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Ocular trauma in the Finnish elderly – Helsinki Ocular Trauma Study

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ABSTRACT.

Purpose: **To describe epidemiology, causes, treatments and outcomes of all ocular injuries in southern Finland among people aged 61 and older.**

Methods: **All new ocular trauma patients, admitted to the Helsinki University Eye Hospital, during 1 year in 2011–2012. The data were from hospital records and prospectively from patient questionnaires. The follow-up time was 3 months.**

Results: **The incidence for ocular injuries among the elderly was 38/100 000/year. From 118 patients 69% were men. The mean age was 70.9 years old (median 67). The hospitalization rate was 14%. Injury types were minor traumas (48%), contusions (22%), chemical injuries (10%), eyelid wounds (8%), open globe injuries (OGI; 7%) and orbital fractures (5%). The injuries occurred at home (58%), institutions (12%) and in other public places (12%). The main causes of ocular injury were falls (22%), sticks (19%), superficial foreign bodies (18%) and chemicals (12%). All OGI and 88% of contusions needed a lifelong follow-up. A permanent visual or functional impairment occurred in 15 (13%) patients. Of these 53% were OGI, 40% contusions and 7% chemical injuries. The causes of permanent injuries were falls (seven cases, 47%), work tools, sports equipment, sticks, chemicals and eyeglasses. The incidence for legal blindness was 2.3/100 000.**

Conclusion: **Minor trauma was the most frequent type, and home was the location of the most occurred eye injuries. Falls were the most frequent and serious cause, but behavioural causes were not significant. Preventive measures should be directed towards the main identified causes and risk factors of the eye injuries in the elderly.**

Key words: elderly – epidemiology – eye injury – falls – population-based – senior

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Introduction

Eye injuries are a major avoidable cause of vision loss and it is fundamental to find the risk factors and characteristics of this phenomenon to prevent the injuries. By doing so, we can avoid the elderly being housebound or ending up too early to the geriatric institutions, and reduce the health care costs.

According to previous studies, the elderly are particularly at-risk of eye injuries (Negrel & Thylefors 1998). However, few previous studies are population-based and comprehensive including all ocular traumas. More so, the detailed outcome by cause is infrequently reported in the senior age group. It was shown in some studies (Tielsch et al. 1989; Klopfer et al. 1992; Wong & Tielsch 1999) that the rates for ocular trauma had two spikes: one among young adults, and the other among persons older than 70–75 years. However, Wong et al. reported in 2000 that persons aged 43 through 54 years were 2.5 times more likely to have a lifetime history of ocular trauma than persons aged 75 years and older. In UK, the cumulative incidence of serious eye trauma among people aged 65 years and older was 1.5/100 000 (Morris et al. 2014). Previously, we have reported the essential epidemiological data of eye injuries among children (Haavisto et al. 2017) and adults aged 17–60 (Sahraravand et al. 2017) in southern Finland.

There are few detailed studies among the elderly in Europe (Desai et al. 1996) concerning the causes and consequences of all eye injuries. This comprehensive study is population-based with a link from the causes to the detailed outcomes of eye injuries serving best the purpose to prevent these injuries among the elderly.

Materials and Methods

The study population included all new patients aged 61 and older referring to the emergency unit of the Helsinki University Eye Hospital (HUEH) during 1 year (1st of May 2011 to 30th of April 2012). Helsinki University Eye Hospital (HUEH) serves an urban and rural population of 1.5 million people. Information was gathered prospectively, and the hospital register was accessed to obtain data on all eye emergency patients who were assigned an ICD-10 diagnosis including eye injury. Also incorrectly used non-trauma diagnoses were searched. The

researchers examined all case histories and confirmed the accuracy of the injury details. The study was approved by ethics committee of the Helsinki-Uusimaa Hospital District and followed the tenets of the Declaration of Helsinki.

During first visit, all new ocular trauma patients were given a questionnaire on detailed information about the trauma-causing event and the circumstances the injury occurred. In the case the questionnaire was not completed, researchers collected all possible background data from the hospital records. Age, gender, laterality, possible previous amblyopia, detailed status findings at first presentation, diagnoses and treatments were recorded from the hospital database.

Whether several injuries were present in the eye or its vicinity, clinically the most significant trauma diagnosis (ICD-10 S- or T-diagnoses) was recorded as the primary diagnosis. The injuries were divided into diagnosis groups according to their primary diagnosis: open globe injury (OGI), contusion, chemicals and burn, orbital and face bone fracture, eyelid, lacrimal and periocular wound, optic nerve trauma and others. The 'other' category included minor traumas: corneal or conjunctival foreign body or abrasion, bruise of eyelids and bulbar area or other superficial periocular, eyelid or head lesion.

The injuries were also classified by the Birmingham Eye Trauma Terminology System, BETTS (Kuhn et al. 2004). BETTS is a classification method for severe bulbar trauma. In the case of periocular wound or fracture, as the main diagnosis with a secondary diagnosis for the globe, BETTS was recorded according to their secondary diagnosis. If both eyes were injured the more seriously injured eye was observed. The epidemiological data was analysed and the distributions presented (Excel; Microsoft Office 2013, Microsoft, Redmond, WA, USA). The percentages were calculated from the reported results. The incidence denominators (age-specified populations) were taken from Statistics Finland PX-Web statistical database. Statistical analysis was performed with NCSS Statistical Software (Hintze J. 2012, NCSS 8. NCSS, LLC. Kaysville, Utah, USA. www.ncss.com).

The follow-up time was 3 months. On the last visit, the final visual acuity (VA), the intraocular pressure (IOP) and the main abnormal status findings were recorded. The severity of the ocular trauma was evaluated using estimated need for lifelong follow-up due to risk of glaucoma, retinal detachment (Rouberol et al. 2011; Noureddin et al. 2014) or other clinical findings (e.g. severe limbal stem cell deficiency, need for ocular prosthesis care), performed major surgery and future surgery, permanent abnormal VA, and other functional visual symptoms or findings like persisting diplopia, chronic macular oedema, scotomas in the field of vision, permanent central haze or blur, metamorphopsia, nyctalopia. Visual acuity (VA) <20/40 was categorized as impaired. Legal blindness was defined as VA y of worse than 20/200. The end-point status compared to cause, diagnosis group and ocular trauma score, OTS (Kuhn et al. 2002), were presented.

Results

General

During 2011–2012 occurred 1151 eye injuries. These included 118 (10%) patients aged 61 and older, and 82 (69%) of these were men. The mean age was 70.9 (median 67) and the oldest was a 96-year-old woman. Sixteen (14%) patients were hospitalized. Ocular trauma incidence among this age group was 38/100 000 [95% confidence interval (CI) = 31/100 000–46/100 000; Table 1], 62/100 000 among men (95% CI = 50/100 000–77/100 000), and 20/100 000 among women (95% CI = 14/100 000–28/100 000). The incidence for the hospitalized was 5/100 000 population/year. The questionnaire was responded by 41%.

Ten eye injuries (8%) were sports-related, seven (6%) work-related and assaults caused five (4%) injuries. No significant seasonal variations occurred. Alcohol was reported to be involved in six injuries (5%). Five accidents occurred in an amblyopic eye. The laterality of the eye injury was 54 times (46%) in the right and the left eye each, and nine times in both eyes (8%) and in one case the data was not available. Protective eyewear was used in six (5%) injuries.

The location where the injury occurred was known in 78 cases (66%). From the known cases 45 (58%) occurred at home: 21 inside and 24 outside. In the hospitals, inwards and other facilities for the elderly, occurred nine (12%) injuries. Eight (10%) eye injuries, all among men aged 61–65, occurred while working (Table 2).

Falls caused the most numerous injuries 26 (22%). At home occurred 57% (13) of all falls, in healthcare institutions 26% (six), and in other public places 17% (four). Other main causative agents were sticks (19%), small foreign particles (18%), chemical agents (12%), human's body part (6%) and sports equipment (6%; Table 3). The data on previous intraocular surgery were not available.

Diagnoses, classifications, clinical findings and surgical treatments

Altogether 24 (20%) patients needed at least one major surgery (95% CI = 13–29%). Table S1 presents the clinical findings grouped according to the primary diagnosis.

According to the BETTS classification, there occurred eight open globe injuries (OGI), 32 closed globe injuries (CGI) and 78 other injuries comprising of periocular wounds, fractures or minor conjunctival or corneal injuries (Fig. 1). Altogether, 78 (66%) of all 118 traumas could not be categorized by BETTS, as the classification does not include superficial eye or adnexal lid, lacrimal or orbital injuries.

Open globe injuries (OGI)

Eight OGIs, among six men and two women, included six ruptures and two

Table 1. Age and gender distribution and the incidence of eye injuries.

Age groups	Men *n* (%)	Women *n* (%)	Total *n* (%)	Incidence *n* (CI)/100 000
61–74	66 (79)	18 (21)	84 (71)	39 (31–48)
≥75	16 (47)	18 (53)	34 (29)	36 (25–51)
All	82 (69)	36 (31)	118 (100)	38 (31–46)

CI = 95% confidence interval.

Table 2. The location of the eye injury occurred.

	Total *N* (%)	Men *N*	Women *N*
Home*	45 (58)	30	15
Institutions†	9 (12)	2	7
Other public places‡	9 (12)	5	4
Work	8 (10)	8	0
Sports places	5 (6)	5	0
Elsewhere	2 (3)	2	0
TOT§	78 (100)	52 (67)	26 (33)

* Twenty-one eye injuries inside the house and 24 injuries outside the house.
† Hospitals, wards, nurseries.
‡ Other public places.
§ Data not available from 40 injuries.

lacerations (Fig. 1). Both lacerations were penetrating injuries. Four of the OGIs were zone-I injuries occurring at limbus or cornea, and two zone-II injuries occurring at sclera by a maximum distance of 5 mm from limbus. The other two cases were zone-III injuries occurring more posteriorly in the sclera.

Four OGIs occurred at home. Nursing home and hospital's internal ward were the sites of two OGIs. One OGI occurred at work and one in other public place. A fall was the primary cause of four OGIs and it was a contributing factor in two injuries where the primary causes were eyeglasses and a stick. Work tools caused two eye injuries. One patient with rupturing OGI was under the influence of alcohol. No one used protective eyewear. Three OGIs occurred in an amblyopic eye.

The initial VA was light perception (LP) in five patients (63%), and no light perception (NLP) in three (37%). In one rupture the initial IOP was 40. IOP was under six in four patients. Three corneal penetrations, three macrohyphaemae, four nonexistent anterior chambers, two uveal or irideal prolapses and two torn irides, two periocular fractures, one penetrating lid laceration and one retina ablation occurred (Table S1). One torn lateral rectus muscle, and one endophthalmitis were observed. Two eyes were eviscerated. Two patients had corneal and six patients scleral suturing operations. Four patients had posterior and one patient anterior vitrectomy. Two patients had their intraocular lenses (IOL) removed, and two needed eyelid surgery. All OGI patients were hospitalized.

Contusions

Contusion was the primary diagnosis in 26 (22%) injuries, 21 men and five women and the secondary diagnosis in three cases. Sticks, sports equipment and falls were the main injury causes (Table 3). Assaults caused two contusions, three injuries occurred under the influence of alcohol and no one used protective eyewear (Table 3). One eye was amblyopic.

Initial VA of 10 patients (38%) was 20/60 or less, and three up to counting fingers (CF). Intraocular pressure (IOP) of seven patients (27%) was over 21 mmHg. Main findings were hyphaemae (10), anterior traumatic uveitis (six), vitreal haemorrhages (five), retinal tears (five), IOL luxations (four), orbital fractures (two), retinal ablation (one) and traumatic cataract (one).

Seven patients (27%) had altogether nine major operations (Table 4): three vitreoretinal surgeries (two with lensectomy and one with scleral fixation of IOL), four conjunctival surgeries, one cataract surgery and one endonasal decompression. Five patients (19%) were hospitalized.

Chemicals and burns

Chemicals and burns were the primary cause in 12 (10%) eye injuries, nine men and three women. Five alkaline, four acidic and three other agents caused the injuries. Two injuries (17%)

Table 3. Cause of injuries in various diagnosis groups.

	Tot (%)	Open globe	Contusions	Chemicals& burns	Orbital Fracture	Eyelid wound	Optic nerve	Other minor
Falls*	26 (22)	4	5	–	6	7	–	4
Sticks/twigs	23 (19)	1	9	–	–	1	–	12
Superf.fb†	21 (18)	–	–	–	–	–	–	21
Chemicals	14 (12)	–	–	12	–	–	–	2
Body part	7 (6)	–	2	–	–	–	–	5
Sport–equip.‡	7 (6)	–	7	–	–	–	–	–
Work tools	6 (5)	2	2	–	–	–	–	2
Eyeglasses	2 (2)	1	–	–	–	–	–	1
Others	5 (4)	–	–	–	–	–	–	5
Unknown	7 (6)	–	1	–	–	1	–	5
Total	118 (100)	8	26	12	6	9	0	57
Falls§	28 (24)	6	5	–	6	7	–	4
Work-related	7 (6)	1	–	2	–	–	–	4
Eyewear¶	6 (5)	–	–	2	–	–	–	4
Alcohol	6 (5)	1	3	–	1	–	–	1
Assaults	5 (4)	–	2	–	–	–	–	3

* Fall as primary cause.
† Superficial foreign body.
‡ Sport-equipment.
§ All falls.
¶ Protective eyewear used.

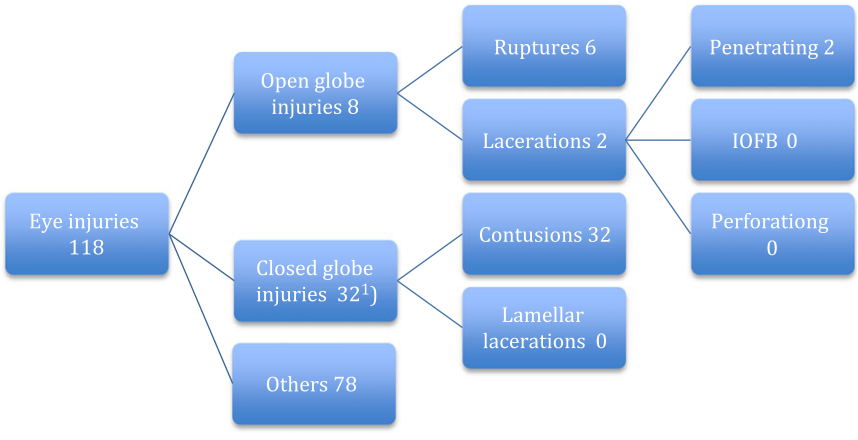

Fig. 1. The elderly's eye injuries grouped according to the Birmingham Eye Trauma Terminology System (BETTS). [1]6 of 32 closed globe injuries were classified into BETTS according to their secondary diagnosis because their primary diagnoses were adnexal (fractures or periocular wounds) which are not included in BETTS. IOFB = intra-ocular foreign body.

Table 4. End-point of injuries in relation to the diagnosis group.

	Number of all injuries *N*	Need for lifelong follow-up *N* (%, CI)	Major surgeries *N* (%, CI)	Permanent impairment *N* (%, CI)
Open globe injury	8	8 (100)	8 (100)	8 (100)
Contusion	26	23 (88)	7 (27)	6 (23)
Chemical & burn	12	1 (8)	1 (8)	1 (8)
Wounds	9	–	6 (67)	–
Fractures	6	–	2 (33)	–
Other (minor)	57	–	–	–
Total	118	32 (27, 19–36)	24 (20, 13–29)	15 (13, 7–20)

N = number of patients, CI = 95% confidence interval.

occurred at work. Alcohol consumption and assault were not involved in this group. Two patients (17%) used protective eyewear.

Initial VA of three patients (25%) was 20/60 or less. All had a normal initial IOP.

One patient had a secondary diagnosis of contusion caused by a rupturing concrete tube. He had macrohyphema, macular oedema and conjunctival ischaemia. An exploding car battery caused conjunctival ischaemia with necrotic areas and a total corneal epithelium loss resulting in a Duan IV chemical injury. He needed amniotic membrane transplantation and hospitalization.

Eyelid wounds

Eyelid wound was the primary diagnosis in nine patients (8%), and the secondary diagnosis in one patient with an orbital fracture. Falls caused seven (78%) eyelid injuries (Table 3). No assaults, alcohol consumption, nor protective eyewear use was involved in this group.

Two patients had lacrimal injuries. One patient had a contusion as the secondary diagnosis. Six patients (67%) needed major surgeries (Table 4), including two lacrimal reconstructions and four eyelid sutures, one of which needing a skin graft. No one was hospitalized.

Fractures

Orbital or facial fracture was the primary diagnosis in six patients (5%); four of them (67%) were orbital blow-outs. All six fractures (100%) involved a fall accident, and one patient had consumed alcohol (Table 3). Fracture was the secondary diagnosis in four cases (three OGI and one contusion), from which, two involved a fall accident, as well.

Three patients (50%) had significant secondary diagnoses including three contusions and one eyelid laceration. Two patients (33%) needed orbital fracture repairs and were hospitalized (Table 4).

Other minor traumas

Minor ocular injury was the most numerous eye injury group including 57 (48%) patients. Superficial foreign body caused 21 (37%) and sticks twelve (21%) injuries. In four cases, falling was the primary cause. Four injuries were work-related, and four patients used protective eyewear (Table 3). Initial VA of 20/60, or below, was recorded for seven patients (12%). Seventeen minor procedures were performed, including sixteen corneal and one conjunctival foreign body removals. No one was hospitalized.

Outcomes

Table 4 presents the final outcomes of the injuries in each diagnosis group. Fifteen (13%, CI = 7–20%) patients, eleven men and four women, were estimated to have a permanent visual or functional impairment. Ten (67%) of these patients had a final VA below 20/40. Seven (47%) of them had a final VA below 20/200 (were legally blind). Therefore, the incidence of legal blindness in southern Finland among the elderly was 2.3/100 000/year. From the seven legally blinded, six were caused by a fall and one by a work tool. In addition, six of them were OGIs and one was a contusion. Four of the blinding injuries occurred at home, one at a hospital's ward, one at work and one in a public place.

Altogether 32 patients (27%, CI = 19–36%) needed a lifelong follow-up.

All eight patients with OGI had permanent impairment. Of these seven (88%) patients had a final VA below 20/40, and one patient had a scarred and partially conjunctivalized cornea with aniridia and aphakia. Three eyes were blinded, two of which eviscerated. Altogether, three patients were aphakic, three patients had corneal complications (partially conjunctivalized corneal scar, stained cornea, corneal transplant with wrinkled Descement membrane), and one patient had a macular complication. All OGI patients were evaluated to need a lifelong follow-up due to a risk of glaucoma (four) or retinal detachment (two) or need for ocular prosthesis care (two). Six (23%) of contusion patients had permanent impairment as follows: reduced VA below 20/40 (three), VA of

20/40 and reduced night vision (one), secondary glaucoma and cystic macular oedema (one) and a prolapsed vitreous into the anterior chamber and a cataract (one). Twenty-three patients (88%) were evaluated to need a lifelong follow-up, mainly due to a risk of glaucoma (19) or retinal detachment (four).

The visual function of one patient of chemical and burn injuries (8%) was permanently impaired because of central corneal opacification. This patient needed a lifelong follow-up due to increased risk of glaucoma.

No patient with eyelid injury, ocular adnexal fracture or minor superficial injury had permanent impairment, nor they needed a lifelong follow-up. One eyelid injury patient had a scarred upper punctum, and one orbital fracture patient reported diplopia only in up-gaze but these findings caused no functional or subjective impairment for the patients.

The causes of permanent injuries were falls (seven), sticks (two), work tools (two), sports equipment (two), eyeglasses with a fall (one), and chemicals with a fall (one). Thus, nine (60%) of permanent impairments resulted from falls, and 32% (nine) of eye injuries involving a fall accident resulted in a permanent visual impairment (Table 5). From all falls 39% (11) were hospitalized, and 57% (16) of the eye injuries involving a fall needed at least one major operation.

Ocular trauma score (OTS)

Table S2 presents the OTS-classification of injuries. From the seven patients with blinding outcomrgg five were included in OTS groups 1 or 2. Ocular trauma score (OTS) could not be calculated for eleven patients.

Discussion

This is a population-based study that reports the epidemiology, clinical findings, diagnoses, treatments and outcomes of ocular trauma in southern Finland among the people over 60 years old during 1 year, and uniquely analyses the outcome in relation to the cause of the eye injury. This is also a hospital-based study. However, as this study includes all new minor and major eye injuries both from rural and urban southern Finland, and HUEH covers a population of 1.5 million inhabitants as both tertiary and secondary care unit, therefore, we preferably use the terms 'population-based study'.

Previously, we reported that the 1-year incidence of eye trauma in working-age adults, aged 17–60, was 66–104/100 000, with the highest incidence in age group 31–45 (Sahraravand et al. 2017). In the current study, in the age group 61–74, the incidence was 39/100 000 and in age group 75 years and older 36/100 000 (Table 1). We may have slightly overestimated the eye injury incidence as 7/118 (6%) of the patients came from other municipalities. On the other hand, some of inhabitants of HUEH district may have sought treatment from other municipalities.

In 1992, Klopfer et al. in the United States, reported, in contrast to our results, that the rates for ocular trauma had two spikes: in young adults, and age group 75 years or older. They also reported that the average annual hospital discharge rate for ocular trauma increased dramatically after the age of 80 years. This is not in concordance with our study, as our hospitalization incidence (5/100 000) was even slightly less than the hospitalization incidence for the working-age adults (6/100 000) in our previous study. The difference in hospitalization rates might be explained in terms of differences in the treatment protocols that can nowadays be undertaken on outpatient basis.

We defined legal blindness as a final VA of worse than 20/200, and reported that seven eye injuries resulted in legal blindness. This is 6% (7/118) from all the eye injuries and 47% (7/15) from the permanently injured patients in this age group. Kuhn et al. reported in 2006 that 51% of the eye injuries resulted in final vision worse than 20/200 among people aged 60 and above in the United States Eye Injury Registry (USEIR). Their report concerned only the serious eye injuries unlike our study containing both minor and major eye injuries. This can explain the different percentages between the two studies.

In this study, we noted some differences in the characteristics of the eye injuries of the elderly compared to the eye injuries of the 17- to 60-year-old working-age adults (Sahraravand et al. 2017):

Firstly, most of the eye injuries of the elderly occurred at home, 58% (Table 2), while in the adults aged 17–60 most of the accidents were work-related.

Secondly, the most frequent causes of eye injuries of the older people were falls (22%), sticks (19%) and superficial foreign bodies (18%; Table 3),

Table 5. End-points of injuries in relation to primary cause.

	Number of injuries *n*	Need for lifelong follow-up *n* (%)*	Major surgeries *n* (%)*	Permanent impairment *n* (%)*
Falls[†]	26	8 (31)	14 (54)	7 (27)
Sticks and twigs	23	9 (39)	5 (22)	2 (9)
Superficial fb[‡]	21	–	–	–
Chemicals	14	1 (8)	1 (7)	1 (7)
Human body	7	2 (29)	–	–
Sport-equipment	7	7 (100)	1 (14)	2 (29)
Work tools	6	3 (50)	2 (33)	2 (33)
Eyeglasses	2	1 (50)	1 (50)	1 (50)
Other causes	5	–	–	–
Unknown	7	1 (14)	–	–
Tot.	118	32 (27)	24 (20)	15 (13)
Falls[§]	28	10 (36)	16 (57)	9 (32)
Work-related	7	1 (14)	1 (14)	2 (29)
Eyewear[¶]	6	–	–	1 (17)
Alcohol	6	4 (67)	2 (33)	1 (17)
Assaults	5	2 (40)	–	–

* % from the cause.
[†] Fall as the primary cause.
[‡] Superficial foreign bodies.
[§] All falls.
[¶] Protective eyewear used.

whereas the major causes in the adults aged 17–60 were superficial foreign bodies (33%), chemicals (13%) and body parts (13%). Similarly, Desai et al. reported in 1996 that falls account for the most frequent cause of injuries (44%) in people 65 years of age and older.

Thirdly, orbital fractures caused no permanent impairment and no need for a lifelong follow-up among the elderly (Table 4), while in the adults aged 17–60 a third of fractures were permanently impaired and almost one-fifth needed a lifelong follow-up.

Fourthly, behavioural aspects were prominent factors in the adults aged 17–60, but not in the senior group: in the working-age group with permanent visual impairments alcohol was involved in 21% and assaults in 16% of the patients, while the corresponding figures for the seniors were 1% and 0%. Consumption of higher levels of alcohol rose among 65- to 79-year-old Finns from the mid-1980s to the early 2000s (Sulander et al. 2004). Furthermore, according to Immonen et al. (2011) although the frequency and quantity of alcohol consumption among Finns living in southern Finland declined with age, 1/5 of men aged 71–80 years and 1/10 of men aged 81–90 years could be classified as at-risk drinkers.

Fifthly, in the adults aged 17–60 most of the permanently impaired cases were caused by body parts (23%), work tools (11%) and sports equipment (11%), while in the senior group, the leading primary cause was falls (47%). In this group work tools, sports equipment and sticks each caused 13% (two) of the permanent impairments (Table 5).

Noticeably, we confirmed the gravity of consequences of a fall accident: 39% of all falls were hospitalized, and therefore, a fall was involved in 69% of all the hospitalized. Fifty-seven percent needed at least one major operation. Furthermore, a fall was involved in 60% of the permanently injured, and 32% of eye injuries involving a fall accident resulted in a permanent visual impairment (Table 5).

We reported 57% of falls occurred at home, 26% in healthcare institutions and 17% in other public places. It is reported in some studies (Desai et al. 1996; Evans et al. 2002; Rubenstein 2006) that among older individuals over 50% of falls occur in the home, possibly related to the fact that nearly 20% of people over the age of 75 years are housebound (Dhital et al. 2010).

This highlights the need for measures to prevent falling-related accidents. Assessment of the home circumstances of patients including the lighting could reduce the risk of falling (Dhital et al. 2010).

The increased risk of falls in the elderly is thought to be multifactorial. A relationship between impaired vision and falls among older people is shown in some studies (Ivers et al. 1998; Klein et al. 2003; Lord 2006; and Kulmala et al. 2008). In addition, Moreira & Kashara in (2017) found that 'the elderly with serious eye injuries have worse sleep quality than subjects of the same age'.

A limitation of our study is the short follow-up time. However, obvious permanent injuries can be seen during the study's follow-up time. Nevertheless, further studies on long-term outcome of eye injuries are needed. Another possible limitation is the low percentage of answered questionnaires (41%). Nevertheless, in the case the questionnaire was not completed, researchers collected all necessary background and treatment data from the hospital records and database.

The fact that from the seven legally blinded six were caused by a fall, six were OGIs, and four of them occurred at home, confirms that falls cause the most serious eye injuries, OGIs are the most serious diagnosis groups, and that the serious eye injuries occur usually at home.

In sum, there were some characteristic features with the eye injuries of the elderly: the incidence of eye injuries among men was 3.1 times more frequent than women. Home was the location of most occurred eye injuries, and falls were the biggest and the most serious cause of eye injuries. Interestingly, behavioural aspects (alcohol consumption and assaults) were not significant causative factors in this group. By identifying the major risk factors of eye injuries in the elderly, we can target the preventive measures towards them.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Table S1. Clinical findings upon presentation.
Table S2. Ocular Trauma Score (OTS) versus diagnosis group, *n* (%).