DOI: https://doi.org/10.17816/OV634582

Orbital injuries: aspects of forensic medical examination in assessing the severity of harm caused to human health

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ABSTRACT

BACKGROUND: Forensic examination plays a key role in establishing the severity of injuries, especially of orbital trauma, which can lead to serious consequences, including vision loss. Examination of forensic reports associated with orbital trauma provides valuable information about the nature of the injuries, their prevalence, and factors influencing the severity of the injury.

AIM: Analysis of the possibilities of an interdisciplinary approach based on the presence of a full ophthalmological status and computed tomography data of the skull in conducting a forensic medical examination of living persons and in the final qualification of the degree of harm to health in orbital injuries.

MATERIALS AND METHODS: An analysis of 37 completed forensic medical examinations of living persons with orbital injuries who were treated in multidisciplinary hospitals in Moscow was carried out. The forensic medical examination was carried out in the Bureau of Forensic Medical Examination of the Moscow Health Department. In 23 cases, the ophthalmological status was assessed at periods from 1 week to 6 months after the injury. In all cases (n = 37; 100%), computed tomography of the facial and cerebral skull was performed. The age of the victims at the time of injury ranged from 12 to 82 years (average 39.7 ± 9.2 years). There were 29 adults among the victims (78.3%), 8 children (21.6%). In terms of gender distribution, there was a significant male predominance — 27 men (73%) versus 10 women (27%).

RESULTS: According to the results of the analysis of forensic medical reports, polytrauma with the simultaneous presence of several severe injuries to various organs and systems, combined with orbital trauma, was recorded in 12 victims (32.4%). A combination of traumatic brain injury and orbital injury without involvement of other organs and systems was detected in 9 victims (24.3%), isolated orbital trauma — in 13 people (35.1%), isolated injury of two orbits simultaneously — in 3 victims (8.1%). From the conclusions of forensic experts, it follows that in 89% of cases, the bone walls of the orbits, formed by the frontal, ethmoid and sphenoid bones, as well as the upper jaw, were damaged, which could subsequently lead to damage to the globe, optic nerve and other orbital structures. Damage to the soft tissue of the orbits with globe contusion was noted in 11% of cases. In 3 cases (n = 3; 8.1%), moderate harm to health was determined based on significant persistent loss of general ability to work. In 14 cases (n = 14; 37.8%), it was not possible to focus on the acuteness of the injured globe before the traumatic episode, due to the fact that the victims had no documented visits to an ophthalmologist before the injury.

CONCLUSIONS: To objectively assess of the orbital trauma and determine the degree of harm to human health, it is necessary to have a full ophthalmological status, including such clinical and instrumental criteria as visual acuteness, presence or absence of ophthalmoplegia and globe dystopia, as well as computed tomography data of the skull, which must be presented in the primary medical documentation.

Keywords: fractures of the orbital walls; forensic medical examination; skull bones; traumatic brain injury; forensic medical examination of living persons.

To cite this article
Medvedeva NA, Serova NS, Pavlova OYu, Davydov DV. Orbital injuries: aspects of forensic medical examination in assessing the severity of harm caused to human health. *Ophthalmology Reports*. 2024;17(3):47–58. DOI: https://doi.org/10.17816/OV634582

Received: 02.08.2024 **Accepted:** 13.09.2024 **Published online:** 23.09.2024

DOI: https://doi.org/10.17816/OV634582

Травмы орбиты: аспекты судебно-медицинской экспертизы в оценке тяжести вреда здоровью

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АННОТАЦИЯ

Актуальность. Судебно-медицинская экспертиза играет ключевую роль в установлении тяжести телесных повреждений, особенно в случаях травмы орбиты, которая может привести к серьёзным последствиям, вплоть до потери зрения. Исследование судебно-медицинских заключений, связанных с травмой орбиты, позволяет получить ценную информацию о характере повреждений, их распространённости, а также о факторах, влияющих на тяжесть травмы.

Цель — анализ возможностей междисциплинарного подхода, основанного на наличии полноценного офтальмологического статуса и данных компьютерной томографии черепа в проведении судебно-медицинской экспертизы живых лиц и в итоговой квалификации степени вреда здоровью при травмах орбит.

Материалы и методы. Проведён анализ 37 судебно-медицинских завершённых экспертиз живых лиц с травмами орбит, проходивших лечение в многопрофильных стационарах Москвы. Судебно-медицинская экспертиза проводилась на базе Государственного бюджетного учреждения здравоохранения города Москвы «Бюро судебно-медицинской экспертизы Департамента здравоохранения города Москвы». В 23 случаях на сроках от 1 нед. до 6 мес. после травмы проведена оценка офтальмологического статуса. Во всех случаях (n = 37; 100 %) была выполнена компьютерная томография лицевого и мозгового черепа. Возраст потерпевших на момент получения травмы составлял от 12 до 82 лет (в среднем 39,7 ± 9,2 года), 29 взрослых (n = 29; 78,3 %) и 8 детей (n = 8; 21,6 %). По гендерному распределению отмечено существенное преобладание мужского пола — 27 мужчин (n = 27; 73 %) против 10 женщин (n = 10; 27 %).

Результаты. По результатам анализа судебно-медицинских заключений политравма с одновременным наличием нескольких тяжёлых повреждений различных органов и систем, сочетанная с травмой орбиты, была зафиксирована у 12 потерпевших (n = 12; 32,4 %). Сочетание черепно-мозговой травмы и травмы орбиты без вовлечения иных органов и систем выявлено у 9 человек (24,3 %), изолированная травма одной орбиты — у 13 (35,1 %), изолированная травма двух орбит одновременно — у 3 (8,1 %). Из выводов судебно-медицинских экспертов следует, что в 89 % случаев были повреждены костные стенки орбит, образованные лобной, решётчатой и клиновидной костями, а также верхней челюстью, что в дальнейшем могло привести к повреждению глазного яблока, зрительного нерва и других структур орбиты. Повреждения мягких тканей орбит с контузией глазного яблока было отмечено в 11 % случаев. В 3 (n = 3; 8,1 %) случаях был определён вред здоровью средней тяжести по признаку значительной стойкой утраты общей трудоспособности. В 14 случаях (n = 14; 37,8 %) не представлялось возможным ориентироваться на остроту травмированного глаза до травматического эпизода, ввиду отсутствия у потерпевших задокументированных обращений к офтальмологу до травмы.

Заключение. Для объективной оценки травмы орбиты и определения степени вреда здоровью человека необходимо иметь полноценный офтальмологический статус, включающий такие клинико-инструментальные критерии, как острота зрения, наличие/отсутствие офтальмоплегии и дистопии глазного яблока, а также данные компьютерной томографии черепа, которые должны быть представлены в первичной медицинской документации.

Ключевые слова: переломы стенок орбит; судебно-медицинская экспертиза; кости глазницы; черепно-мозговая травма; судебно-медицинская экспертиза живых лиц.

Как цитировать

Медведева Н.А., Серова Н.С., Павлова О.Ю., Давыдов Д.В. Травмы орбиты: аспекты судебно-медицинской экспертизы в оценке тяжести вреда здоровью // Офтальмологические ведомости. 2024. Т. 17. № 3. С. 47–58. DOI: https://doi.org/10.17816/OV634582

Рукопись получена: 02.08.2024 **Рукопись одобрена:** 13.09.2024 **Опубликована online:** 23.09.2024

BACKGROUND

A forensic medical examination is central to determining the injury severity, especially of orbital trauma, which can lead to serious consequences, including vision loss [1]. An analysis of forensic medical reports of orbital trauma provides valuable information on the nature of injuries, their prevalence, and factors affecting the injury severity [2, 3]. The number of forensic medical examinations of orbital injuries has increased dramatically over the past 5 years, which is associated with an increase in car accidents, criminalization, and domestic violence, as well as military escalation [4, 5]. The forensic medical examination of patients with orbital trauma is a relevant interdisciplinary problem. A reliable grading of the degree of harm resulting from the orbital injury is challenged by the lack of scientific studies performed not only by forensic medical experts, but also by specialists in related disciplines, such as ophthalmology and traumatology. As there is no unified, interdisciplinary algorithm for the forensic medical examination of orbital trauma, clinicians and forensic medical experts tend to be subjective when making conclusions [1].

The orbit is located midface. Among all facial bone traumas with eye injury, orbital trauma accounts for 36%–64% of cases [6, 7]. Over 85% of patients with multiple orbital wall fractures require inpatient and surgical treatment [7]. Orbital injuries are mostly multiple and combined, as the orbital walls are located close to the skull base and calvarium. This challenges the forensic medical examination and making definite conclusions on the degree of harm to a person [8, 9].

Grading the degree of harm to a person is regulated by the rules approved by Decree of the Government of the Russian Federation No. 522 On Approval of the Rules for Grading the Degree of Harm to a Person, dated May 17, 2007. Harm to human health means compromised anatomical integrity and dysfunction of organs and tissues caused by physical (including mechanical), chemical, biological, and psychogenic environmental factors. Specific articles (111–115 and 118) of the Criminal Code of the Russian Federation state liability for harm. They divide the degree of harm into severe, moderate, and mild (Table 1). Although the classification of degree of harm in the Criminal Code is legally in effect, clinicians grade it based on qualifiers in accordance with medical criteria approved by Order of the Ministry of Health and Social Development of the Russian Federation No. 194n dated April 24, 2008.[1] However, the degree of harm to a person should not be confused with the general medical notion of the severity of the patient's condition.

The study aimed to analyze the possibilities of an interdisciplinary approach based on the comprehensive ophthalmologic status and cranial computed tomography (CT) data for the forensic medical examination and final grading of the degree of harm to patients with orbital injuries.

MATERIALS AND METHODS

An analysis of 37 completed forensic medical examinations of patients with orbital injuries treated in multidisciplinary hospitals in Moscow was carried out.

[1] Order of the Ministry of Health and Social Development of the Russian Federation No. 194n On Approval of Medical Criteria for Grading the Degree of Harm to a Person, dated April 24, 2008 (as amended on January 18, 2012; registered with the Ministry of Justice of Russia on August 13, 2008 under No. 12118; Rossiyskaya Gazeta, 2008:188 (4745)).

Table 1. Classification and signs of the severity of harm caused to human health (in accordance with the Criminal Code of the Russian Federation)
Таблица 1. Классификация и признаки тяжести вреда здоровью (в соответствии с Уголовном кодексом Российской Федерации)

Qualifier	Degree of harm		
	severe	moderate	mild
1. Threat to life	+	–	–
2. Loss of vision, speech, or hearing	+	–	–
3. Loss of any organ or its function	+	–	–
4. Significant persistent loss of general capacity for work	Minimum by one third	10%–30% inclusive	–
5. Minimal persistent loss of general capacity for work	–	–	Less than 10%
6. Long-term damage to health	–	More than 21 days	–
7. Short-term damage to health	–	–	Up to 21 days inclusive
8. Complete professional disability	+	–	–

The forensic medical examination was performed at the Bureau of Forensic Medical Examination of the Moscow Healthcare Department. Clinical ophthalmologic status of 23 patients was assessed within 1 week to 6 months after the injury. Facial bone and cranial CT was performed in all cases (*n* = 37; 100%). The age of the victims at the time of injury ranged from 12 to 82 years (mean age: 39.7 ± 9.2 years). Among the victims, 29 were adults (*n* = 29; 78.3%), and 8 were children (*n* = 8; 21.6%). As for sex distribution, there were more males (*n* = 27; 73%) than females (*n* = 10; 27%).

RESULTS

An analysis of forensic medical reports demonstrated that multiple trauma with several severe injuries to various organs and systems in combination with an orbital injury was reported in 12 victims (*n* = 12; 32.4%). The following types of trauma were identified: a combination of craniocerebral trauma and orbital injury without damage to other organs and systems in 9 people (*n* = 9; 24.3%), isolated unilateral orbital injury in 13 people (*n* = 13; 35.1%), isolated bilateral orbital injury in 3 victims (*n* = 3; 8.1%)

Forensic medical experts concluded that in 89% of cases, the orbital walls consisting of the frontal, ethmoid, sphenoid, and maxillary bones, were damaged. This damage could lead to further involvement of the globe, optic nerve, and other orbital structures. In most of these cases, the orbital medial wall (31%) and floor (22%), formed by the lamina papyracea and orbital surface of the maxilla, respectively, were damaged. Damage to the lateral orbital wall in the area of the greater wing of sphenoid were reported in 20% of cases. Damage to the roof in the area of the orbital surface of the frontal bone was noted in 16% of cases. Injuries of the soft orbital tissues with globe contusion accounted for 11% of cases. However, the source documentation did not describe the nature of the soft tissue damage and globe contusion severity.

A radiologist with experience in forensic medical examinations reviewed available electronic reports of orbital imaging studies and revealed that fracture lines extended from midface to the skull base in the area of the orbital walls in 17 cases (*n* = 17; 46%). This was unequivocally classified as serious harm based on life-threatening physical injury parameter. However, in more than 50% of cases, harm was determined based on the duration of damage to health. Notably, this qualifier is the least reliably objective, primarily because it does not reflect the injury severity, unlike a life-threat qualifier. In three cases (*n* = 3; 8.1%), moderate harm was identified based on significant persistent loss of general capacity for work. In 14 cases (*n* = 14; 37.8%), pre-trauma visual acuity of the injured eye could not be used, as the victims did not have documented pre-trauma visits to an ophthalmologist. The most complicated and debatable cases were bilateral orbital injuries with globe damage, which led to unilateral enucleation in 3 victims. These challenges are primarily caused by inadequate injury description in medical reports of diagnostic imaging studies and insufficient materials provided for examination, which may lead not only to expert error, but also impedes establishing the time and mechanism of injury. The key aspect in interpreting orbit CT is the inability to visualize orbital walls with facial bones, skull base, and calvarium in detail.

Injury mechanisms were the following: 23 (63%) car accidents (one of the most common causes of orbital injury), 9 (24%) intentionally inflicted blows to the face, and 5 (13%) cases of falling from heights. Orbital trauma consequences documented 6 months after the injury included the following: unilateral vision loss in 4 (9%) patients, persistent diplopia in 12 (34%), optic nerve atrophy in 8 (23%), cosmetic defects in the midface area in 10 (26%), and enucleation in 3 (8%) patients. Cosmetic defects included the asymmetry of the facial bones and changed globe position.

DISCUSSION

Clause 6.3 of the medical criteria for grading the degree of harm to a person states that complete persistent bilateral blindness or an irreversible condition, when an injury, poisoning, or other external causes lead to visual impairment equivalent to visual acuity of 0.04 or worse, is classified as serious harm.[2] Unilateral vision loss is assessed based on persistent loss of general capacity for work. Enucleation of a previously sighted eye due to an orbital injury is also assessed based on persistent loss of general capacity for work. Clause 24 of the table of percentages of persistent loss of general capacity for work due to various injuries, poisoning, and other external causes (appendix to the Medical criteria) indicates a decrease in visual acuity in each eye as a result of direct trauma based on pre- and post-trauma visual acuity (Table 2).

The notes to this clause state that if pre-trauma visual acuity is not available or inconsistent, the assessment should be based on visual acuity of the intact eye.[3] Therefore, to make reliable expert conclusions of the forensic medical examination of orbital injuries, standards for the source medical documentation are required, so it should include pre-trauma visual acuity and post-trauma follow-up data with changes in visual acuity. In our practice, we have noted the main problem of forensic medical examinations of orbital trauma with long-term

[2] Order of the Ministry of Health and Social Development of the Russian Federation No. 194n dated April 24, 2008.

[3] Same reference.

consequences, which is the missing data on initial pre-trauma visual acuity. If initial visual acuity of the affected eye is not available, the expert should use visual acuity of the intact eye for the assessment, which is not always possible in practice. Kuleshy [10] described a clinical case where an expert conclusion could not be made based on the existing rules for grading the degree of harm to a person. The patient had bilateral globe injuries, OD post-traumatic panophthalmitis, OS severe contusion, total hyphema, vitreous hemorrhage, retinal detachment, secondary glaucoma, and subconjunctival scleral rupture. During the forensic medical examination, medical records with victim's pre-trauma visual acuity were requested. However, the victim had never visited an ophthalmologist, so pre-trauma visual acuity could not be identified. Panophthalmitis led to enucleation of the right eye, leaving no "intact" eye from a forensic point of view to grade the degree of harm resulting from the left eye injury [10]. Thus, according to clause 27 of Order of the Ministry of Health and Social Development of Russia, the degree of harm was not determined. The degree of harm to a person cannot be determined if medical records are missing or do not contain sufficient information, including the results of instrumental and laboratory investigations, which precludes from assessing the nature and degree of harm to a person.[4]

The examination of orbital injury is challenged not only by various types of orbital injuries, but also by limited guidelines and regulations specifying the grading of the degree of harm resulting from the injury. Currently, medical criteria to be used by a forensic medical expert and requirements to source medical documentation are nor clear in these cases. Therefore, currently available criteria for forensic medical examination should be revised, and guidelines for examination of victims with orbital injuries should be established.

The main issue of forensic medical examination of orbital injuries is the lack of guidelines and standards. Orbital injuries are a complex and multifaceted medical phenomenon, requiring a forensic medical expert to be highly qualified and have comprehensive knowledge. The issue is not only various injury types, but also the lack

[4] Same reference.

Table 2. Percentages of permanent loss of general ability to work as a result of various injuries, poisonings and other consequences of external causes

Таблица 2. Проценты стойкой утраты общей трудоспособности в результате различных травм, отравлений и других последствий воздействия внешних причин

Decreased visual acuity in each eye caused by a direct injury		Percentage of persistent loss of general capacity for work
pre-trauma visual acuity	post-trauma visual acuity	
1.0	0.9	5
	0.8	5
	0.7	5
	0.6	5
	0.5	10
	0.4	10
	0.3	15
	0.2	20
	0.1	25
	0.09–0.05	30
	0.04 or worse	35
0.9	0.8	5
	0.7	5
	0.6	5
	0.5	5
	0.4	10
	0.3	10
	0.2	15
	0.1	20
	0.09–0.05	30
	0.04 or worse	35

Table 2 (continued) / Окончание таблицы 2

Decreased visual acuity in each eye caused by a direct injury		Percentage of persistent loss of general capacity for work
pre-trauma visual acuity	post-trauma visual acuity	
0.8	0.7	5
	0.6	5
	0.5	10
	0.4	10
	0.3	15
	0.2	20
	0.1	25
	0.09–0.05	30
	0.04 or worse	35
0.7	0.6	5
	0.5	5
	0.4	10
	0.3	10
	0.2	15
	0.1	20
	0.09–0.05	25
	0.04 or worse	30
0.6	0.5	5
	0.3	10
	0.2	10
	0.1	15
	0.09–0.05	20
	0.04 or worse	25
0.5	0.4	5
	0.3	5
	0.2	10
	0.1	10
	0.09–0.05	15
	0.04 or worse	20
0.4	0.3	5
	0.2	5
	0.1	10
	0.09–0.05	15
	0.04 or worse	20
0.3	0.2	5
	0.1	5
	0.09–0.05	10
	0.04 or worse	20
0.2	0.1	5
	0.09–0.05	10
	0.04 or worse	20
0.1	0.09–0.05	10
	0.04 or worse	20
Below 0.1	0.04 or worse	20

of clear and unified guidelines and regulations specifying the grading of the degree of harm resulting from orbital injuries. The lack of clear criteria and standards for the forensic medical examination of these injuries leads to several serious issues and subjective expert opinions. Different experts, based on their knowledge and experience, may come to different conclusions on the degree of harm, which does not allow completely satisfying claims and making a fair court ruling.

Insufficient source medical documentation means that primary care professionals do not always fully consider the specifics of orbital injuries or perform the necessary tests, thus challenging the following examination [1]. There are known challenges in assessing the consequences of trauma, as orbital injuries often have delayed consequences, such as impaired visual and motor globe functions, cosmetic defects, and globe enucleation [2, 11, 12]. To adequately assess the consequences, long-term follow-up and specific tests are required with proper medical documentation.

V.V. Zharova, V.A. Klevno, and E.N. Grigorieva analyzed errors in the forensic medical examination of orbital injuries. They retrospectively analyzed the primary examination reports to identify misinterpretations and errors in the forensic medical reports. The authors concluded that in most cases, forensic medical experts assessed orbital injuries independently, without consulting with clinicians or considering ophthalmological complications, which led to errors [13, 14].

CONCLUSION

The following steps are required to solve the described issue:

1. Development of unified guidelines. A set of clear standards and criteria for grading the degree of harm resulting from orbital injuries should be in place. The guidelines should include mandatory examinations, diagnostic methods, and criteria for assessing the severity of harm.

2. Advanced training of forensic medical experts. Specialized courses on the diagnosis and examination of orbital injuries should be conducted.

3. Formation of a database for orbital injuries will allow analyzing changes in trauma incidence, identifying trends, and developing new diagnostic and treatment methods.

4. Establishment of standards in primary care. Primary care professionals should be trained on the specific clinical manifestations of orbital injuries and rules for medical record keeping.

5. Implementation of these measures will fill existing gaps in guidelines and improve the quality of the forensic medical examination of orbital injuries. Improving the quality of the forensic medical examination of orbital injuries is central to ensuring fairness and effectiveness of justice.

CASE REPORT

A 62-year-old male patient presented to Radiology Diagnostics Department No. 2 of University Clinical Hospital No. 1 for examination, clarification of further treatment strategy, and midface CT. The medical history showed that the patient sustained a workplace injury resulting from an impact with a concrete mixer. The primary surgery was performed at a local hospital and included removal of the left globe. An ophthalmologic examination showed that visual function of the right eye was preserved. An orbital implant was placed, and then left periorbital scar tissues were removed. Currently, the patient is undergoing multi-stage surgical rehabilitation (Fig. 1–5).

The qualifiers of severe harm (Article 111 of the Criminal Code of the Russian Federation; clause 4a of the Rules for grading the degree of harm to person) are a life threat; loss of vision, speech, or hearing; loss of any organ or its function; abortion; mental disorder; development of drug addiction or substance abuse; significant persistent loss of general capacity for work minimum by one third; complete professional disability; permanent facial disfigurement.

Thus, during the initial forensic medical examination to grade the degree of harm based on medical documentation, the qualifier “life threat” could not be applied, as the fracture lines of the left orbital walls were anatomically limited by the facial bones. Injuries classified as

Fig. 1. Photo of the patient before the planned endoprosthetics of the left orbit
Рис. 1. Фото пациента перед планируемым эндопротезированием левой орбиты

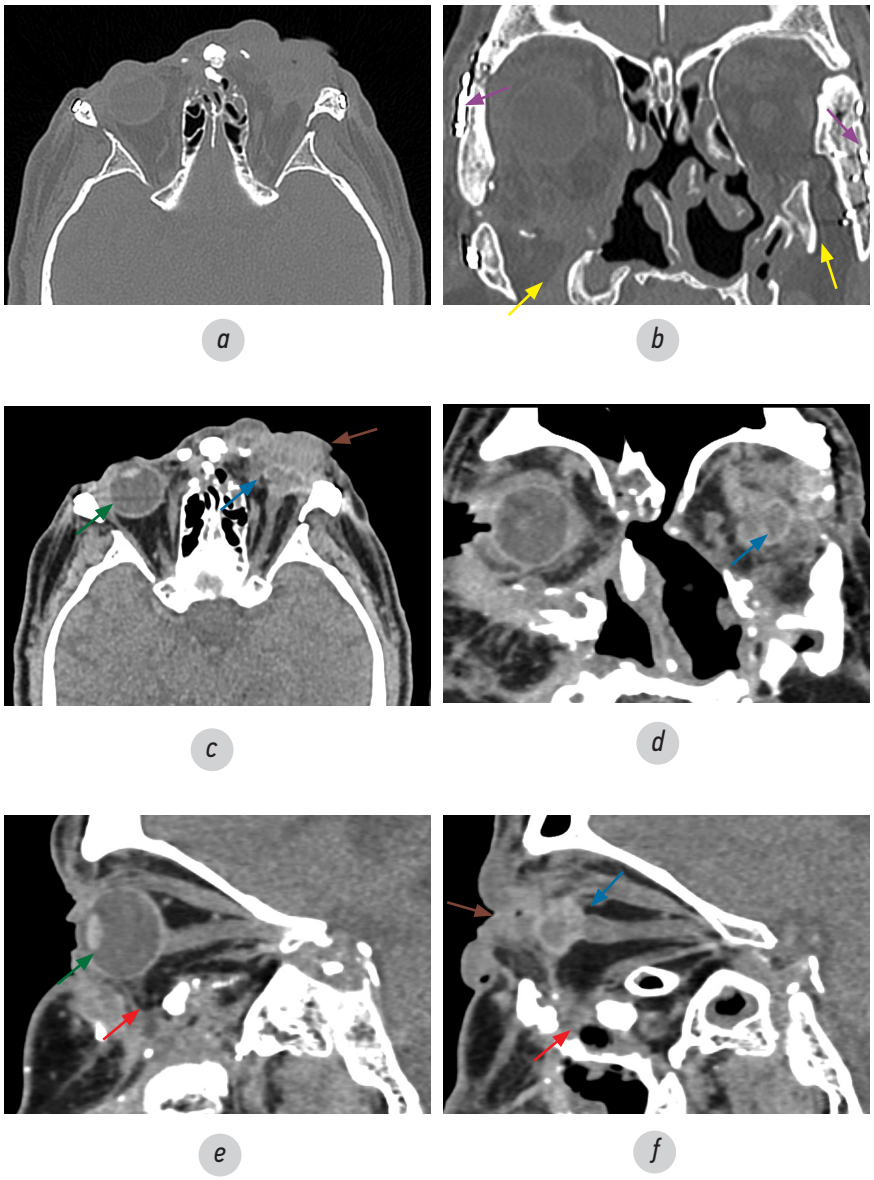

Fig. 2. MSCT. Condition before the planned endoprosthetics of the left orbit: *a* — axial slice, bone window mode; *b* — coronal slice, bone window mode; *c* — axial slice, soft tissue window mode; *d* — coronal slice, soft tissue window mode; *e*, *f* — sagittal slice, soft tissue window mode. Severe post-traumatic deformations of the bones of the face middle zone and fractures of all orbital walls (except the upper ones) are visualized. Due to total fractures of the lower orbital walls (yellow arrows), the soft tissue contents of the orbits prolapse into the cavity of the maxillary sinuses (red arrows). Condition after enucleation of the left globe: residual tissue of the globe (sclera) is determined in the cavity of the left orbit for further formation of the musculoskeletal stump (blue arrow). In the area of both zygomatic bones and zygomatic-frontal sutures, elements of metal osteosynthesis are identified (purple arrow). The right globe is intact, with rounded clear contours, unchanged shape, the lens is visualized (green arrow). Severe post-traumatic deformations of the facial soft tissues are noted; in the area of the periorbital tissues on the left, an increase in volume and thickening of the tissues are detected (brown arrow)

Рис. 2. Мультиспиральная компьютерная томография. Состояние перед планируемым эндопротезированием левой орбиты: *a* — аксиальный срез, режим костного окна; *b* — корональный срез, режим костного окна; *c* — аксиальный срез, режим мягкотканного окна; *d* — корональный срез, режим мягкотканного окна; *e*, *f* — сагиттальный срез, режим мягкотканного окна. Визуализируются выраженные посттравматические деформации костей средней зоны лица, переломы всех стенок орбит (кроме верхних). В связи с тотальными переломами нижних стенок орбит (жёлтые стрелки), мягкотканное содержимое орбит пролабирует книзу в полость верхнечелюстных синусов (красные стрелки). Состояние после энуклеации левого глазного яблока: в полости левой орбиты определяется остаточная ткань глазного яблока (склера) для дальнейшего формирования опорно-двигательной культи (синяя стрелка). В области обеих скуловых костей и скулолобных швов определяются элементы металлоостеосинтеза (фиолетовая стрелка). Правое глазное яблоко сохранно, с округлыми чёткими контурами, неизменённой формы, хрусталик визуализируется (зелёная стрелка). Отмечаются выраженные посттравматические деформации мягких тканей лица, в области периорбитальных тканей слева определяется увеличение объёма и уплотнение тканей (коричневая стрелка)

DOI: https://doi.org/10.17816/OV634582

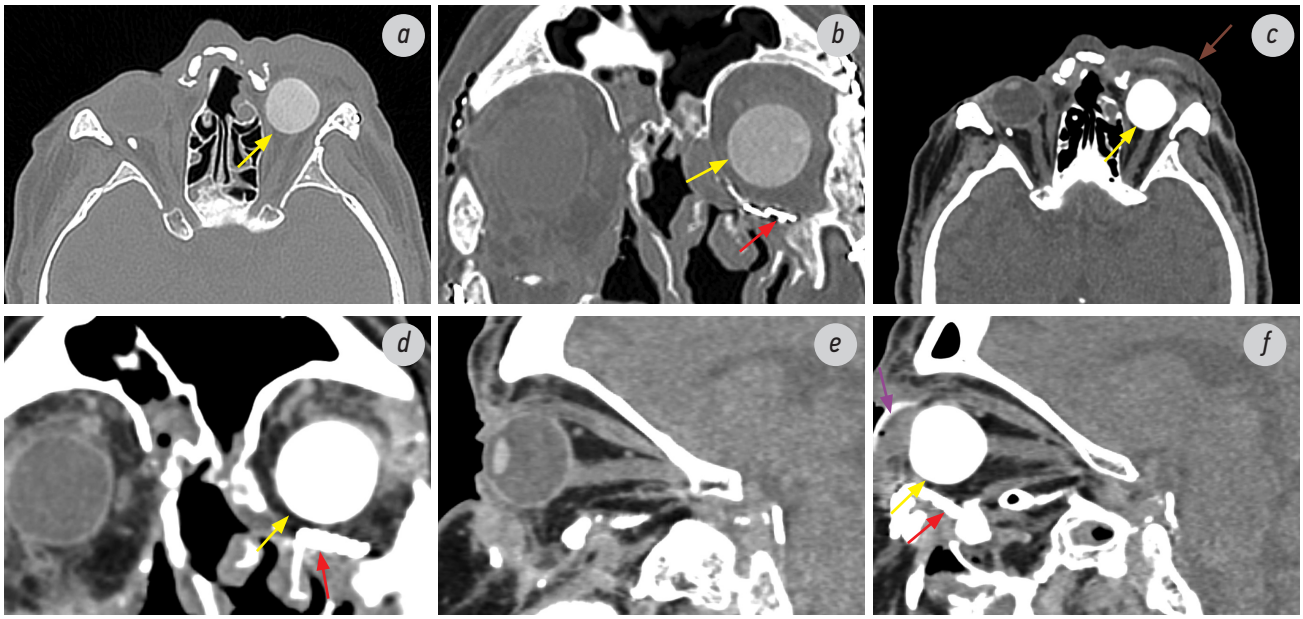

Fig. 3. Condition after endoprosthetics of the left orbit. MSCT: *a* — axial slice, bone window mode; *b* — coronal slice, bone window mode; *c* — axial slice, soft tissue window mode; *d* — coronal slice, soft tissue window mode; *e*, *f* — sagittal slice, soft tissue window mode. Condition after endoprosthetics of the left eyeball and mesh installation in the area of the left lower orbital wall (red arrow): in the cavity of the left orbit an endoprosthesis (yellow arrow) of a spherical shape with direct oculomotor muscles sutured to the endoprosthesis capsule is determined — a formed musculoskeletal stump (MSS), outwards from the MSS an external cosmetic prosthesis is determined (purple arrow). After endoprosthetics, pronounced post-traumatic deformations of the soft tissues of the face remain; in the area of the periorbital tissues on the left, an increase volume and thickening of the tissues is also noted (brown arrow)

Рис. 3. Состояние после эндопротезирования левой орбиты. Мультиспиральная компьютерная томография: *a* — аксиальный срез, режим костного окна; *b* — корональный срез, режим костного окна; *c* — аксиальный срез, режим мягкотканного окна; *d* — корональный срез, режим мягкотканного окна; *e*, *f* — сагиттальный срез, режим мягкотканного окна. Состояние после эндопротезирования левого глазного яблока и установки пластины в области нижней стенки левой орбиты (красная стрелка): в полости левой орбиты определяется эндопротез (жёлтая стрелка) сферической формы с подшитыми к капсуле эндопротеза прямыми глазодвигательными мышцами — сформированная опорно-двигательная культя, кнаружи от которой определяется наружный косметический протез (фиолетовая стрелка). После эндопротезирования сохраняются выраженные посттравматические деформации мягких тканей лица, в области периорбитальных тканей слева также отмечается увеличение объёма и уплотнение тканей (коричневая стрелка)

Fig. 4. Operation: *a* — excision of the deformed periorbital soft tissues on the left; *b* — gross specimen, fragment of removed periorbital soft tissue on the left

Рис. 4. Этап операции: *a* — иссечение деформированных периорбитальных мягких тканей слева; *b* — макропрепарат, фрагмент удалённых периорбитальных мягких тканей

Fig. 5. Photo of the patient after surgical treatment (excision of periorbital soft tissues on the left)

Рис. 5. Фото пациента после очередного этапа хирургического лечения (иссечения периорбитальных мягких тканей слева)

severe based on an outcome and consequences are not life-threatening and are assessed by the outcome and consequences for the health and victim's capacity for work. In this case, the removal of the previously sighted eye after an injury was assessed based on persistent loss of general capacity for work. As the left eye was sighted, the qualifier "duration of loss of capacity for work" was not applied.

CONCLUSION

To objectively assess an orbital injury and grade the degree of harm to a person, an ophthalmologic status should be comprehensively evaluated, and source medical documentation should include such clinical and instrumental criteria as visual acuity, presence of diplopia, ophthalmoplegia, and dystopia, as well as cranial CT. CT data and social significance of orbital trauma suggest that CT is the best method for diagnosing fractures of the orbital walls. To increase the reliability of the forensic medical examination, original electronic data should be assessed.

ADDITIONAL INFO

Authors' contribution. All authors made a substantial contribution to the conception of the study, acquisition, analysis, interpretation of data for the work, drafting and revising the article, final approval of the version to be published and agree to be accountable for all aspects of the study. Personal contribution of each author: N.A. Medvedeva — concept and design of the study, collection and processing of materials, writing the text; analysis of the received data; N.S. Serova — concept and design of the study, analysis of the data obtained, final edits, consultation of diagrams and CT images; O.Yu. Pavlova — collection and processing of materials, literature review; D.V. Davydov — study concept and design, final edits.

Funding source. The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests. The authors declare that they have no competing interests.

Consent for publication. Written consent was obtained from the patient for publication of relevant medical information within the manuscript.

ДОПОЛНИТЕЛЬНАЯ ИНФОРМАЦИЯ

Вклад авторов. Все авторы внесли существенный вклад в разработку концепции, проведение исследования и подготовку статьи, прочли и одобрили финальную версию перед публикацией. Личный вклад каждого автора: Н.А. Медведева — концепция и дизайн исследования, сбор и обработка материалов, написание текста; анализ полученных данных; Н.С. Серова — концепция и дизайн исследования, анализ полученных данных, окончательные правки, консультация схем и КТ-изображений; О.Ю. Павлова — обработка материалов, обзор литературы; Д.В. Давыдов — концепция и дизайн исследования, окончательные правки.

Источник финансирования. Авторы заявляют об отсутствии внешнего финансирования при проведении исследования.

Конфликт интересов. Авторы декларируют отсутствие явных и потенциальных конфликтов интересов, связанных с публикацией настоящей статьи.

Информированное согласие на публикацию. Авторы получили письменное согласие пациента на публикацию медицинских данных и фотографий.

REFERENCES

1. Moshetova LK, Romodanovsky PO, Arzhimatova GSh, et al. Modern aspects of clinical and forensic diagnosis of orbital trauma. *Russian Journal of Clinical Ophthalmology*. 2015;15(4):211–215. (In Russ.) EDN: VOXFNN

2. Indiaminov SI, Davranova AE, Rasulova MR. The significance of classifications of mechanical injuries of the organs of vision for solvingthe problems of forensic medical examination. *The Bulletin of Contemporary Clinical Medicine*. 2022;15(4):34–39. EDN: ZUZRSP doi: 10.20969/VSKM.2022.15(6).34-39

3. Avdeev MI. *Forensic medical examination of living persons*. Moscow: Medicine; 1968. 376 p. (In Russ.)

4. Kryukov VN, Buromsky IV. *Manual on forensic medicine*. Moscow: Norma; INFRA-M; 2014. 656 p. (In Russ.)

5. http://www.gibdd.ru/stat [Internet]. Indicators of the state of road safety [cited 2024 September 13]. Available from: http://www.gibdd.ru/stat

6. Pavlova OY, Serova NS. Protocol of multispiral computed tomography in the diagnosis of injuries of the middle zone of the face. *Russian Electronic Journal of Radiology*. 2016;6(3):48–53. (In Russ.) EDN: WYKBED doi: 10.21569/2222-7415-2016-6-3-48-53

7. Gundorova RA, Neroev VV, Kashnikov VV. *Traumas of the eye*. Moscow: GEOTAR-Media; 2009. 560 p. (In Russ.)

8. Medvedeva NA, Serova NS, Pavlova OY, Gridasova IS. Radiation diagnostics of orbital wall fractures and its role in forensic medical examination of living persons. *Russian Electronic Journal of Radiology*. 2024;14(2):6–18. EDN: BVNXRC doi: 10.21569/2222-7415-2024-14-2-2-6-18

9. Davydov DV, Gridasova IS, Serova NS, et al. Development of schematic representations for globe removal and formation of the supporting-motor stump for use in ophthalmological and radiological practice. *Ophthalmology Reports*. 2023;16(4):43–53. EDN: XNGIQW doi: 10.17816/OV623658

10. Kulesha NV. Actual issues of forensic medical examinations in eye injuries. In: Selected issues of forensic medical examination. Collection of articles. No. 18. Khabarovsk: Far Eastern State Medical University, 2019. P. 114–117. (In Russ.) EDN: ICYFES

11. Pavlova OY, Serova NS, Davydov DV, Gridasova IS. MSCT protocol in adult patients after globe endoprosthetics. *Russian Electronic Journal of Radiology*. 2023;13(4):26–35. EDN: NQUSSP doi: 10.21569/2222-7415-2023-13-4-26-35

12. Anisimova IA. Harm caused to human health: concept, types. *Bulletin of Tomsk State University*. 2007;(302):113–116. (In Russ.)

13. Klevenno VA, Grigorieva NE. *Forensic medical evaluation of severity of health damage in fractures of bones of zygomatico-orbital*

complex. Moscow; Russian Center for Forensic Medical Examination of the Ministry of Health and Social Development of Russia; 2012. 113 p. (In Russ.)

14. Zharov VV, Klevno VA, Grigorieva NE. Forensic medical criteria for determining the severity of health damage in fractures of zygomatic bones. *Forensic Medical Expertise*. 2010;53(2):10–12. EDN: PWXQLR

СПИСОК ЛИТЕРАТУРЫ

1. Мошетова Л.К., Ромодановский П.О., Аржиматова Г.Ш., и др. Современные аспекты клинической и судебно-медицинской диагностики травм орбиты // РМЖ. Клиническая офтальмология. 2015. Т. 15, № 4. С. 211–215. EDN: VOXFNN

2. Индиаминов С.И., Давранова А.Э., Расулова М.Р. Значение классификаций механических травм органа зрения для решения задач судебно-медицинской экспертизы // Вестник современной клинической медицины. 2022. Т. 15, № 4. С. 34–39. EDN: ZUZRSP doi: 10.20969/VSKM.2022.15(6).34-39

3. Авдеев М.И. Судебно-медицинская экспертиза живых лиц. Москва: Медицина, 1968. 376 с.

4. Крюков В.Н., Буромский И.В. Руководство по судебной медицине. Москва: Норма, ИНФРА-М, 2014. 656 с.

5. http://www.gibdd.ru/stat [электронный ресурс]. Показатели состояния безопасности дорожного движения. Режим доступа: http://www.gibdd.ru/stat Дата обращения: 13.09.2024.

6. Павлова О.Ю., Серова Н.С. Протокол мультиспиральной компьютерной томографии в диагностике травм средней зоны лица // Российский электронный журнал лучевой диагностики. 2016. Т. 6, № 3. С. 48–53. EDN: WYKBED doi: 10.21569/2222-7415-2016-6-3-48-53

7. Гундорова Р.А., Нероев В.В., Кашников В.В. Травмы глаза. Москва: ГЕОТАР-Медиа, 2009. 560 с.

8. Медведева Н.А., Серова Н.С., Павлова О.Ю., Гридасова И.С. Лучевая диагностика переломов стенок орбит и её роль в судебно-медицинской экспертизе живых лиц // Российский электронный журнал лучевой диагностики. 2024. Т. 14, № 2. С. 6–18. EDN: BVNXRC doi: 10.21569/2222-7415-2024-14-2-6-18

9. Давыдов Д.В., Гридасова И.С., Серова Н.С., и др. Разработка схематических изображений по удалению глазного яблока и формированию опорно-двигательной культи для использования в практике врачами офтальмологического и рентгенологического профилей // Офтальмологические ведомости. 2023. Т. 16, № 4. С. 43–53. EDN: XNGIQW doi: 10.17816/OV623658

10. Кулеша Н.В. Актуальные вопросы проведения судебно-медицинских экспертиз при травмах глаз. В кн.: Избранные вопросы судебно-медицинской экспертизы. Сборник статей. Вып. 18. Хабаровск: ДГМУ, 2019. С. 114–117. EDN: ICYFES

11. Павлова О.Ю., Серова Н.С., Давыдов Д.В., Гридасова И.С. Протокол МСКТ у взрослых пациентов после эндопротезирования глазного яблока // Российский электронный журнал лучевой диагностики. 2023. Т. 13, № 4. С. 26–35. EDN: NQUSSP doi: 10.21569/2222-7415-2023-13-4-26-35

12. Анисимова И.А. Вред, причинённый здоровью человека: понятие, виды // Вестник Томского государственного университета. 2007. № 302. С 113–116.

13. Клевно В.А., Григорьева Н.Е. Судебно-медицинская оценка тяжести вреда здоровью при переломах костей скулоорбитального комплекса. Москва: РИО ФГБУ РЦСМЭ Минздравсоцразвития России, 2012. 114 с.

14. Жаров В.В., Клевно В.А., Григорьева Н.Е. Судебно-медицинские критерии определения степени тяжести вреда здоровью при переломах скуловых костей // Судебно-медицинская экспертиза. 2010. Т. 53, № 2. С. 10–12. EDN: PWXQLR

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