

Ocular Trauma in Childhood at the University Hospital Ostrava in the Years 2007-2011

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SUMMARY

Objective: to investigate and analyze the group of child patients with ocular trauma in the Ostrava region in the Czech Republic.

Methods: A retrospective observational case series. We reviewed and analyzed clinical records of all the paediatric patients with ocular trauma treated at the University Hospital Ostrava in the years 2007 – 2011. Age, sex, mechanism of injury, type of ocular trauma, the consequences of injury and period of the year when the accident occurred were evaluated. BETT classification used in this study was modified and extended by chemical and thermal injuries and orbital trauma. Ocular burns, including thermal and chemical burns, were graded using the classification for ocular surface burns by Dua.

Results: 448 children (309 boys, 139 girls), aged from 3 months to 17 years (median 10 years) were included in this study. The most common ocular injury was closed globe injury (253 patients, 56,5 %), the next common were orbital injuries (149 patients, 33,3 %), burns injuries (39 patients, 8,7 %), the least frequent were open globe injuries (7 patients, 1,6 %). The most common mechanism of ocular trauma was hit by object (34,6 %), followed by trauma caused by blows and falls (15,2 %) and hit by another person (10,3 %). The 50,9 % of injuries occurred in days of school attendance. 10,3 % of injuries occurred directly at the school or preschool facilities. 6,5 % of the injuries were polytraumas, which required interdisciplinary cooperation.

Conclusion: This study demonstrated that the incidence of eye injuries is greater in boys, mainly adolescents. Closed globe injuries are the predominant type of ocular trauma in childhood. The mechanism of ocular trauma is variable. Nonetheless there is a relation between the mechanism and the age of the child. Further research in terms of how the preventive measures would affect the incidence and severity of ocular trauma in children would be beneficial. The modified BETT classification of ocular trauma, including chemical and thermal injuries and orbital trauma may better address current requirements.

Key words: ocular trauma, childhood, mechanism of ocular trauma

Čes. a slov. Oftal., 69, 2013, No. 4, p. 149–154

The work was presented in an abbreviated form as an electronic poster at the World Congress of Paediatric Ophthalmology and Strabismus, held in Milan, Italy from 7 to 9 September 2012. It was also presented in an abbreviated form at the event – 3rd Trends in Paediatric Ophthalmology and Strabology held in Lázně Bělohrad on 1-2 June 2012.

The article made use of the text from the original dissertation work of Dr. Juraj Timkovič, following the unanimous approval of the attestation commission.

INTRODUCTION

The most frequent causes of treatment of patients in childhood age include injuries to various parts of the body, not excluding the head area and the eyes.

These injuries may result in serious and permanent disorders of visual functions. Overall the frequency of injuries in children increases with age. The highest incidence is in the period of puberty and adolescence. Amongst the most common causes are sports activities, handling of fireworks, shooting toys, injuries to the eyes and eye socket within the framework of combined injuries. Within the examination and anamnesis the possibility of maltreatment must not be overlooked, especially in the case of preverbal children [3].

With the development of society the causes and results of childhood injuries are also changing. In the current literature we have not found a summary study devoted to the issue of ocular traumas in children in the Czech Republic. For this reason we decided to

evaluate a group of all paediatric patients treated in the University Hospital Ostrava in the period from 2007 to 2011 with a diagnosis of ocular trauma.

METHOD

We conducted a retrospective analysis of the medical documentation of all paediatric patients treated in the University Hospital Ostrava in the period from 1 January 2007 to 31 December 2011 due to trauma of the eye, orbit and periorbital area. In addition to the age and sex of the patients, the observed parameters included the mechanism of the injury, the character of damage to the eye, consequences in the case of serious injury and the time of year in which the injury occurred

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(school holidays, state holidays and weekends). In the study we used the Birmingham Eye Trauma Terminology (BETT), modified by extending with chemical and thermal injuries and orbital traumas [5, 6, 7, 10]. We included open and closed injuries to the eyelids and fractures of the orbit amongst ocular traumas. In accordance with the BETT system we divide open ocular injuries into rupture, penetrating injury, ocular injury with intraocular foreign body and perforating injury. Closed injuries incorporated contusion of the eye, laceration of the conjunctiva, superficial foreign body on conjunctiva or cornea, erosion and lamellar defect of the cornea. The scope of the injury to the eye and the periorbital area by thermal and chemical burns was evaluated according to Dua [1].

RESULTS

The population comprised 448 children (309 boys, 139 girls) aged from 3 months to 17 years (average 10 years, SD \bar{I} 5.26, median 10 years). More than one half of injuries (55.1%) were treated by an ophthalmologist within the framework of emergency services, the other treatments

took place within regular working hours. The division of the frequency of injuries according to age and sex is illustrated by Graph no. 1. The most frequently represented type of injury was closed ocular injury (253 patients, 56.5%), followed by the group of orbital traumas (149 patients, 33.3%), chemical and thermal injuries (39 patients, 8.7%), and the lowest representation was of serious open eye injuries (7 patients, 1.6%) [Table 1]. The distribution of ocular traumas, their mechanism and the place of occurrence according to age is illustrated in summary [Graphs 2, 3, 4]. In 25.9 % of cases this concerned an injury caused by another person, typically a patient's fellow pupil or friend of approximately the same age. Of this number 28.4% of cases represented an intentional attack by another person.

3.1 SCHOOL AND PRE-SCHOOL FACILITY

Almost one half of traumas (49.1%) occurred during school holidays, state holidays and weekends, whilst the remainder took place on days of school attendance. 10.3% of all traumas occurred directly in a school or pre-school facility. Amongst these traumas closed injuries predominated (52.2%), followed

by orbital traumas (45.7%), in one case (2.2%) we recorded chemical injury to the eye upon handling organic solvent during a chemistry lesson. The most common ocular trauma in a school or pre-school facility was a blow from an object (52.2%), most frequently by sports requisites (29.2%) during a physical education lesson. During the observation period we did not record any serious open eye injury at a school or pre-school facility. The average age of children with a trauma of the eye or periorbital area was 10 years (SD \bar{I} 4, median 10 years).

3.2 POLYTRAUMA

In 29 children (6.5%) an ocular trauma occurred within the framework of an associated injury, which required hospitalisation and interdisciplinary co-operation. The most common cause of polytrauma was a fall from a height or bicycle (37.9%), followed by car accident (17.2%), sports activity (13.8%) and explosion (10.3%), whilst other causes occurred sporadically. The most common type of trauma within the framework of associated injuries was orbital traumas (75.9%), in which 14 cases (63%) represented orbital fractures. In three cases (10.3%) this concerned an open injury to the eye following

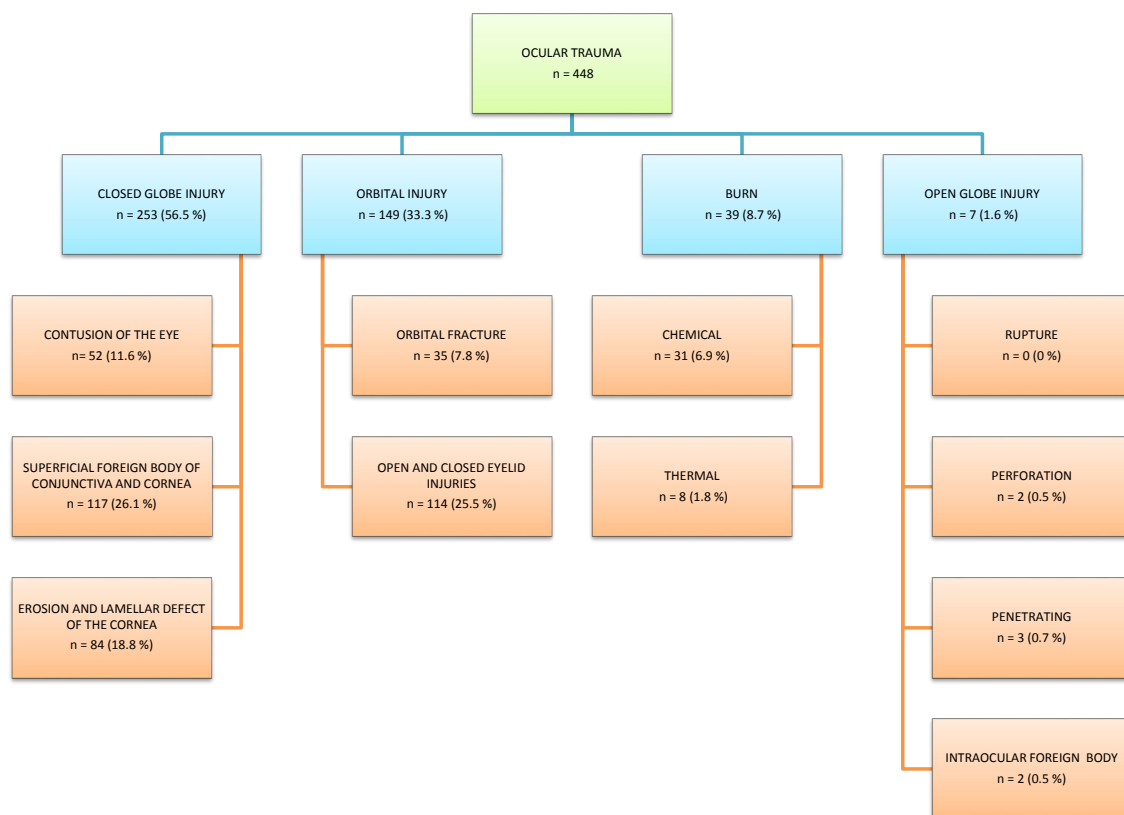
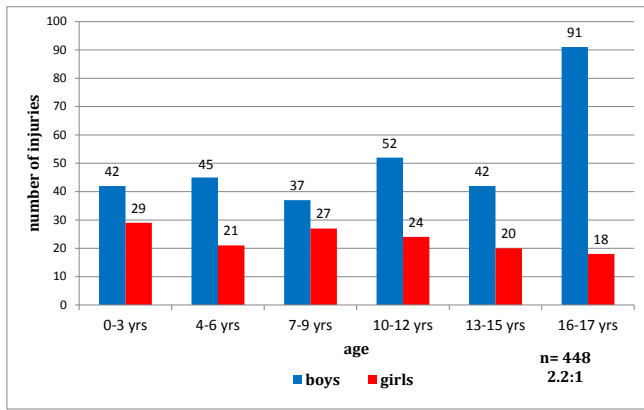
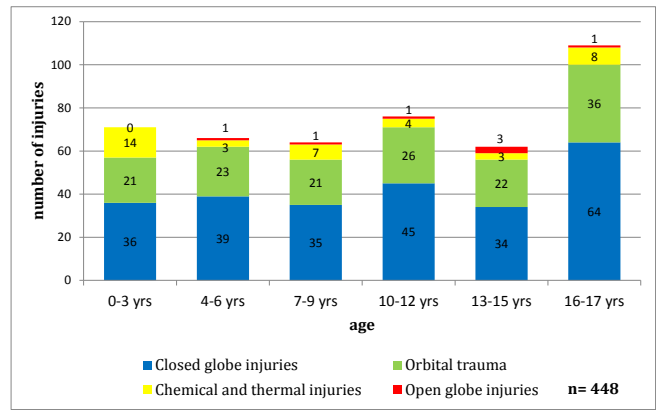


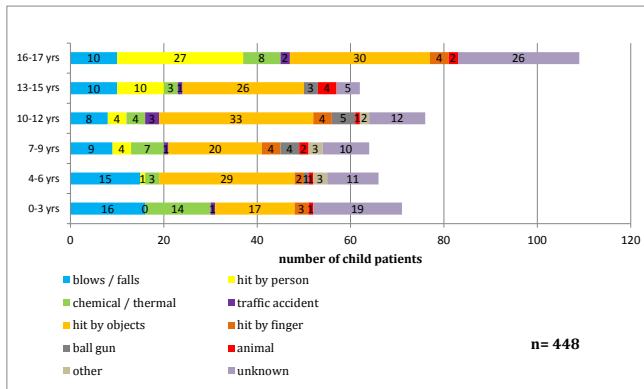
Table 1. Representation of individual types of traumas to the eye and periorbital area – a total of 448 paediatric patients were divided according to the type of trauma. The number of patients and the percentage are stated in each box. The Birmingham Eye Trauma Terminology (BETT) was used in the study, modified and extended by chemical and thermal injuries and orbital traumas [5, 6, 7, 10].



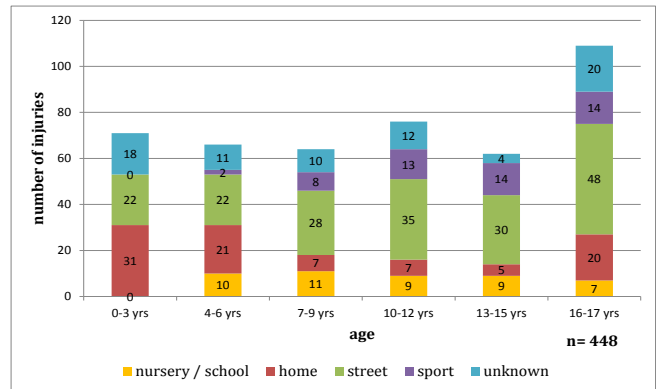
Graph 1. Distribution of ocular traumas according to age and sex in 448 children treated at University Hospital Ostrava in the period from 2007 to 2011



Graph 2. Distribution of individual types of ocular traumas according to age in 448 children treated at University Hospital Ostrava in the period from 2007 to 2011



Graph 3. Distribution of mechanisms of traumas according to age in 448 children treated at University Hospital Ostrava in the period from 2007 to 2011. The mechanism of the ocular trauma is variable, nevertheless a relationship exists between the mechanism and the age of the child.



Graph 4. Location of traumas according to age in 448 children treated at University Hospital Ostrava in the period from 2007 to 2011

explosion. The average age of children at the time of trauma was 9.8 years (SD 4.94, median 10 years).

3.3 CLOSED INJURIES

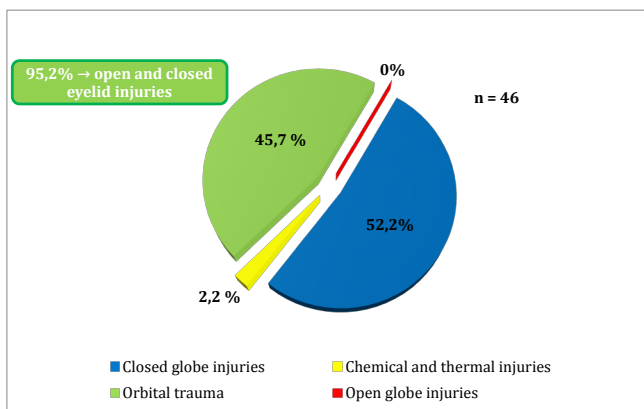
253 children constituted the heterogeneous group of patients with a closed injury, in which we included contusion of

the bulb, erosion and lamellar defects of the cornea and superficial foreign body on the conjunctiva or cornea in accordance with the modified BETT system. The proportion of the individual subtypes is presented in Table 1.

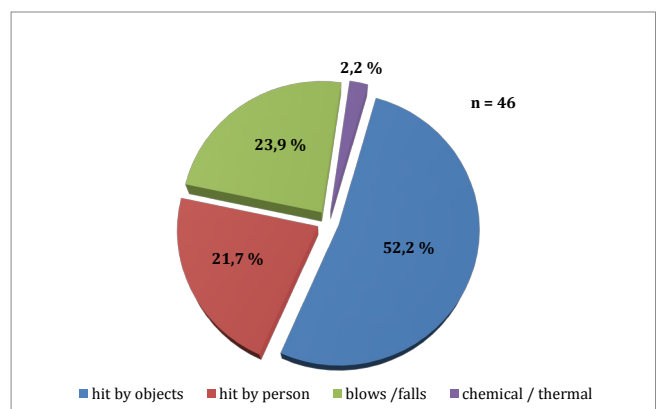
3.3.1 FOREIGN BODY ON CORNEA

OR CONJUNCTIVA

Almost one half of closed injuries (46.2%) comprised superficial foreign bodies on the conjunctiva or cornea. The frequency of this type of injury according to age in summary is illustrated by graph 7. The cause could not be determined in 54.7% of cases. Most frequently



Graph 5. Distribution of individual type of ocular traumas at school and pre-school facility in 48 children treated at University Hospital Ostrava in the period from 2007 to 2011. The majority of orbital traumas (95.2%) included closed and open injuries to the eyelids.



Graph 6. Cause of ocular traumas at school and pre-school facility in 46 children treated at University Hospital Ostrava in the period from 2007 to 2011

the foreign bodies originated from forest and grass vegetation (26.4%), followed by metallic foreign bodies acquired in connection with grinding and handling of metallic objects (17.0%), wooden foreign bodies (13.2%), other causes were less frequent and were highly variable. In 97.4% of cases an examination was conducted with extraction of the foreign body under local anaesthesia, in three cases (2.6%) we had to perform treatment under general anaesthesia. This concerned children aged 3-6 years, whereas the average age of children with a foreign body on the conjunctiva / cornea was 10.2 years (SD ± 5.33, median 10 years).

3.3.2 EROSION AND LAMELLAR DEFECTS OF CORNEA

In the group of 84 children with superficial erosion of the corneal epithelium, the most common cause of injury was being hit by an object (57.1%), most often a wooden stick (10.4%), sports activity and a spherical projectile from a children's shooting toy were identical at 8.3%. In 21.4% of cases it was not

possible to determine the cause. A summary of the other causes of superficial injury to the cornea in children is illustrated in graph 8. The average age of children at the time of injury was 8.5 years (SD ± 5.05, median 9 years).

3.3.3 CONTUSION OF BULB

In the group of 52 children with ocular contusion 75% of cases concerned affliction only of the anterior segment, whilst in 13 cases (25%) the anterior and posterior segments of the eye were afflicted. The most common cause of injury in 80.0% of cases was a blow from an object, most often with sports requisites (35.7%), artificial projectile from children's shooting toy (21.4%), wooden stick (14.3%). Severe contusion of the eye with permanent consequences occurred in 9 cases (17.3%), in one case in connection with permanent reduction of visual functions. The scope of the post-contusion affliction of the eye is illustrated by Graphs 9 and 10. 51.9% of these traumas were caused by another person. The average age of children at the time of the trauma was 12.6 years

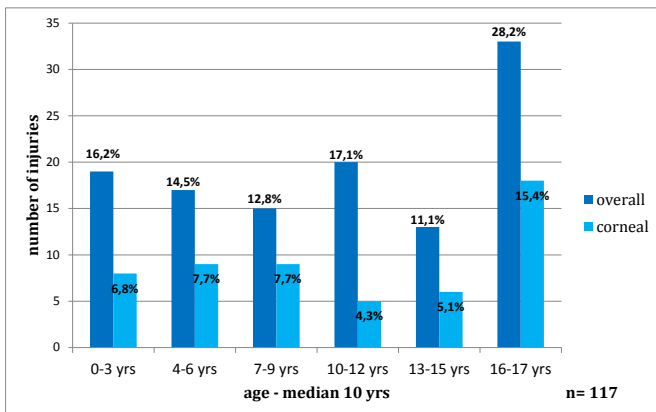
(SD ± 3.77, median 13 years).

3.4 ORBITAL TRAUMA

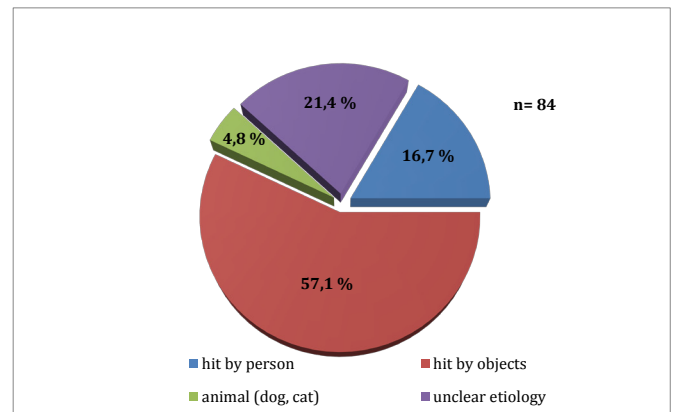
Orbital traumas, also covering injury to the periocular area with a number of 139 children in the group represented the second most common type of ocular injury in children. The percentage representation of the individual subtypes of orbital traumas in our group is presented in Table 1.

3.4.1 CLOSED AND OPEN INJURIES TO EYELIDS

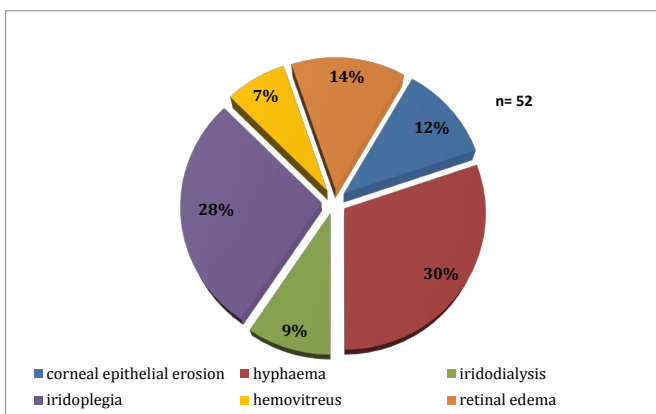
Of 114 patients with an injury to the eyelids and periocular area, 50% of cases concerned an open wound. In 61.4% of these children, suture of the wound was performed under local anaesthesia, 31.6% were treated with a strip, in the case of 2 patients (3.5%) we had to perform treatment under general anaesthesia. In 2 cases (3.5%) the wound of the eyelid was left for secondary healing due to the large time interval since the injury. The most common cause of trauma of the eyelid and/or periocular area was falls and impacts during sport and a blow from another person, both at the level of 14.5%. It is necessary



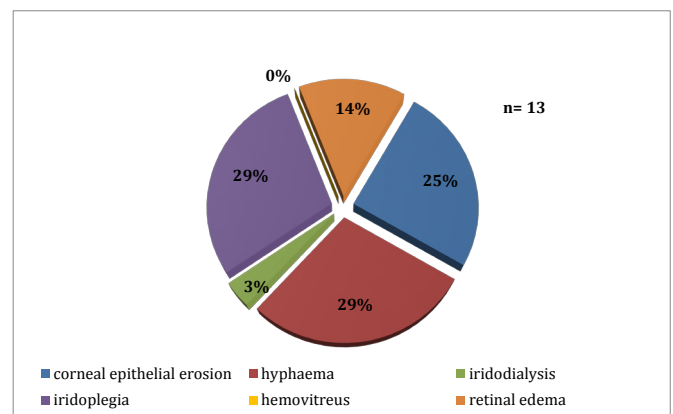
Graph 7. Distribution of foreign bodies on cornea and conjunctiva according to age in 117 children treated at University Hospital Ostrava in the period from 2007 to 2011



Graph 8. Spectrum of causes of superficial injury to cornea in 84 children treated at University Hospital Ostrava in the period from 2007 to 2011



Graph 9. Scope of affliction of eye following contusion in 52 children treated at University Hospital Ostrava in the period from 2007 to 2011



Graph 10. Scope of affliction of eye following contusion in 13 children after blow to eye from projectile from children's pellet gun in the period from 2007 to 2011

ssary to emphasise that 26.3% of these injuries were caused by another person, in which 46.7% of cases concerned intentional attack. The average age of children with injured eyelids was 9.4 years (SD ± 5.3, median 9.5 years).

3.4.2 FRACTURE OF ORBIT

During a five-year period we recorded 35 children with a fractured orbit. Of these, 40% of cases concerned an associated injury requiring interdisciplinary co-operation. The most common cause was a blow from another person (40%), and of these as many of 78.6% were cases of intentional attack. The second most common cause was falls and impacts (28.6%), other causes were less common. In two children aged in the category of up to 3 years (one fall from a balcony, one fall from a window), the absence of a person supervising the child played a role. Of the total number of 35 cases, 28.6% were referred by an ophthalmologist and subsequently a review and reconstruction of orbit was performed in co-operation with a stomatological surgeon, ortholaryngologist or neurosurgeon. The average age at the time of injury was 12.4 years (SD ± 4.45, median 14 years).

3.5 CHEMICAL AND THERMAL INJURIES

Of the 39 patients with thermal and chemical injuries, 31 cases (79.5%) were

chemical injuries and 8 cases (20.5%) thermal injuries to the eye and surrounding area. In 4 cases hospitalisation was required at the burns centre, with interdisciplinary co-operation. The most common cause of chemical burn was handling of a cleaning and washing agent (29%), glue / solvent (19.4%), building material (16.1%), pepper spray (12.9%), other causes were less common. The largest percentage of these chemical and thermal injuries (35.9%) was recorded in the age category of up to 3 years. In all cases this represented 1st degree injury according to the Dua classification, without permanent consequences in the sense of deterioration of visual functions or ocular complications in the long-term perspective. The average age of the children at the time of the injury was 8.3 years (SD ± 5.73, median 8 years).

3.6 OPEN INJURIES TO THE EYES

A summary of serious open injuries to the eye, age and sex of patients, mechanism of trauma, scope of affliction of the eye and permanent consequences in the long-term perspective are illustrated by Tables 2 and 3. From the mechanisms of the traumas it is evident that whilst girls tended to be more or less passive participants in the occurrence of the trauma, all of the boys actively shared to a greater or lesser degree in their injury. In none of these cases was

an adult person present who could have prevented the risk-laden behaviour which led to the child's injury.

DISCUSSION

As with Serrano in his extensive sample of ocular traumas, in our study we also recorded approximately twice the frequency of occurrence of traumas in boys than in girls [12]. We observe the highest incidence in the period of puberty. We are of the opinion that the predominance on the part of boys may be caused by their larger instrumental vigour and probably also more aggressive behaviour than in the case of girls. We agree with the opinion that children in school age are more prone to injuries than younger age categories, which evidently ensues from the fact that these children are more physically active and are under the influence of their peers. This is reflected in the choice of the types of games they play and also in the manner in which they react to conflict situations.

In his study Serrano also recorded the highest frequency of injuries in households and emphasises the large need for primary prevention programmes focused on parents and the home environment [12]. In our sample group the most frequent place of injury was the street (41.3%), with household injuries in

Table 2. Basic characteristics of 7 patients with open eye injury treated at University Hospital Ostrava in the period from 2007 to 2011

PATIENT	SEX	AGE	MECHANISM OF INJURY
1	F	4 years	Blow from metal letterbox
2	F	7 years	Stabbing with pocket knife
3	M	11 years	Explosion of fireworks in glass bottle
4	M	13 years	Blow from wooden stick
5	M	14 years	Explosion of home-made explosives
6	M	15 years	Explosion of an aluminium can containing explosive substance
7	M	17 years	Firing of projectile with suicidal intent

Table 3. The table summarises initial vision, scope of injury and condition of visual functions 6 months after the injury in 7 patients with open eye injury treated at University Hospital Ostrava in the period from 2007 to 2011. BCVA – best corrected visual acuity

PATIENT	BCVA – UPON ADMISSION	SCOPE OF INJURY	BCVA 6 MONTHS AFTER INJURY
1	Not possible due to age	Perforating injury to cornea	Unknown
2	Vision 6/18	Penetrating injury to sclera	Vision 6/9
3	Light sensitivity, projection incerta	Perforating injury to cornea and penetrating injury to sclera	Movement, projection downwards certa, otherwise incerta
4	2.5m/60	Perforating injury to cornea	Vision 6/18
5	Movement, light sensitivity, projection certa	Multiple penetrating injury to bulb with multiple intraocular foreign bodies, traumatic cataract	0.5m fingers, light sensitivity, projection certa
6	light sensitivity, projection certa	Perforating injury to cornea and penetrating injury to sclera, multiple intraocular foreign bodies	Without light sensitivity
7	Movement, light sensitivity, projection certa	Penetrating injury to sclera	Vision 6/9

second place (20.3%). Strahlman analysed ocular injuries in children younger than 16 years of age with the necessity of hospitalisation. He states sports activities as the main cause of injury, and these constituted a fundamental part of traumas in all age categories [13]. In our sample group injuries to the eye and the periocular area during sports activities constituted only 11.4% of all traumas. However, in a range of traumas we documented it was not possible to identify the cause, an example of this is 54.7% of cases of foreign bodies in the outer eye. Moreira emphasises that the presence of a warning adult plays an important role in the prevention of ocular injuries in children [9]. In our study we recorded traumas in the majority of cases during times of absence of an adult person, which creates a risk situation for potential accident and injury to children.

Falls and impacts, blows from various objects and contact with caustic substances are the main causes of ocular traumas in children in ours and other studies [4, 8, 9, 11, 12, 13]. Identification of further potential risk situations is important for the possibility of prevention of frequently serious injuries to the eyes, presenting a risk of permanent affliction of visual functions. In addition to the restriction of sale on the basis of age, there are no effective public or legal measures which would bring about a prevention of the use of fireworks by children, which is very frequent during New Year's celebrations and other public events. During the observation period we ourselves recorded one such severe open injury to the eye in connection with the handling of fireworks, which was linked to severe permanent damage to visual functions. Another interesting case is

injury to the eye caused by a lit cigarette, caused by the negligence of smoking parents, which thankfully did not have permanent consequences. We also emphasise the necessity of heightened measures on the part of parents upon the performance of regular household activities such as cooking, ironing, baking or cleaning using chemical agents. Within a five year period we recorded several injuries in connection with these activities. The case of a fifteen month old boy with burns to the face, neck and torso following the overturning of a frying pan with hot oil, or the case of a six year old boy with burns to the eyelids and face from a hot iron are such an example. In both cases this represented an injury without permanent consequences from an ophthalmological perspective.

We devote special attention to dangerous children's shooting toys. In their study, Gajová and Řehůřek indicate the seriousness of injuries to children's eyes from shooting weapons, linked to a risk of damage to sight. In a group of 21 patients they describe 2 cases of severe injury with permanent consequences. The most frequent cases of damage to the eye include erosion of the corneal epithelium, hyphema, iridoplegia, vitreous haemorrhage and retinal oedema [2]. In our study population we recorded 13 cases of injury to the eye from a pellet gun. In 61.5% of cases this concerned a severe contusion of the ocular bulb with haemorrhage into the anterior chamber, with transitional iridoplegia linked to temporary disorder of visual functions. In 30.8% of cases we recorded retinal oedema. None of the patients had permanent consequences in the sense of a permanent reduction of visual func-

tions. We identify with the opinion that pellet guns should never be used by children. From anecdotal evidence we know a case of an ophthalmologist who confiscates pellet guns from children on her housing estate. Is this a correct and effective method of prevention?

CONCLUSION

Injuries in childhood age place increased demands not only on the attending physician, but also on the child's environment. During the course of examination it is essentially necessary to take into account the specifics of the childhood age. It is often difficult to obtain the relevant information about the circumstances of the occurrence of the injury, its mechanism and a precise description of the subjective complaints from a child patient, frequently in situations of emotional stress which ensue from the necessity of co-operation of the doctor not only with the child but also with the parents. The study demonstrated that the occurrence of injuries to the eyes is more frequent in boys, especially adolescents. The predominant type of ocular traumas in children is closed injuries. The mechanism of ocular trauma is variable, nevertheless there is a relationship between the mechanism and the age of the child. We consider the absence of adequate supervision by an adult person to represent a significant risk factor in the occurrence of serious injury to the eyes in children. It is a question of further research as to whether it would be possible to avoid a proportion of injuries through preventive measures in order to increase child safety. However, this issue exceeds the scope of the presented study.

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