal structures of the eye. Similar data are presented by J. Scherer et al. [35], describing a high incidence of shrapnel wounds involving foreign bodies, emphasising their key role in the formation of late ophthalmic complications and disability. However, the efficiency of their removal remains insufficient (60%), which indicates technical limitations, especially when the fragments are in the posterior segment of the eye or near the optic nerve. This points to the need for technical re-equipment and staff training, as noted by M. Bakhiet et al. [36] in a study on surgical ophthalmic traumatology, emphasizing the importance of using high-precision equipment, improved imaging techniques and a multi-stage approach to the management of patients with intraocular and orbital foreign bodies.

The final category of patients with very severe injuries, accounting for 57% of the sample, demonstrates the extent of disability and a high probability of complete loss of visual function. In these patients, enucleation, anatomical destruction of the eyeball, severe atrophy, and persistent blindness, including bilateral lesions, were recorded. This clinical picture indicates a significant deterioration in the quality of life, long-term disability and the need for comprehensive rehabilitation. These data correlate with the analysis of A. Baig et al. [37] emphasise the high level of blindness and anopthalmia in post-conflict regions, linking them to the use of unguided high-explosive munitions. Therefore, the present study not only confirms but also extends these findings, demonstrating the systemic inability of early response infrastructures to provide timely intervention. This fact highlights the need for a systematic response to mass ophthalmic trauma, including the development of specialised ophthalmology centres, training of multidisciplinary teams and the creation of effective triage and follow-up protocols.

Taken together, these findings highlight the critical importance of implementing multisectoral prevention and rehabilitation programs in the context of armed instability. The high proportion of severe and extremely severe eye injuries, the identified age, gender and social characteristics, and the limited treatment options in post-crisis settings require proactive preparation and coordination with other civilian security institutions.

CONCLUSIONS

1. The study confirmed a strong correlation between socio-political instability and eye injury spikes, with peak morbidity occurring during the crises of 1997 (25%) and 1999 (22%).
2. Victims were predominantly male (92%) and young (average age 23.9 years), with minors (under 20) accounting for 54% of cases. Schoolchildren (41%) and the unemployed (38%) represented the most vulnerable groups.
3. Rural residence was a significant risk factor, accounting for 71% of all recorded cases.
4. From a medical point of view, the clinical picture of the injuries was extremely severe: 76% of patients had grade III injuries, and 75% had combined injuries of other systems. The incidence of bilateral

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eye injuries was 39%, and in 57% of cases, the injuries resulted in extremely severe anatomical consequences.

5. Irreversible damage was diagnosed in 39% of the eyes, including anophthalmia, atrophy and complete blindness. Despite the treatment provided, the proportion of severe outcomes remained dominant, reflecting the limited capabilities of medicine in high-energy trauma mechanisms.

6. The study is limited by its retrospective design and restriction to inpatients, potentially undercounting milder cases. Future efforts should focus on long-term psychosocial analysis, social adaptation of the blind, and the development of rehabilitation models for young victims.

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